Developing Ideation Cards to Support the Design of Mixed Reality Games

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To my parents.

Don't sit in front of the computer all day, go outside and play.

(My mother)

Abstract

Mixed reality games combine interactive digital content with real world environments, objects, and actors by utilizing a multitude of different sensors. While offering plenty of opportunities for designers, they are also notoriously difficult to design. This is in part due to them still being a relatively new form of gaming with only very few examples of commercially successful games. This means that the majority of aspiring designers lacks knowledge about the design space of these games – something that is crucial in order to create new and exciting experiences. While there exist several authoring tools to facilitate the development of mixed reality games, these tools do not provide guidance on the game design aspects. The design of mixed reality games is likewise bringing together experts from different domains (e.g. game design, technology, locales). In order to support this multifaceted and collaborative design process I have developed the Mixed Reality Game Cards. These are a deck of ideation cards that encapsulate the design space of mixed reality games in the form of physical playing cards. The cards can be used for rapid idea generation (i.e. creating a multitude of ideas from scratch in a short time) and in-depth idea development (i.e. further expanding and refining an idea). The Mixed Reality Game Cards consist of four types of cards to support idea generation as well as idea development. Opportunity Cards are the building blocks of an idea and describe potential elements of a design. Question Cards prompt the design group to consider the experience from different angles to refine the design. Challenge Cards surface typical design issues and problems that might occur. These domain-specific cards are supported by Theme Cards that are taken from the board game Dixit in order to provide additional domain-extrinsic sources of inspiration. I developed the Mixed Reality Game Cards iteratively over the course of seven studies following a Research through Design approach. This provided valuable insight into what makes ideation cards such powerful facilitators of collaborative design sessions. I identify content, appearance, and rules as crucial elements under direct control of an ideation card designer and tangible as well as playful interactions as dynamics that emerge during an ideation session.

This thesis describes the development of the Mixed Reality Game Cards and uses the insights gained from this process to reflect on ideation cards as design tools in general, expanding our understanding of them.

Acknowledgements

Four years ago, I moved from Germany to the UK to pursue a PhD at the Mixed Reality Lab at the University of Nottingham. In the beginning, this was quite the transition from my former job as a researcher with Fraunhofer FIT. I was a student again! The people at the MRL quickly made me feel at home, and it turned out to be exactly the stimulating research environment that I hoped it would be. My journey here has now come to an end, and I have truly learned a lot in my time here. About love, life, and probably also about research.

First of all I would like to thank the people that made the MRL such an amazing place to be. The current and former office dwellers of C8, and especially Khaled, Martin, Paul, Stuart, and Neha. You guys made sure it was not only inspiring but also gloriously fun to be there. You are the perfect crew!

I am also grateful for all the members of the research projects I worked on, in particular the people of IPerG (who profoundly affected my research trajectory up to this day) and TOTEM (who survived me being project coordinator).

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Lastly, I am eternally grateful for the family I am lucky to be a part of. My sisters, and of course my parents. Who always encouraged me to pursue my dreams and were supportive of all my shenanigans. Thank you!

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Part I: Set-up

Ideas are like fish. You don't make the fish, you catch the fish.

(David Lynch)

1. Introduction

1.1. Overview

Mixed reality games create a hybrid experience by combining real world and virtual elements. Together, digital technology and physical reality create a new type of game that engages players by turning them into their own avatars. Players travel across the city to reach locations that have been given a new meaning in the context of the game. The advance of modern technology has made it possible that everybody who owns a smartphone is suddenly a potential player of these games. Still, relatively few mixed reality games have reached a large audience, with Pokémon Go (Niantic Labs, 2016) and perhaps Geocaching (O'Hara, 2008) being the big exceptions. At the same time, interesting mixed reality games have been staged by artists like Blast Theory, and other games have been developed by academics and researchers. While such games may not have reached a large audience, they serve as best practice examples and have investigated a variety of game design opportunities and challenges. Attempts have also been made to structure and compile this design knowledge (Montola et al., 2009).

Throughout my career as a researcher and academic I have worked on several of these games, often in multidisciplinary teams of technologists, game designers, and domain experts. Games were usually created through a collaborative design process where each party's specific expertise was crucial for the overall success of the game. Incidentally, everybody brought with them a different understanding of the design space, or was perhaps mostly unknowing about it. Likewise, when working as a lecturer I noticed that students would usually be overwhelmed by the task of developing a mixed reality game. They had next to no previous knowledge that could serve as a basis for their designs as they never even played mixed reality games before. This usually caused them to create rather basic designs while at the same time making some very common mistakes that could have been easily avoided with more experience.

In order to support both of these use cases I found it necessary to not only encapsulate the existing design knowledge about mixed reality games, but perhaps even more importantly make it easily accessible in a way that supports collaborative and multidisciplinary design sessions of users with varying backgrounds. Popular

approaches for encapsulating design knowledge and supporting the design process are design patterns or design guidelines. However, these are arguably not quite suited to be used in dynamic group design sessions.

More promising in this regard seemed to be ideation cards that create embodied knowledge that is easily sharable between participants and at the same time provides a playful approach to design.

Another important motivation for my PhD was the desire to create something that could be easily used outside of academia by interested designers of mixed reality games. In a certain sense, I wanted to design a product that was informed by rigorous academic practice but was ultimately aimed at targets outside of academia. The physicality and accessibility of ideation cards made them a promising medium to explore.

Ideation cards like IDEO Method Cards (IDEO, 2002) or MethodKit (Möller, 2012) have appeared and grown in popularity in recent years as a tool to support early stages of design. They are physical cards that encapsulate design knowledge in a compact and accessible way. Participants typically use the cards in a manner akin to a game: cards get shuffled, drawn randomly, played (i.e. discussed), and discarded or stored for later reference. In academia, several ideation card decks have likewise been developed, and in turn also studied. Especially Hornecker (2010) has investigated why ideation cards are such successful tools. Ideation cards support initial idea generation as well as developing an idea further, and they do this by inspiring designers, allowing them to focus, and by structuring the design discussion.

While some work discusses the question of "why", an in-depth analysis of "how" is missing from the discourse that goes beyond providing simple examples. However, it is necessary to break down the inner workings and dynamics of ideation cards and ideation card sessions to truly understand how to best utilize them and how to design future decks of ideation cards.

In this thesis, I will describe how I developed the Mixed Reality Game Cards iteratively over the course of seven studies with participants from diverse backgrounds and experience levels. The studies build the basis for a thorough investigation of the different phenomena related to ideation cards. I have identified the **content** and **appearance** of the cards as well as the accompanying **rules** as the

defining characteristics that are under direct control of the ideation card designer. During a session, the users then engage in **tangible** as well as **playful interactions**. Together, these five elements shape the design session and enable ideation cards to be effective as facilitators for collaborative design session. Ultimately, the work results in implications for the design and use of ideation cards, and provides a basis to hypothesize on how technology could meaningfully be used within card-based design sessions.

1.2. Research Goals

The research goals for this thesis can broadly be divided into two broad topics: a) facilitating the design of mixed reality games by developing domain-specific ideation cards; b) expanding the wider knowledge about ideation cards as tools for collaborative design.

Mixed reality games are games that combine physical and digital elements in a meaningful way. Related (and often overlapping) genres are location-based games, pervasive games, and augmented reality games. In academic literature these games have been explored from a variety of perspectives, for example how to enable them technically (Cheok et al., 2004; Thomas et al., 2002), the effects of embedding them into the real world (Bell et al., 2006; Benford et al., 2006), and how to design them (Waern et al., 2009; Wetzel et al., 2008).

As such, there exists knowledge about mixed reality games in general, also for example in the form of an in-depth compilation of design reflections (Montola et al., 2009). What is lacking, however, is a way to **make this knowledge easily accessible** for designers in a way that **directly supports design sessions**. This includes **identifying the design elements crucial for mixed reality games**. While being aware of insights presented in e.g. the aforementioned sources is certainly helpful (or perhaps also necessary), they cannot be used during unfolding design negotiations. **How can this extensive knowledge be encapsulated so that designers of different levels of experience and backgrounds can engage in collaborative and dynamic design?** This requires the knowledge to be collected, encapsulated, and presented in an appropriate way.

For this thesis I have chosen tackle these questions by developing a deck of ideation cards for mixed reality game design.

There exists a substantial body of ideation card decks that are used for a variety of different topics and domains. When these cards have been developed inside of academia, reports often include a reflection of the considerations taken into account when designing the cards themselves, e.g. regarding phrasing or the choice of images. In order to design a deck of ideation cards for mixed reality game design, it is however important to gain a deeper understanding of the effect that ideation cards have on the design process: **What makes ideation cards so suitable to facilitate design activities?** And more specifically: **How to design ideation cards supporting mixed reality game design?**

Among the most salient effects of ideation cards are them being a source of inspiration, helping participants focus on specific topics, and providing guidance along the design process. Some of these effects are attributed to the content of the cards (Mueller et al., 2014), the rules of the cards (Kultima et al., 2008a), and the physicality of the cards (Hornecker, 2010).

At the same time ideation cards lend themselves to be used for various purposes. The Method Cards for example are used in a meta sense by introducing different ways of creating ideas. Other cards are custom-made for specific sessions and serve as a tangible representation of interesting data (e.g. video clips of users). Perhaps the majority of ideation cards however are context-specific. They provide an overview of a specific design space and serve as a repository of concepts. These concepts are then either used for generating ideas from scratch (e.g. VNA Cards (Kultima et al., 2008a), PLEX Cards (Lucero and Arrasvuori, 2010)) or for developing an idea in more detail (e.g. Tangible Interaction Framework Cards (Hornecker, 2010), Exertion Cards (Mueller et al., 2014)).

In this thesis, I want to develop an understanding of **how exactly ideation cards shape the design process**. In particular, I want to not only identify the qualities that allow ideation cards to support idea generation and idea development, but also to **unpack these qualities in detail and investigate the intricacies of their workings**. More precisely, I want to explore the role that **content**, **appearance**, **rules**, **tangible interactions**, and **playful interactions** take on in the unfolding design process. What is the effect that each of them has, and, perhaps even more importantly, **what is the cause for this effect?** In order to do this, I will likewise **unpack the design process** into its defining elements and put these into context

with the qualities of ideation cards. The research will result in a holistic model of ideation cards and their intricacies to inform design decisions of future ideation card creators.

1.3. Methodology

In order to achieve the research goals, I decided to develop a deck of ideation cards within the domain of mixed reality games. By creating a new deck from scratch any insights gained from studies can directly feed back into the design of the cards (and rules). This allows for an iterative development approach with high flexibility. Furthermore, creating ideation cards likewise is a research activity that informs the knowledge around ideation cards itself. This will ultimately result in a better understanding of what is involved in the design of a deck of ideation cards and thus provide insight into what kind of guidelines are needed.

The main contribution of this thesis consists of two interlocking parts. One contribution is the development of the Mixed Reality Game Cards, the other is a deep reflection on ideation cards in general in regards to the research goals described in the previous section. Due to the iterative approach, both of these aspects heavily influenced each other: The cards were used to explore ideation cards in general, and the insights gained directly fed back into the iterative design of the cards. My overall methodology can therefore be summarized as an example of research through design. Frayling (1993) has provided a classification of how research and design (as well as art) can relate to each other. He distinguishes between research into art and design, research through art and design, and research for art and design. The first category includes historical, aesthetic, perceptual research as well as exploring theoretical perspectives on art and design. Research through design on the other hand covers materials research, development work, and action research. Lastly, research for art and design has an artefact as the end product *where the thinking is, so to speak, embodied in the artefact, where the goal is not primarily communicable knowledge in the sense of verbal communication, but in the sense of visual or iconic or imagistic communication*. Zimmerman et al. (2007) further define research through design with a stronger focus on the artefact that is being produced: *designers produce novel integrations of HCI research in an attempt to make the right thing: a product that transforms the world from its current state to a preferred state*. In that sense, research through design combines both research activities as well as design activities. The research is

the outcome of the design activity, while the design activity is informed by the research and also produces a design artefact. Zimmerman et al. (2010) also voice some critique around research through design:

> *Since RtD [research through design] is an inquiry process revolving around the making of a product, service, environment, or system, the knowledge gained can be implicit; residing almost entirely within the resulting artifact.*

Gaver (2012) defends research through design:

> *[..] most of use agree that the practice of making is a route to discovery, and that the synthetic nature of design allows for richer and more situated understandings than those produced through more analytic means.*

Furthermore, he believes that *theory should be allowed to emerge from situated design practice*. Gaver and Bowers (2012) suggest annotated portfolios as a way to communicate meaning around the artefacts that a designer has created. By putting them into context with each other new meaning is created that is suitable to transport the underlying theory.

In order to respond to the criticism and make sure that my design and research activities are tightly interwoven, I based my work from the beginning on a theoretical scaffolding and with the clear intention of producing separate, theoretical outcomes. This approach is visualized in Figure 1.

Related work about ideation cards and mixed reality games serve as the theoretical background to create the Mixed Reality Game Cards. These cards are then evaluated in a series of studies. The insights gained from these studies build a theory which in turn is used to iteratively design the Mixed Reality Game Cards. The theory itself is furthermore also informed by and evaluated against existing observations about ideation cards. This way, the outcome of the thesis will be an artefact (the Mixed Reality Game Cards) as well as an accompanying theory that explains the findings and puts them into the greater context of ideation cards. Theory and artefact exist together, and both are informed by the other.

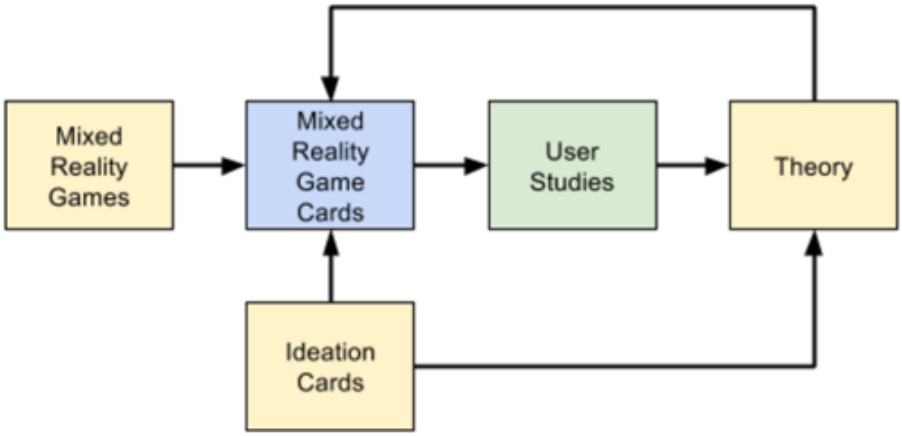


Figure 1. Theoretical underpinning and outcome of the thesis (yellow), design component (blue), investigative studies (green).

In order to derive design knowledge from my activities, the process I followed is similar to the Grounded Theory approach. Grounded Theory was first introduced by Glaser and Strauss (2009) and describes how a theory is iteratively build from data. One of the core concepts behind Grounded Theory is simultaneous data collection and analysis which means that collection and analysis of data are not strictly separated but instead constantly inform and influence each other. This mirrors the practicalities of conducting research through design: the design activities inform the research, and the research informs the design activities. The overall structure of the conducted stuies is a reflection of this: Insights gained from one study would help frame the next study (and its data collection), and insights gained from a later study would be used to go back and analyse an earlier one.

I decided to utilize qualitative methods for data collection and analysis. Maxwell (2012) argues that qualitative methods are well suited for *identifying unanticipated phenomena and influences* and *understanding the process by which events and actions take place*.

I have conducted a total of seven studies that each informed different aspects of the design of the cards themselves or explored the perceptions of the various participants in regards to using the cards. Study participants were intentionally diverse and reflect the potential user groups for ideation cards: students, academics, artists, professional developers, domain experts. Likewise, previous experience with designing games and/or mixed reality ranged from several years to non-existent. By choosing participants with such varied backgrounds I assured a deeper

understanding of ideation cards in different contexts than when using more homogenous groups. Data collection varies slightly between studies but overall includes video and audio recordings, post-session semi-structured interviews, questionnaires, field notes, and the design outcomes produced by the study participants. (The studies and their relationships to each other are described in more detail in chapter 4.3.) To gain insights from the data and to inform my design activities, I used thematic analysis (Braun and Clarke, 2006).

Overall, this approach seemed suitable for observing and unpacking the intricacies of ideation card sessions and related phenomena and was also compatible with the overall Research through Design methodology.

1.4. Research Outcomes

As one major contribution, the Mixed Reality Game Cards are the produced design artefact (Figure 2). A total of 91 cards extensively cover the design space of mixed reality games.

Figure 2. The final deck of the Mixed Reality Game Cards

The cards are divided into three distinct categories: Opportunity, Question, and Challenge Cards. Opportunity Cards consist of established an interesting game mechanics and elements of mixed reality games. They are the building blocks of an

idea. Question and Challenge Cards ask high and low level questions of the designers and confront them with issues and problems specific to mixed reality games. The cards can be used for the rapid generation of ideas as well as the thorough development and exploration of a single idea. This distinguishes them from other ideation cards that typically are focused on one of the two uses cases. The final version of the cards is depicted in section 10.5. After the conclusion of the studies, I also developed a guide that provides a more detailed overview of each card. It is designed to be read in preparation or as reflection of a design session, but can also be used during a session should questions arise. As the guide was not used in any of the studies depicted in this thesis it can be found in the appendix.

From a theoretical point of view, I have identified **rules**, **appearance**, **content**, **tangible interactions**, and **playful interactions** as the five main qualities of ideation cards that make them so well suited to support collaborative design sessions. Together, they influence and affect **inspiration**, **focus**, **knowledge**, and **negotiation** to shape the resulting **idea**. For aspiring designers of ideation cards I present a set of guidelines that highlight the important aspects of cards and how these can be implemented. Finally, I use these insights to speculate on potentially mixed reality ideation cards, i.e. cards that are supported by technology. In order to not lose the strong points of ideation cards I argue for applying mindful mixed reality that supports but not controls any design sessions.

1.5. Thesis Structure

This thesis is divided into three main parts and consists of 11 chapters.

Part I: Set-up (chapters 1 to 3)

Chapter 1: Introduction gives an overview of thesis topic, research goals, chosen methodology, and the Mixed Reality Game Cards as the resulting design artefact.

Chapter 2: Playing in Mixed Realities discusses the design space of mixed reality games by taking a look at interesting existing games and what design knowledge exists about these types of games in general.

Chapter 3: Encapsulating Design Knowledge provides the background about ideation cards and compares them to design guidelines, design patterns, and strong concepts. Different existing decks of ideation cards are discussed and compared in order to contextualize the research and design goals.

Part II: Design (chapters 4 to 7)

Chapter 4: Designing Mixed Reality Game Cards builds on the preceding two chapters and introduces the basic concepts behind the cards. It describes the ideas behind Opportunity, Question, and Challenge Cards and outlines how the content for the cards was derived.

Chapter 5: Phase 1 – Initial Exploration describes the first iteration of the cards and three studies that were conducted with them. These give first insights into how ideation cards are being used and explore the basic concepts of the Mixed Reality Game Cards.

Chapter 6: Phase 2 – Refinement introduces the second iteration of cards. As the previous phase, three studies were conducted that explore the underlying principles in more detail and experiment with different set-ups.

Chapter 7: Phase 3 – Final Validation consists of the third iteration of cards and rules and presents the last study conducted with the cards in order to confirm the preceding findings.

Part III: Results and Discussion (chapters 8 to 11)

Chapter 8: Designerly Reflections takes the experiences derived from the studies and puts them into context with idea generation and idea development.

Chapter 9: Tangible and Playful Interactions discusses how ideation cards afford and foster specific actions that emerge during the design sessions.

Chapter 10: Unpacking Ideation Cards reflects on the preceding results on puts them into the greater context of ideation cards. The chapter provides design implications for future designers, researchers, and users of ideation cards, and also discusses the potential for supporting ideation card sessions with technology.

Chapter 11: Conclusions summarizes the thesis and discusses the role of research through design in the context of the thesis. It concludes with a look at the unfolding impact of the Mixed Reality Game Cards and identifies potential future work.

2. Playing in Mixed Realities

2.1. Overview

In this chapter I will take a look at the design space of mixed reality games. First of all, this requires to define the term and draw comparisons to similar types of games such as pervasive games, or location-based games. Following up on it I will give an overview of existing landmark games of the genre as well as providing detailed accounts of specific games. For the latter, I have selected four games and experiences that I have in-depth knowledge of because I either designed / developed them or because I was a participant. Overall, this section will focus on highlighting common and uncommon game elements as well as important questions and challenges that the games had to overcome (or suffer from). Afterwards I will discuss several academic sources that have taken a closer look at the design of mixed reality games and how this knowledge was distilled and e.g. put into the form of guidelines. The work presented in this chapter served as the basis for many (but not all) of the cards in the deck of Mixed Reality Game Cards.

2.2. Definition

In this thesis, I am interested in games that go beyond traditional video games in the sense that they are not bound to a screen but instead incorporate real world elements into the experience. Terms that might describe such a game are mixed reality games, pervasive games, and location-based games.

Nieuwdorp has compared several academic publications in order to define pervasive games and found that the term is often used interchangeably with others such as ubiquitous games, augmented reality games, mixed reality games, mobile games, alternate reality games, live action role play, affective gaming, virtual reality games, smart toys, location-based games, location-aware games, adaptronic games, crossmedia games, or augmented tabletop games. Overall, she observes the following competing views on what constitutes a pervasive game:

> *There are two perspectives from which pervasive games can be discussed within the discourse on gaming: (1) a technological one that focuses on computing technology as a tool to enable the game to come into being [..] and (2) a cultural one that focuses on the game itself and, subsequently, on the way the game world can be related to the everyday world.*

Since then, especially Montola et al. (2009) have championed the cultural perspective of pervasive gaming and arrived at the following definition:

> *A pervasive game is a game that has one or more salient features that expand the contractual magic circle of play spatially, temporally, or socially.*

Location-based games on the other hand are not as well defined. While there seems to be an understanding of what such a game constitutes, I was unable to find a "canonical" definition. Instead, authors tend to use their own definitions. As an example, we might look at Benford et al. (2003) who introduce the term as follows:

> *Location-based games, a new form of entertainment, take place on the city streets. Players equipped with hand- held or wearable interfaces move through the city. Sensors capture information about the players' current context, which the game uses to deliver an experience that changes according to their locations, actions, and, potentially, feelings.*

Based on these and similar definitions (Sotamaa, 2002), location-based games possess the following two main characteristics:

1. They utilize technology for sensing the player's location.
2. The player interacts with the game by changing location.

Location-based games put a strong emphasis on the real world place that the game is being played in and make it an important element of the design. Interestingly, this makes the majority of all location-based games also pervasive games due to spatial expansion.

While such a definition already comes close to what I was envisioning, location plays a somewhat too central role in it. The term itself emphasizes the importance of the physical place suggesting that this is always the most crucial element of the game. However, I was interested in games that perhaps have a more balanced approach towards combining technology with the physical world. While locations certainly are one example of such an involvement of the "real environment" I found the focus on them slightly too limiting.

Another term that has been used for pervasive games and location-based games has been mixed reality games. The term mixed reality was popularized by Milgram and Kishino (1994) as part of their virtuality continuum (Figure 3).

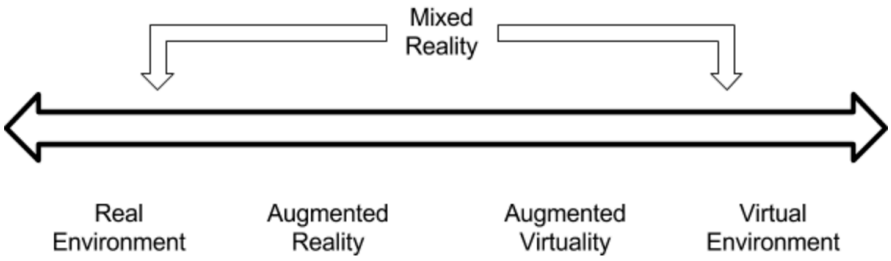


Figure 3. Simplified representation of the virtuality continuum according to Milgram and Kishino.

The virtuality continuum describes a spectrum of opposite ends with the real environment on one end and the virtual environment on the other. In between lies mixed reality where reality and virtuality are combined with each other. Milgram and Kishino used the virtuality continuum to describe a taxonomy of visual displays. However, their approach also lends itself to a perhaps more cultural perspective. On the one end of the continuum we have the real world, the physical environment, people, and tangible objects. The other end is represented by the virtual, technology, and the digital. In the context of gaming it allows us to place e.g. board games, card games, playground games, and live-action roleplaying (larp) on one end of the continuum (Real Environment), and traditional video games as well as virtual reality games on the opposite one (Virtual Environment). Any game however, that somehow combines the physical with the digital can then be classified as a mixed reality games.

For the context of this thesis, mixed reality games are defined as follows:

Mixed reality games are games that combine physical and digital elements in a meaningful way.

This is a rather broad definition that includes all location-based games as well as a large amount of pervasive games. From a practical point of view most of the games discussed in this thesis will fall into all three categories.

2.3. Mixed Reality Games

In order to understand the design space of mixed reality games, it is important to take a look at existing games. In this section I will describe ten such games in more detail. Six of them have been extensively covered as part of academic research: Geocaching (Neustaedter et al., 2011; O'Hara, 2008), Can You See Me Now?

(Benford et al., 2006), Feeding Yoshi (Bell et al., 2006), Insectopia (Peitz et al., 2007), Shhh! (Linehan et al., 2013), and Blowtooth (Kirman et al., 2011). I have selected these games as they cover a wide range of the design space and because the authors describe interesting considerations relevant for their design. The remaining four games are ones that I have either worked on during my time as a researcher at Fraunhofer FIT (TimeWarp (Blum et al., 2012) and Tidy City (Wetzel et al., 2011b)) or games that I have played myself. This provides me with an in-depth understanding of mixed reality games from a first-hand perspective. I will discuss the design of these games as well as important questions and challenges arising or justifying these design decisions. At the end of the section I will briefly describe a selection of additional games in order to show the vast the design space of mixed reality games.

2.3.1. Geocaching

One of the oldest and certainly longest running location-based games is Geocaching (Neustaedter et al., 2011; O'Hara, 2008). The game was created after Selective Availability was disabled from GPS in May 2000. This allowed the general public to access GPS data with an increased precision from around 100m to about 10m. The game was inspired by Letterboxing (Hall, 2003) and is a simple scavenger hunt type game. Players are on the search for so-called geocaches (or short: caches) that are hidden in the real world. The coordinates leading to a cache are published on websites and are available to anyone who wants to play the game. A cache is a physical box that typically contains a logbook and an assortment of small objects (e.g. badges, little figurines). When a player has found such a cache they write their name in the logbook and take one of the trinkets from it and deposit one of their own. They then place the container at exactly the same place as it was before. Anybody can create new caches and add them to the game by simply hiding an appropriate container and reporting its coordinates on one of many Geocaching websites.

Neustaedter et al. (2011) have analysed the game and report several factors that contribute to this scalability which ultimately is responsible for the global success of the game. Geocaching allows lightweight creations as well as elaborate creations which lowers the entry barrier but allows dedicated players to increase their engagement with it. On a more practical level, the players themselves monitor the

game elements, other players, and non-players. This assures that the game stays playable and problems are reported and fixed by the community itself. Furthermore, the players of the game have also developed specific customs that help understand and evolve the game. O'Hara (2008) has taken a closer look at the motivations that keep players engaged with the game. According to him, these include social walking, discovering and exploring places, collecting, tracking one's progress, competition, and individual as well as social challenges.

2.3.2. Can You See Me Now?

Can You See Me Now? (Benford et al., 2006) was created as a collaboration between artist group Blast Theory and the Mixed Reality Lab at the University of Nottingham. The game was first staged in 2001 and was then toured for several years. Can You See Me Now? has won the Prix Ars Electronica and was nominated for a BAFTA in Interactive Arts.

Perhaps somewhat unusual for a mixed reality game, the players participate in the game via an online interface and are thus able to join the game from any place with internet connectivity. The players then enter a virtual representation of the city where the game takes place. They can move around the virtual space and have to avoid being caught by the so-called runners. These are NPCs that roam the same city – however unlike the players they do not do this virtually but are physically running through the real streets. This means that runners and players inhabit the same hybrid space, just in different dimensions. Where the runners can get physically exhausted and streets might be difficult to navigate due to traffic, the players do not suffer from these obstacles. Each runner not only constantly uploads their position via GPS to the virtual city, audio is also streamed which allows runners to taunt and call out players.

Reflecting about the game, Benford et al. mention uncertainty as an important element to consider when designing such games. Uncertainty was created by flaws in the employed technology, e.g. unstable data connectivity and imprecise GPS data. This would lead to four states of being of a runner: connected and tracked, tracked but not connected, connected but not tracked, and neither connected nor tracked. In order to mitigate any negative effects this might have on the overall experience, the authors provide several coping strategies.

Removing uncertainty tries to eliminate possible reasons for technological failure by for example putting up additional infrastructure to provide better overall connectivity. Another way of removing uncertainty would be to map the quality of GPS reception throughout the game area and instruct runners to avoid critical areas. Such an approach is made difficult by the fact that the quality of GPS is not constant throughout the day and can thus not be fully predicted.

Hiding uncertainty is the second strategy they propose. This is done by for example sanity checking GPS data coming in from the runners and removing implausible data (e.g. a runner appearing inside a lake). In addition, the creators of the game also intentionally decided to not calling players "caught" but instead "seen" – the latter state being much fuzzier and thus less prone to perceivable errors.

Managing uncertainty describes methods of overcoming the technical problems by providing for example alternative means of reporting position. Especially self-reported positioning can be used to cover gaps in precision or total loss of tracking as for example employed in Uncle Roy All Around You (Benford et al., 2004). Manual orchestration is another way of managing uncertainty. Here, game master influence the game state directly and instruct and monitor the runners in order to identify, prevent, and fix any occurring problems.

Revealing uncertainty another strategy the authors propose. Here, the assumed accuracy of the GPS location was exposed to the runners who would then be aware of the underlying technical infrastructure and its shortcomings. Having this feedback enabled runners to be mindful of the current situation and allowed them to undertake countermeasures such as moving to a new location to regain connectivity and tracking.

Exploiting uncertainty is the final approach of how to deal with flawed technology. Instead of trying to remedy the effects, seamful design (Chalmers and Galani, 2004) can be employed instead. Players are encouraged to use a lack of connectivity or tracking to their advantage. Poor coverage suddenly becomes an integral part of the gameplay instead of negatively affecting it.

2.3.3. Feeding Yoshi and Insectopia

Feeding Yoshi (Bell et al., 2006) and Insectopia (Peitz et al., 2007) are both similar games in that they make use of the existing technological infrastructure to create game content and are played over extended period of times.

In Feeding Yoshi, players have to collect fruits to feed the titular Yoshi characters. Yoshis and different types of food are generated when players are in range of WiFi networks. Secured wireless networks become Yoshis and open networks become fruit plantations.

Insectopia uses a similar approach but instead of WiFi networks game objects (insects) are generated based on Bluetooth signal. Players in Insectopia are trying to create a collection of valuable insects that they can pick up whenever they are in range of a Bluetooth device. A collected insect will "die" after eight days, forcing the player to always be searching for insects to keep their collection.

By making use of an existing infrastructure, both games circumvent the problem of content creation and placement. Game objects will appear automatically generated by the algorithm when a WiFi network or Bluetooth signal is detected. Both games also integrated well with day-to-day activities of the players. Instead of playing the game for a specific duration, players would instead start short play sessions, collect Yoshis / fruits / insects and continue with their normal life.

A second mode of play was reported by Bell et al. where players would change their daily routine in order to incorporate play sessions into it. They also state how players perceived play differently depending on where the game took place. The would feel uneasy for example in crowded areas or in industrial or business districts with a high amount of surveillance cameras. Playing from home, however, and being able to feed the "local" Yoshi created a positive feeling in players.

Peitz et al. have made similar observations about Insectopia. Playing the game raised the awareness of technology penetration as well as awareness of personal habits for the players. The game gave new perspectives to familiar locations, and players had to learn to understand the hidden context of Bluetooth signals. Unlike in Feeding Yoshi, crowded areas were seen as positive, most likely due to the fact that these were filled with people carrying Bluetooth devices around and thus becoming valuable from the point-of-view of the players.

2.3.4. Shhh! and Blowtooth

At first sight, both of these games might be rather different. However, upon closer inspection they both play with the underlying conventions of the place where they are being played.

In Shhh! (Linehan et al., 2013)players score points by making loud noises. The twist of the game lies in the fact that it can only be played inside a library. This is in stark contrast to the social rules usually in place at a library. The game requires players to break these rules fully aware that this might have out-of-game consequences like being kicked out of the library or just angry stares from other visitors of the library. Perhaps unsurprisingly, players were rather inventive with making acceptable loud noises. One player used the hand dryer in the bathroom, another player carried books and let them drop to the ground, "accidentally". Linehan et al. see such play as an interesting direction to take for pervasive games. Highlighting and contradicting the social conventions of a place with such a game invites critical reflection of the environment itself. Niemi et al. (2005) have stressed the importance for designers of to take anonymity and accountability into account when considering non-players in the context of pervasive games.

Blowtooth (Kirman et al., 2011)is a game in a similar vein played at airports. In the game, players have to smuggle drugs through airport security. They do this by offloading their contraband to an unsuspecting non-player by scanning their Bluetooth signal. Once through security, players have to locate the same non-player in order to reclaim their goods. Like Shhh!, Blowtooth plays with the notion of acceptable behavior at different locations. While evaluating the game Kirman et al. were surprised to find out that players did not report increased levels of anxiety while passing through airport security. This might have to do with the fact that, unlike Shhh!, playing Blowtooth does not attract the attention from non-players. Furthermore, the game is limited to the phone of the player where in Shhh! any noise generated will be noticed by any non-players in the vicinity.

However, both games are excellent examples for designs that can only work at specific locations due to the underlying social meaning. Where other mixed reality games might try to create an experience that is in congruence with the location, here both games deliberately cause a mismatch between expected behaviour and game content.

2.3.5. TimeWarp

TimeWarp (Blum et al., 2012) is a mobile augmented reality game that was part of the IPCity research project. During my time at Fraunhofer FIT I worked on the final version as the main developer and was also responsible for game design.

TimeWarp is set-up to be played collaboratively by two players. The players explore the Old Town of Cologne with the help of two Ultra-Mobile PCs (UMPCs). They have been hired by a character called Agent Morgan who introduces himself as a member of Chrono Police and tasks the players to travel to different time periods of Cologne. Throughout the game Agent Morgan appears via a "live" video feed from the future. The overall goal for the players is to locate four robots that have escaped from the future and are now scattered through time. According to Agent Morgan, the presence of these robots in other time zones than their own poses a threat to the time-space-continuum.

Both UMPCs support the players in different ways in their search for the robots: one player takes on the role of Navigator while the other becomes the Observer. The Navigator has access to a map interface that displays the current position within the surrounding area and any nearby robots. The Navigator can also create time portals and communicates with Agent Morgan as well as the robots. The Observer's UMPC displays an augmented reality view of their surroundings. The live video feed from the camera on the back of the device is augmented with 3D characters and time period specific objects. Tracking of the player's position is done with a combination of GPS, inertia sensors and gyroscope.

The gameplay is based on three main mechanics:

- Creating and using time portals to travel to other time periods
- Communicating with other characters
- Manipulating the augmented reality environment

The Navigator can create time portals in the vicinity of the players. A time portal is rendered as a large animated and fluorescent green sphere in the augmented reality view. The players have 30s to physically walk through such a portal in order to use it. This is often complicated by the fact that the time portals seemingly float around. However, this is due to imprecisions in GPS data and not a scripted behaviour. Despite this seemingly technical flaw, evaluations of the game showed

that players actually enjoyed "hunting" time portals quite a lot as it was a welcome physical exercise that stood in stark contrast to the slow-paced and narrative heavy core of the game.

Whenever the players meet one of the robots, they can engage with it via a multiple-choice dialogue that the Navigator controls. The robots would always be in some sort of predicament and ask the players to help them. At the same time, they would try to convince the players that they are actually sentient beings and should not be sent back to Agent Morgan as he would end their existence by reformatting the hard drives. Ultimately, the players are given a choice for each robot: They can either send them to Agent Morgan or to an alternative time period where they (supposedly) do not endanger the time-space-continuum.

In order to help the robots in their endeavour players had to solve different small tasks. The robot stranded in Roman times had fallen apart and players have to find and collect all separate parts. The robot in a future time period had started to work for a space port and players have to help him repair landing lights so a space ship could land safely (Figure 4). The two robots in medieval times have to be reunited by the players before convincing Agent Morgan to perform a wedding ceremony for them.

Figure 4. The future time period in the augmented reality game TimeWarp (© Fraunhofer FIT).

In order to win the game, players had to locate all robots and send them away through time portals before the overall time limit of the game ran out.

TimeWarp went through multiple iterations before the described final version was deployed. Earlier versions were plagued by complicated user interfaces as each specific task required different types of interactions (Herbst et al., 2008). These were consequently streamlined so that all AR interactions always followed the structure "aim and select", i.e. the Observer had to point the UMPC at the AR object and could interact with it when in range by simply clicking. Originally, the game was played with augmented reality head-mounted displays. However, as the game was played outdoors, bright and sunny days would make the game almost unplayable as players were unable to see the rendered content. The game was also extended from being single to multiplayer. This allowed us to split the interface in two, further reducing the cognitive load necessary. Perhaps more importantly however, this was also done for evaluation purposes as a collaborative game requires players to communicate with each other.

Staging the game in the Old Town of Cologne was not a trivial task. Narrow alleyways did not lend themselves well for the augmented reality parts of the game. We also quickly learned to avoid areas with car traffic as players were often focused too much on the game instead of looking out for their own safety. We also had to find the right balance for placing the robots in the game area. If they were placed too close to each other the game became too easy. However, we also had to avoid distances that were too long as this would just lead to players walking around without being able to engage with the game. After playtesting, we finally decided to choose a surprisingly small area for the game at banks of the river Rhine where we had access to safe and open spaces.

Having to rely on GPS for tracking the players and creating an augmented reality environment had some obvious drawbacks. The 3D content would be rather unstable and constantly seem to change position. While this was a problem with static objects like a large Roman arch, the sensor flaws actually also added to the enjoyment of the players. This was the case with the time portals. Players only had limited time to walk through them, however the instabilities and imprecisions of the GPS made the portals seemingly move around. In many instances this lead to players having to "chase" the time portals. The physical exertion was a welcome change of pace, and many players reported this as one of their favourite elements of the game. The Roman arch on the other hand was a great example for engaging AR content due to its sheer size. It stood taller than 10 metres and players were

eager to explore it on more detail. In order to so they had to physically walk around it and lean back and look upwards to take in the full sight. Again, the physical aspects added to the overall experience.

2.3.6. Tidy City

While I was coordinating the TOTEM research project one of the games we developed was Tidy City (Wetzel et al., 2011b). For the design, we collaborated with Michael Straeubig, a freelance game designer with an experience in location-based games.

The game is a simple scavenger hunt game in the vein of Geocaching. Players select a mission in their vicinity, and then see a map interface on their smartphone. Several locations are highlighted where they will be able to "pick up" a riddle. When they are close enough, they can view the riddle and add it to their virtual inventory. A riddle always consists of a name, a textual description, and an image. Together these three elements hint towards a real world location. Players continue collecting these riddles while trying to solve the ones they already have. When players think they are standing at the physical location described by the riddle, they can test their suspicion. This is done by comparing their current GPS location with the required destination. If they are wrong, they lose a point, but if they are right the riddle is solved and they gain points depending on its difficulty level. Figure 5 shows two typical situations from the game. In addition, the game then also reveals another picture of the location as well as giving further explanations (e.g. about the thoughts behind the riddle, or about the history or current relevance of the location).

Figure 5. Navigating to a riddle in Tidy City (left) and solving it (right).

The game does not have a time limit, and players can resume the different missions whenever they wish. They can also compare their score with other players who have played the same mission.

We also released a web-based authoring tool and an app that allowed all players to create and publish their own missions.

Tidy City is an example for a very simple location-based game. Our main goal was to design a game with really simple mechanics in order to make it accessible to a wide range of players. We also wanted to play a game that can be played casually and over a long period of time at one's own pace. This style of the game also allows players to play alone or in teams sharing one device. The variety of possible missions likewise caters for very diverse groups of people as one can easily envision missions for children created by their parents, teachers authoring missions for their students, tourists exploring the famous sights of a city etc. An important question to consider for designers of their own missions is the area they place their riddles in. Do they want to create a game where players can stumble upon the right solution by accident (e.g. a small area), or do they want to create one with an explicitly large area where this is not possible (and thus possibly make the game not solvable in a short period of time)?

Another important design goal for us was to create a smartphone game that encourages players to pay attention to their surroundings and not focus on the screen of the device. In a typical game, players look at the map to see where they can find riddles, and then only check the map occasionally as a navigation aid. While trying to solve a riddle, players might glance at the text and the image from time to time, their main focus however is on reflecting on the words and paying close attention to the physical world around them in order to perhaps spot the location in question.

Due to its simplicity, Tidy City also avoids a lot of other common pitfalls that other mixed reality games might suffer from. Rules and interface are simple to grasp, and we staged the game successfully for elderly people as well as young children.

Mission designers can furthermore prevent flaws in GPS reception from affecting the game experiences negatively by setting the maximum radius for each riddle separately (e.g. in an area with bad GPS reception a player might not need to be standing on the exact spot).

Designers of the specific missions also have to think about what locations they want to employ in their riddles. Here it is important for example to make sure that the riddle will also be still solvable six months later.

2.3.7. The Monitor Celestra

The Monitor Celestra (Berättelsefrämjandet, 2013)was a technology supported live-action role playing game (larp) set in the Battlestar Galactica universe (a science fiction TV show). The game was staged three times on consecutive weekends in Gothenburg in March 2013 by a Swedish organizer team. I participated in the second run and observed the game masters during the third.

130 players participated during each run. The game was structured into four acts of 7-9 hours each and took place over three days. Players dressed up in costumes to properly convey their in-game characters.

Players were cast as a member of one of the following groups: crew of the Monitor Celestra (the in-game name of the vessel), military, researchers, security personnel, and civilian refugees. All of these groups had different goals and power structures, but were more or less working together.

The larp took place on military destroyer Småland that had become a museum ship. The ship was prepared thoroughly, aiming to create a perfect illusion for the players: everything they saw inside the ship had a diegetic meaning and could be used as part of the game. This for example included obstructing all windows, covering existing signage, and hanging up posters that matched the game world. The ship was also equipped with hidden loudspeakers that would provide environmental sounds from e.g. engines and when through hyperspace. Players were also given a lot of additional props or brought them themselves to further add to the illusion. Furthermore, the organizers installed computer terminals throughout the ship that players could use to control the Monitor Celestra. They had access to life-support systems, torpedoes, could plan hyper jumps, configure the engine and much more. All of these terminals were scattered throughout the ship to make sure all areas of the ship had interesting stations and for example reduce the importance of the bridge. In order to match the low-tech aesthetics of the Battlestar Galactica universe, all of these terminals were controlled with physical buttons, switches and levers (Figure 6). The terminals were networked which enabled the game masters could view their status and any changes in their control room. It was also possibly to manually interfere to create special events or malfunctions.

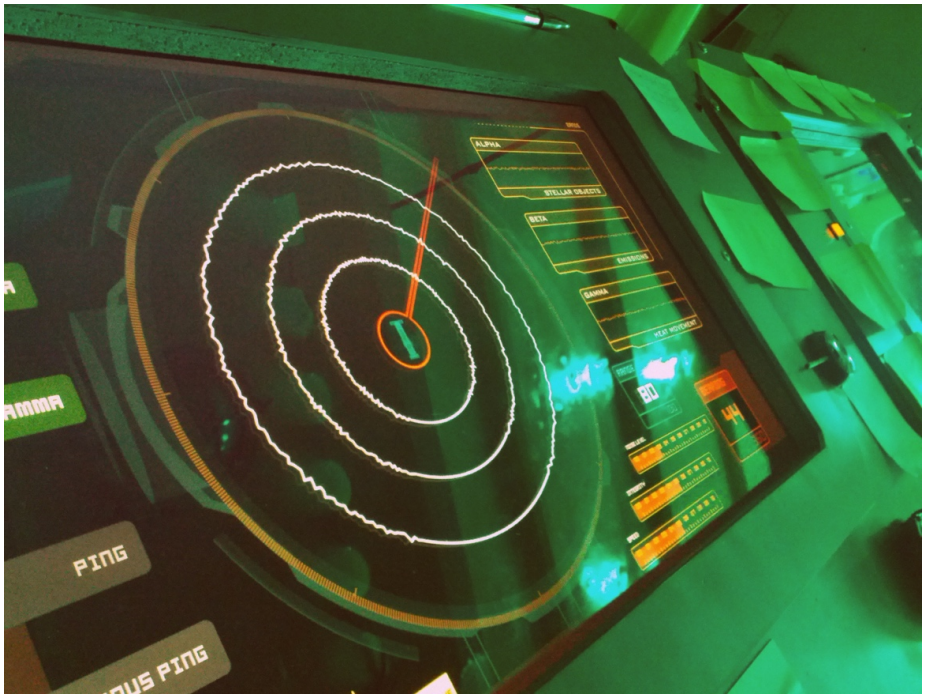


Figure 6. Terminal controlling the radar system on board the Monitor Celestra.

Game masters also created all communication with any other ships throughout this game. This could range from written messages to live radio calls. Players could also use the installed phone handsets to call the different stations on the ship or a small scout vessel travelling with the Celestra. The crew of the scout vessel were in fact the game masters. This way they could give hints or guidance to players in a diegetic way without disturbing the immersion.

A final way for the game masters to be aware of what was happening on the ship were non-player characters (NPCs) and participated in the game under instruction from the game masters.

Another technological element of the game was an A.I. that inhabited the ship. Players could communicate with it via a text-based chat system. The A.I. itself was controlled by the game masters.

The game used a lot of technology in order to create a perfect illusion of the envisioned setting. In addition, the monitoring and controlling of these systems allowed the game masters to be relatively aware of what was going on during the game. An important point in the design was the goal to have all direct and indirect communication between players and game masters to be diegetic. This enabled

players to not be disturbed in their immersion as they never had to break character. It also provided the game masters with a natural and unobtrusive way to orchestrate the game and interact with the players. The immersion was further strengthened by the impressive set (which players would quickly forget was not a real spaceship), and the detailed costumes that were provided to them. It enabled players to fully dive into the game and experience life (and death) on a spaceship.

Being a larp, the biggest emphasis on the game was put on the overall atmosphere and plot developments that dealt with topics of like paranoia, despair, and hopelessness but also heroism, sacrifice, and forgiveness. Another important aspect was the fact that the whole game was extremely rules light, so that role playing instead of mechanics were emphasized. Great care was also taken to help players transition into and out of each act by playing dramatic music as a sign to start and end the gameplay.

One of the biggest challenges for the organizers was the preparation of the location with the technology. A technical failure on this end would have meant a complete breakdown of this important feature of the game, so great care had to be taken to ensure the different terminals could communicate with each other and the game master servers. It was also impossible to test the system under full load in the weeks leading up to the game as on the one hand the museum was still operating and it was obviously impossible to get 130 test players on location. Another important element to consider where the interfaces of the terminals. They needed to be simple and easy to understand while still providing the illusion of being actual terminals for controlling a spaceship.

Staging a game on a destroyer also came with some health and safety issues. Tight and not very well lit areas of the ship were especially dangerous when players were quickly running around due to them being excited and immersed in the situation. For this reason, safety personnel were patrolling the ship throughout the game (disguised as crew). The organizers also spread out the terminals throughout the whole ship in order to prevent everything happening in the same area of the ship, in part motivated by enabling everyone with easy access but also due to fire regulations.

2.3.8. Fortnight

Fortnight is a playful experience created by performance artist group proto-type (2011). It was performed during two weeks in Nottingham in early June 2015 and had been previously run in Bristol, Lancaster, Manchester, Oxford, and Coventry.

The night before the start of the experience, all participants received a welcome letter and a small felt badge that doubled as a visual identifier (as everyone was encouraged to wear it the whole time) as well as a digital identifier (as inside there was a NFC tag).

From then on, participants received a text message every morning inviting them to visit a certain location in Nottingham for a daily task. These locations ranged, among others, from second hand and vintage shops, to the Theatre Royal, art galleries, a pub, and even a private house. At the locations, participants would typically find some kind of object (e.g. a box) with a hidden NFC reader. The first mission for example took place in the backroom of a hotel. Participants had to tap their badge onto a red telephone which would trigger the phone and make it ring. The phone call was a pre-recorded voice message that asked one of several questions to the participant, e.g. "What would be the worst place to fall down in Nottingham?". This was a common theme of the daily tasks - finding out what the participants think about Nottingham, what they connect with the city, and what they had experienced. Sometimes this was done at the locations, at other times a SMS was sent during the day prompting participants to answer. Additionally, every day the Fortnight elves (the nickname the game masters chose for themselves) sent an email out which could include a poem, a short story, philosophical thoughts, or links to interesting web resources.

The artists never revealed themselves, but they arranged for the participants to meet. One of those gatherings took place at a park inviting the participants to watch the sunset together while enjoying a free fruit drink and listening to a violin player.

On the second day of the experience, every participant also had the chance to acquire a rubber duck from a fountain at one location. Everybody was then encouraged to take pictures of their duck and share these and other thoughts by logging into the official Fortnight Nottingham Twitter account (Figure 7).

Figure 7. Participants acquired a rubber duck and were encouraged to take pictures of its adventures.

For me, Fortnight worked best when there was a strong relation between the location and the task. The aforementioned phone call at the hotel for example did not feel very relevant for a hotel location. During one visit in a second-hand shop however, participants were invited to use a ViewMaster system to watch slides while an audio narrator gave a very unusual impression of what was seen. This worked really well, as a ViewMaster is a device you would actually find at such a place.

Other tasks were engaging because of the unusual locations that were used. Fortnight led us into the Bromley Library for example which is only accessible by its members and otherwise closed to the public. On one of the last days we were invited into a private house where the owner had prepared a slideshow about his travels and then invited everyone to leave thoughts about "home" and "travelling" in a notebook.

Fortnight was very accessible to participants as it did not require a smartphone. Instead each participant got a NFC tag and the rest of the communication was done via SMS when the NFC tag was used at a location. It was also not necessary to visit every daily location, so depending on one's availability it was possible to put a variable amount of effort into participating. This effect was strengthened by the daily emails and the not-location specific SMS triggers. While I only replied to very

few of them but visited all locations, other participants engaged via these alternative means quite intensively. Participating in a location-based experience over the course of two weeks can be quite time consuming if one is expected to visit a specific location every day. Here, the approach of making everything opt-in and providing multiple ways of interacting with the experience prevented any such issues appearing.

The artists put a lot of thought into how to bookend the experience. The welcoming letter was hand-delivered to mailboxes of the participants and addressed to them personally. Likewise, Fortnight also had an official ending. All participants were invited to a final party where some of the things participants had produced (e.g. answering questions) was on display.

A big design issues however was the tendency to cause overcrowding. The locations themselves were usually accessible between 10am and 6pm. This however meant that there usually was a rush around noon (lunch break) and after 5pm (after work). When I went to locations late in the day, there would often be a queue of people waiting to take their turn as some of the tasks took several minutes to complete.

In order to deal with potential technical errors, to make sure all participants could get help, and to make sure all tasks were operational and accessible the artists had hired a few helpers. This assured that the experiences usually went smoothly as participants could get help when needed. However, for me personally this often had negative effect on the intimacy of the situation. Helpers would for example often sit more or less directly next to the artefact that had to be used, thus increasing the awareness of one's actions and reducing immersion.

2.3.9. Additional Games

While the aforementioned ten games give a varied overview of the design space that mixed reality games operate in, there naturally exist other noteworthy games. The following overview does not make any claims of being complete or exhaustive. Instead, I have selected games that exemplify interesting potential features of mixed reality games.

Mister X Mobile (Bihler et al., 2009) is a real world implementation of the board game Mister X / Scotland Yard. A group of players needs to catch Mister X before time runs out in a hectic chase around the game area.

Chromaroma (Mudlark, 2010) is played by travelling on the London Underground. Each station is a location in the game, and players gain points and achievements for travelling along specific routes. Movement is tracked by scraping the data from the Oyster Card accounts of participating players.

Rider Spoke (Rowland et al., 2009) invited players to cycle around the city. They can discover audio notes and stories left by other players, and can record and place their own to add content to the game.

In Interference (Bichard and Waern, 2008) players get handed a large voodoo doll made out of red leather that reacts when the correct melody is played on a bone flute. Players use it to open and close augmented reality portals while uncovering a mysterious story and interacting with several NPCs.

Day of the Figurines (Flintham et al., 2007) is played completely by text messaging. Players move their avatars around by sending and receiving SMS. The state of the game is represented on a large map where game masters move the titular figurines between real world locations.

Johann Sebastian Joust (Die Gute Fabrik, 2014) is a game played with PlayStation Move controllers. Players must move slowly and carefully while trying to get their opponents to make sudden movements which eliminates them from the game.

Epidemic Menace (Fischer et al., 2007) is an augmented reality game where players have to hunt down viruses. The viruses move and multiply depending on current weather conditions. At the same time players have to uncover who is behind the release of the viruses by speaking to NPCs and analysing surveillance footage.

In Cargo (Moran et al., 2013) players have to visit different locations to earn points while trying to figure out if they can trust instructions issued by an A.I. Players carry NFC cards that they use to "check-in" at a location.

AREEF (Oppermann et al., 2013) is an underwater augmented reality game where players explore a reef while diving in a real swimming pool.

Conspiracy For Good (Stenros et al., 2011) is an alternate reality game where large groups of players work together over several weeks to uncover a global conspiracy in real time. Notable predecessors of this genre are The Beast (Weisman et al., 2001) and I love Bees (McGonigal, 2008).

Heartlands (or 'Ere Be Dragons) (Davis et al., 2006) tracks the heartbeat of players. In order to play the game successfully they need to explore their surroundings while staying calm and relaxed.

ARQuake (Thomas et al., 2002) and Human Pacman (Cheok et al., 2004) are augmented reality counterparts of established videogames. Both games are played with a laptop connected to a head-mounted display and use GPS tracking for positioning.

2.4. Overarching Design Work

A few attempts have been made to collect existing design knowledge about mixed reality games. As justified above, I will take a look at work on mixed reality games, pervasive games, and location-based games due to the substantial overlap. While there exist only few exhaustive compilations of general guidelines, several academics have highlighted design lessons derived from specific games. In this section I will first take a look at aforementioned collections and then discuss some more detailed accounts about particular design opportunities or challenges.

2.4.1. Pervasive Games – Theory and Design

The seminal work in the area is perhaps the book Pervasive Games - Theory and Design (Montola et al., 2009). The authors take a systematic look at pervasive games, discussing how spatial, temporal, and social expansion can be used for design. They also give advice on broader design strategies, and reflect on the different ways how technology in general and mobile phones specifically can be used to enable these games. Furthermore, they also take a look at ethical challenges of staging these games in public spaces.

In an early chapter of the book (p31-p46), the authors describe different genres of pervasive games: Treasure Hunt, Assassination Games, Pervasive Larps, and Alternate Reality Games. The further extend this list with "emergent genres", types of games that were not yet fully established and well defined when the book was written. These emergent genres are: Smart Street Sports, Playful Public Performances, Urban Adventure Games, and Reality Games. Each of these genres is described in detail with illustrative examples that surface the salient features of each and the differences to the other genres.

In later chapters the authors talk about designing for the different dimensions of expansion (spatial, temporal, social). Under the heading Playing in Prepared Locations (p80) they stress the impact that unusual locations can have on the player experience. This effect can even be enhanced by preparing the location for the game specifically by adding props and technology.

One interesting and often overlooked detail of pervasive games according to the authors is the bookending of pervasive experiences (p103): *The very start of a pervasive game often makes or breaks the whole game experience.* Here, they discuss the question of how to transition players into the game. While this is certainly not relevant for all pervasive games, it is a crucial design decision for games that rely more on atmosphere and for example employ role playing.

The authors also discuss several other design issues that regularly appear in pervasive games. For example, on page 153 the authors describe the difficulties that multiplayer pervasive games might have to deal with in order to achieve critical mass. Because pervasive games are bound to a specific real world location, the group of potential players is drastically reduced when compared to a game that is purely played online. While the latter can attract players from the whole world, a pervasive game staged in in a specific city can only draw from the inhabitants of the city. Later on page 205 the authors discuss Invitations and Invasions. As pervasive games are often played in public space, this public space and the corresponding rules and regulations need to be taken into consideration. Often times, players will feel that the game gives them permission to e.g. trespass onto private property.

Overall, Pervasive Games: Theory and Design is a rich resource when thinking about pervasive games (and thus also mixed reality games). It provides an intensive collection of relevant games, and discusses their design from different perspectives. The authors also do not only talk about best practice approaches regarding game mechanics, but they also critically evaluate them and state problems that might arise from utilizing them. Here, they also provide means on how to overcome these challenges and give valuable advice for designers of such experiences.

2.4.2. Game Design Patterns for Mobile Games

Davidsson et al. (Davidsson et al., 2004) describe Game Design Patterns for Mobile Games. Here, they discuss games that are played on handheld devices. As such, some of the patterns cross over into the design space of mixed reality games (or mobile mixed reality games). The patterns follow the same structure as the more generic ones described in Patterns in Game Design (Björk and Holopainen, 2005).

24 patterns of the collection seem to be relevant for mixed reality games: Physical Navigation, Player Physical Prowess, Player-Location Proximity, Artifact-Location Proximity, Player-Player Proximity, Player-Artifact Proximity, Artifact-Artifact Proximity, Game Element Trading, Augmented Reality, Hybrid Space, Pervasive Game, Real Life Activities Affect Game State, and Extra-Game Input.

Several of these patterns deal with proximity triggers between players, locations, and artefacts (Player-Location Proximity, Player-Player Proximity, Player-Artifact Proximity, Artifact-Location Proximity, Artifact-Artifact Proximity). The game state changes as soon as a certain proximity is detected between two entities. Looking at it in a more fine-grained way, it is possible to describe the proximity mechanic as three different events:

- Entity A and entity B have just come into proximity with each other (triggered once)
- Entity A and entity B are currently in proximity (triggered continuously)
- Entity A and entity B are no longer in proximity (triggered once)

The pattern Physical Navigation describes the basic interaction present in all location-based games: The player has to physically move about to interact with the game (by e.g. triggering proximity). Player Physical Prowess describes the fact that the player's own physical skills are used as compared to video games where the player controls an avatar that has a predefined strength or speed. Game Element Trading talks specifically about physical objects that are being exchanged during the game, e.g. during Geocaching. Augmented Reality describes the technology of the same name: Meshing 3D models with the real world view. Hybrid Space, Pervasive Game, Real Life Activities Affect Game State, and Extra-Game Input all describe different ways how the real world can affect the game state with the help of technology (e.g. by using sensor data as an input).

2.4.3. Designing Mobile Augmented Reality Games

As part of my previous academic work I have studied mobile augmented reality games in more detail. A collection of game design considerations concerning these games have been published in the form of guidelines (Wetzel et al., 2011a).

One important concept for our look at mobile augmented reality games was semantical location context. While many augmented reality games can be called mobile (because they are played on a mobile device) we further separated these games into Faux Mobile AR Games, Loosely Coupled Mobile AR Games, and Contextual Mobile AR Games. Faux mobile denotes games that are independent of the location the game is played. They are mobile in the sense that they are played on a mobile device and allow the player to change their position. This change however has no effect on the game state. An example is Invisible Train where an augmented reality train travels around a small game board. Loosely coupled games have some relation to the environment. Players have to physically change their position in order to interact with the game. Example games are Human Pacman (Cheok et al., 2004), ARQuake (Thomas et al., 2002), or Epidemic Menace (Fischer et al., 2007). Contextual games utilize the same game mechanics – however the content of the game is closely connected to the real world place where the game is played. Moving the game to another place would require a substantial effort and might not even be possible. TimeWarp is one such game with its tight connection of story to the Heinzelmännchen legend of Cologne (Blum et al., 2012). The analysis of these games results in a set of guidelines which are depicted in Table 1.

Overall, the guidelines suggest elements that might create a positive experience for the players (e.g. promoting exertion, including non-player characters, adding physical elements). However, a large part of them also warns of common pitfalls that might plague a mobile augmented reality game. Examples are long distances between game locations, crowded areas, accidents and general safety concerns, too complicated interactions, not considering sensor flaws.

General	Justify the use of AR. Engage players physically.
Virtual Elements	Create meaningful AR content Create fully-fledged characters. Create a rich scenery. Go beyond the visual.
Real World Elements	Make the journey interesting. Comprise atmospheric elements from the reality. Include other (non-digital) media. Think about security. Plan ahead.
Social Elements	Use complementing roles. Use non-player characters. Encourage discussions. Avoid crowded areas.
Technology and Usability	Make the technology part of the game. Keep the interaction simple. Take display properties into account. Take tracking characteristics into account. Avoid occlusion-rich areas. Design seamfully and for disconnection.

Table 1. Design guidelines for mobile augmented reality games.

2.5. Design Space of Mixed Reality Games

The previous sections serve as an overview of the rich design space of mixed reality games. All of the games utilize technology in a meaningful way in order to create a hybrid game space. Coming back to the distinction between physical games, digital games, and mixed reality games as a genre between the two, we can further distinguish between different types of mixed reality games. In some games, technology stands at the forefront (TimeWarp, Can You See Me Now?), in others technology is just a means to an end and real world considerations take the spotlight (Shhh!, Fortnight). Another group of games balances both aspects (Tidy City, Insectopia). Table 2 places each of the discussed games into a continuum with completely physical and completely digital games posing as the boundaries. Placing these games into the three categories is to some extent a subjective matter – some games might justifiably be positioned in a neighbouring group. As a rule of thumb, I have put games where the focus is on the real world closer to the physical end of the spectrum, whereas games where technology is central to the experience are closer to the digital end of it.

physical	mixed reality			digital
Chess Poker Tag	Blowtooth Cargo Chromaroma Fortnight Geocaching Johan Sebastian Joust Monitor Celestra Rider Spoke Shhh!	Conspiracy For Good Feeding Yoshi Heartlands I love Bees Insectopia Interference Mister X Mobile The Beast Tidy City	AREEF ARQuake Can You See Me Now? Day of the Figurines Epidemic Menace Human Pacman TimeWarp	Pac-Man Super Mario Doom

Table 2. Classifying games as physical, digital, or mixed reality. Mixed reality games are further split depending on whether the player experience is more dominated by the physical or the digital aspects of the game.

While mixed reality games can put a different emphasis on the digital or the physical, they all have in common that the games are uniquely defined by this combination. Technology works as an enabler – it would be difficult to imagine most of these games to be played without technology. The real environment and physical activities and objects on the other hand create an arguably more interesting experience than a completely digital one (or at least a different one). Games like Tidy City provide players with a new perspective on their surroundings. Shhh! plays with the notion of social rules. Can You See Me Now? causes clashes between the real world and a virtual representation of it.

Apart from these unique opportunities, these games also confront the designer with a set of challenges that traditional video and board games do not face. How are flaws in technology catered for? How to best include physical locations with all their limitations (space, safety) into a game? What are social and ethical repercussions of mixed reality games? Mixed reality games utilize elements that are not under full control of the designer (public spaces) which forces them to plan for the unexpected. This stands in stark contrast to fully physical or digital games where the designer has full control over every part of the experience, perhaps apart from player-player interactions. Responding to such issues is something aspiring designers first have to learn. Mixed reality games combine the design space of physical games and digital games and extend it with their own particular opportunities and challenges.

A few academics have looked at these types of games from a cultural, mechanical, and technological perspectives and identified several of the inspiring and numerous

elements of these games alongside with common problems and best practice advice. I believe that collecting and surfacing these in order to make them accessible for creators of mixed reality games and experiences is an important task. Providing a quick but sufficient overview of the design space of mixed reality games will help new designers find their way around it, and enable experienced ones to push the boundaries of their designs.

The design space itself can roughly divided into three important aspects:

- physical elements of mixed reality games
- digital elements of mixed reality games
- game mechanics for mixed reality games

While the first two deal with the tools and elements that are available for a game, the latter looks at it more from a conceptual point of view. What kind of game mechanics can be employed in mixed reality games? These mechanics of course make use of the physical (locations, objects, people) and also of the digital (technology, sensors). In that sense, the mechanics are interactions that are enabled by the digital and the physical. At the same time, it is important to take into considerations the opportunities as well as the challenges that arise from combining these three aspects. Figure 8 visualizes the design space of mixed reality games and gives examples for elements to consider.

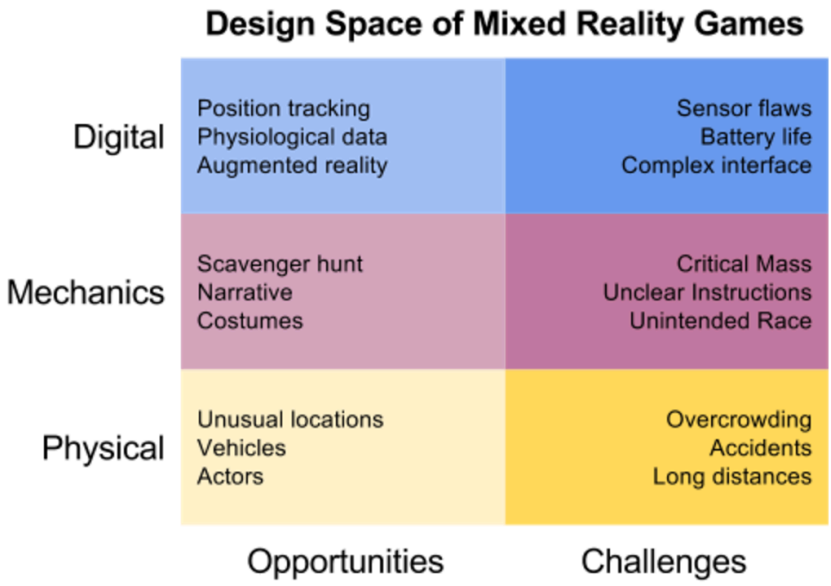


Figure 8. Design Space of mixed reality games.

2.6. Chapter Summary

Mixed reality games still count as a novel genre of games and despite the huge player bases of Geocaching and also Ingress, it took the recent launch of Pokémon Go for them to become widely known. Especially in academia and the arts, mixed reality games have been developed in the past that allow us to view our environment from new perspectives by bridging the gap between the physical world and the digital one. Mixed reality games play with the notion of place and location; they bring gaming (back) into the streets of the cities.

The case studies presented in this chapter and the in-depth look at several other interesting mixed reality games surely shows the huge potential that these games have and the vast design space that they operate in. Not only are they able to draw from extensive design knowledge of "traditional" video games, but they extend them with physical and locative elements. Playground games like Tag or Hide and Seek likewise influence the development of new and exciting mixed reality games. As such mixed reality games are multidimensional and arguably more complex than the underlying genres of games they draw from.

By being more than the sum of their parts mixed reality games offer vast opportunities for designers. At the same time, however, this also leads to a lot of challenges that video game designers do not need to worry about (e.g. limitations of a physical space, uncontrollable nature of locations). While there have been several attempts at encapsulating this emerging design knowledge, the design space of mixed reality games is still far from being fully chartered. This, it seems, makes them a promising genre to be explored with the help of ideation cards. Building a core set of design elements, the cards will then enable designers to find new combinations and explore these within the game designs they create. This, in turn, will enable new perspectives on mixed reality games and ultimately cause the core set to be extended. This is one of the strengths of ideation cards as unlike e.g. design patterns they are about the creation of something new and not (mainly) about the description of the status quo.

Lastly, mixed reality games offer an interesting test-bed for ideation cards as the design of these games is often highly multidisciplinary. Game designers work together with technologists as well as domain experts. Examples for such diverse teams can be seen in The Monitor Celestra, TimeWarp, or Can You See Me Now?

to different extents. Game designers string together different mechanics. Technologists evaluate the suitability and peculiarities of different sensors. Domain experts provide the content and are knowledgeable about the environment the game takes place in. In that sense, the design space of mixed reality games as depicted in Figure 8 is also often times reflected in the composition of the design team. Ideation cards for mixed reality games will have to support these diverse user groups with different levels and areas of expertise and guide them along the collaborative design process.

3. Encapsulating Design Knowledge

3.1. Overview

In this section I will take a look at different means of supporting designers in their practice. I will briefly compare design patterns, strong concepts, design guidelines and ideation cards and then motivate how the latter are most appropriate for the endeavour as they are arguably best suited for collaboration of multidisciplinary groups. This is followed by a closer look at different ideation card decks that have been developed in the past in academia or are commercially available. These decks serve as reference points throughout the thesis to situate the Mixed Reality Game Cards within the greater context of ideation cards. The chapter ends with a brief discussion of their commonalities and differences.

3.2. Guidelines, Patterns, Strong Concepts

According to Schön (1987) practitioners possess something he calls *tacit knowledge*. This concept summarizes their learned understanding of the design space which they draw from when doing design work:

> *Often we cannot say what it is that we now. When we try to describe it we find ourselves at a loss, or we produce descriptions that are obviously inappropriate. Our knowing is ordinarily tacit, implicit in our patterns of action and in our feel for the stuff with which we are dealing. It seems right to say that our knowing is in our action.*
>
> *Similarly, the workaday life of the professional depends on tacit knowing-in-action. Every competent practitioner can recognize phenomena – families of symptoms associated with a particular disease, peculiarities of a certain kind of building site, irregularities of materials or structures – for which he cannot give a reasonable accurate or complete description. In his day-to-day practice he makes innumerable judgements of quality for which he cannot state adequate criteria, and he displays skills for which he cannot state the rules and procedures. Even when he makes conscious use of research-based theories and techniques, he is dependent on tacit recognitions, judgements, and skillful performances.*

Making this knowledge accessible so that other designers can learn from it and apply it themselves is an important task. There exists a variety of different approaches on how to encapsulate such design knowledge. Popular examples

include presenting them as design principles, design rules, or design guidelines. Rogers (1997) describes these as follows:

> *The main difference between them is their degree of generalization; the former being the most general and the latter being the most specific. An example of the former is "design for consistency" and an example of the latter is "always place the exit button in the bottom right-hand corner of the screen."*

These approaches often also exist side by side like in Lidwell et al.'s compendium "Universal Principles of Design" (2010). Here they collect *laws, guidelines, human biases, and general design considerations* that apply universally across all disciplines. In Nielsen's "10 Heuristics for User Interface Design" (1995) we find another example for a collection of design knowledge, this time for a much narrower field.

Alexander et al. (Alexander, 1979; Alexander et al., 1977) took a more systematic approach by creating the first design pattern language (for architecture). Design patterns are a way to formalize design problems and solutions. They all follow the same overall structure and can likewise reach from high-level to very low-level. One of their distinct features is showing the connection between different patterns illustrating how they affect, support or contradict each other. While the original design patterns are prescriptive in nature, Björk and Holopainen (2005) for example have taken the same approach but in a strictly descriptive manner. Instead of pointing out problems in (game) design and describing a solution for it, they instead just neutrally report on phenomena they have identified.

As a last example, we might also consider "strong concepts" as introduced by Höök and Löwgren (2012). They situate their approach between theories and instances as so-called *intermediate-level knowledge* and define it in the following way:

> *Strong concepts are design elements abstracted beyond particular instances which have the potential to be appropriated by designers and researchers to extend their repertoires and enable new particulars instantiations.*

This ability to be used in the generative process is something they also attribute to patterns, guidelines, and heuristics.

In summary, we can say that the aforementioned approaches broadly speaking provide the following qualities for designers studying and applying them:

- **Knowledge**. They help designers to learn about the design space and make tacit knowledge available.
- **Communication**. They create a common language that designers can use to quickly and effectively convey and refer to specific concepts.
- **Creativity**. They are able to inspire designers who want to create new artefacts or ideas.
- **Improvement**. Designers can use them to inspect current designs and enhance them.
- **Analysis**. They can be used to investigate and evaluate existing designs.

While these approaches are excellent examples of how to make design knowledge accessible, one might argue that the way this knowledge is represented does not lend itself naturally to be used **during** a design session. Instead, guidelines, patterns, and strong concepts take on a perhaps more encyclopaedic role. They are great sources for studying up and learn about design concepts before putting them into place; or for diving deeper into them after a design session. While designing, they might also be used like a reference book in order to inform oneself more deeply about a specific topic that has come up. Table 3 gives examples of such envisioned moments of usage.

Pre	Learning about new concepts Reading about potentially interesting elements
During	Looking up unclear concepts Occasional browsing for inspiration
Post	Deepening understanding of chosen concepts Validating created design

Table 3. Guidelines, patterns, and strong concepts and how they are used before, during, and after a design process.

On the one hand this is certainly due to how they are structured and presented (as a book, as a wiki), but also because they do not tend to come with ideas on how to use them actively as part of a design session. However, for the purpose of this PhD I was more interested in a way to use existing design knowledge actively to support a (potentially collaborative) design process **while it is happening**. For this purpose, ideation cards seemed to be a more suitable choice.

3.3. Ideation Cards

As the name suggests, ideation cards are playing cards that are used to mediate ideation sessions. The cards in a deck typically convey certain aspects of the design space under investigation (with exceptions) and they allow designers to have a tangible representation of their idea. Ideation cards are much more dynamic than the aforementioned approaches as they share the same affordance as playing cards. They can be shuffled, played on a table, arranged in groups, rearranged, discarded. Brandt and Messeter (2004) place them in the category of design game which allows users to playfully collaborate in the design process. This way, ideation cards actively shape and support the design process – they are an integral part of it. This is achieved by not only providing the cards as such but also by prescribing rules that then guide the interaction with them.

In this section I will first introduce a variety of ideation card decks and then discuss their differences and commonalities. I start the section with commercially available cards before highlighting several ideation decks developed as part of research. While there are many more ideation decks I have selected the following because they either possessed interesting features or where a systematic evaluation of the ideation cards as a tool is part of the research.

3.3.1. IDEO Method Cards

One of the most well-known decks of ideation cards are the IDEO Method Cards (IDEO, 2002). These are 51 cards that describe different design methods like body storming or affinity diagrams. The cards are divided into four categories (learn, look, ask, try), and each card consists of the following three elements:

How - gives instructions on the method itself.

Why - motivates when to use this specific method.

Example - describes a use of the method within IDEO itself.

The back of the card features an image illustrating the method.

The IDEO Method Cards can be used during any type of design process as they are context agnostic due to describing specific design methods. The purpose of the cards is described as follows:

The Method Cards are intended as inspiration for practicing and aspiring designers, as well as those seeking a creative spark in their work. It's a design tool meant to help you explore new approaches and develop your own. Use the deck to take a new view, to inspire creativity, to communicate with your team, or to turn a corner.

In this sense the content of the cards guides the structure of the ideation session but does not contribute directly to the idea under development.

3.3.2. MethodKit Cards

The similarly named MethodKit Cards (Möller, 2012) are not one specific deck but instead 24 different ones following one of two set ups: frameworks and libraries.

The 17 framework decks contain cards that cover the different elements that should be considered for a specific domain. The domains are as diverse as product development, public health, wedding planning, kitchen design, or gender equality. The deck for workshop planning for example consists of 60 cards covering elements like WiFi, mental preparation, budget, expectations, participants, and venue.

In the 7 library decks each card features one example around a concrete theme. The themes are tech building blocks, trends, human needs, selection criteria, locations, personas, and business models. As an example, the tech building blocks deck consists of a total of 120 cards among them VR headset, internet banking, weather forecasts, public transport timetable, and smoke.

All cards have in common that they feature the name of the concept, a large icon illustrating it and a one-line explanation. The cards themselves are supposed to be used for collaborative design sessions developing projects (frameworks) and brainstorming as well idea mashups (libraries). The cards can of course also be combined with each other.

The creators of the cards also outline the following 10 design principles behind the cards:

1) *A visual tool*
2) *As little information as possible on the cards*
3) *Description without direction*
4) *Straightforward language*
5) *The sweet spot between structure and creativity*

6) *Discussions are more important than the cards*
7) *Create tools out of the reoccurring things*
8) *Tool that makes you ask important questions*
9) *Covering the essentials*
10) *The cards will not do the work for you*

These principles can be broadly put into the following categories:

How to derive content: Common and interesting topics (7, 8, 9)

How to present the content: Quickly to grasp, read, and understand (1, 2, 4)

How to promote discussions: No solutions, structure the process, not in the foreground (3, 5, 6, 10)

3.3.3. Deck of Lenses

Another example of commercially available cards is the Deck of Lenses (Schell, 2008a). This deck of 113 cards is a supplement to the book "The Art of Game Design: A book of lenses" (Schell, 2008b). The approach of both book and deck is to provide various different perspectives (lenses) on game design and confront the reader with them in the form of questions. One example from the deck is "The Lens of Technology" which is presented as follows:

> *To make sure you are using the right technologies in the right way, ask yourself these questions:*
>
> *What technologies will help deliver the experience I want to create?*
>
> *Am I using these technologies in ways that are foundational or decorational?*
>
> *If I'm not using them foundationally, should I be using them at all?*
>
> *Is this technology as cool as I think?*
>
> *Is there a "disruptive technology" I should consider instead?*

Examples for other lenses are venue, surprise, challenge, cooperation, balance, juiciness, atmosphere, and playtesting. Each of these lenses is also illustrated with an image.

How should one use the deck of lenses? Schell describes it the following way:

> *Think of an idea for a game.*
>
> *Try it out (no, really, try it out), you have to play games to see if they work!*
>
> *Figure out what is wrong with it, and change it so it is better. Then go back to step 2.*
>
> *Steps 1 and 2 you can do yourself, but Step 3 is where you need the Deck of Lenses.*

The cards support designers who already have an initial idea to focus on it and develop it further, proofing it against the different lenses.

3.3.4. VNA Cards

Kultima et al. have developed the VNA Cards (2008a). VNA stands for Verb, Adjective, Noun which directly describes the type of cards found in the deck. There are 80 verbs, 80 nouns, and 80 adjectives. Each of the 240 cards contains exactly one of these words and nothing else. The words are derived from an analysis of 40 digital and non-digital games. Example cards are:

- Verbs: bounce, dig, confuse, bluff
- Nouns: snake, street, furniture, nation
- Adjectives: tricky, messy, wooden, homelike

Using the cards is rather straightforward. The first person draws a verb card and describes a game idea that comes into mind. A second person then draws a noun and extends the idea. Finally, a third person reveals an adjective and uses it to finalize the game idea. Then a new round starts with a different initiator. VNA is used to generate short ideas for games and not fully developed designs. The following is an example idea for a game (Fishmania) that was generated by using VNA Cards (Kultima et al., 2008b):

> *Player controls fish and his task is to collect a shoal of similar fish and exit the area before it gets too polluted by a ship. There are also predators present which are threat to the player and his shoal.*

Kultima et al. (2008a) state that VNA utilizes the playfulness and familiarity of playing to great success, especially when compared to traditional brainstorming sessions:

Typical brainstorming requires someone to shake the participants in the beginning to loosen them up and to guide the session in order to keep the focus. The playful atmosphere for the session is easy to achieve by idea generation games since they refer to the playful conventions familiar to anybody who has experiences of any card games, whereas typical brainstorming sessions seem formally more like serious business meetings. We are used to playing card games by taking turns in an equal setting, usually in a non-serious mode. Business meetings are led hierarchically by bosses and with division of labor. Creativity is found in the settings familiar to the former, not the latter.

3.3.5. PLEX Cards

Lucero and Arrasvuori have designed PLEX Cards (2010) based on a framework for playful experiences (Korhonen et al., 2009). The deck consists of 22 cards each referring to a different category of playful experiences: captivation, challenge, competition, completion, control, cruelty, discovery, eroticism, exploration, expression, fantasy, fellowship, humor, nurture, relaxation, sensation, simulation, submission, subversion, suffering, sympathy, and thrill. The final version of the cards displays this title and a short one-line explanation of the concept as well as two images illustrating it. Lucero and Arrasvuori describe the iterative design process of the cards in detail. They noticed that participants without previous understanding of the categories sometimes had problems interpreting the cards, e.g. due to specific technical terms ("fog of war") or referencing unknown examples (tv series 24; Nokia Sports Tracker). Other times the definitions of the categories reused the title of it thus not doing much in actually explaining it, or images could likewise fit other categories well. In their second iteration of the cards the aforementioned issues were fixed, revealing another issue with the illustrations. Some cards depicted celebrities which narrowed the range of the card category as they led participants to preconceived interpretations depending on their view of the person depicted. Likewise, some images were criticised because they were too specific and detailed and therefore did not widen the interpretation of a card but instead narrowed it. Further iterating on their card design they settled on each card being represented by two images: one showing human emotion in an abstract way with the other giving a concrete example of a possible interaction.

Lucero and Arrasvuori describe two ways of using the cards: PLEX Brainstorming and PLEX Scenario, both designed for two participants.

PLEX Brainstorming aims to generate a lot of ideas in a short amount of time. To this end first a seed card is chosen randomly and revealed. Each participant then draws three cards into their hand. One of them starts and uses the seed card as a starting point for an idea. The second participant then eventually plays one of their cards and explains how it extends the idea. The round ends when the first participant adds one of their cards and likewise uses it to evolve the idea. Afterwards, both participants can discuss the idea freely before they write down a description of the idea. The method can then be repeated as often as one likes to generate more ideas. This method was inspired by VNA with the important change that participants could choose from their hand which card to play as compared to VNA where all three cards are drawn randomly and not just the seed card.

PLEX Scenario aims to go beyond the rudimentary ideas typically developed in PLEX Brainstorming. Three PLEX Cards are chosen randomly and revealed. The two participants then need to place them on a paper template divided into the following three areas:

> *Card 1: Beginning. Who are the people in the story? How does this category launch the story?*
>
> *Card 2: Continuation. How does this category cause the story to continue in a new direction?*
>
> *Card 3: The End. How does this category bring the story to closure?*

Participants are allowed to freely change the order of the cards during this process. In a variation of the technique, participants get to choose three cards to use from a random selection of seven cards.

Lucero and Arrasvuori report on how the cards have been received:

> *Participants perceive the PLEX Cards as an inspiring tool for idea generation either when used individually or in combination.*

They also note the differences between the two methods of utilizing the cards:

> *Regarding PLEX Brainstorming and PLEX Scenario, we received both positive and negative comments on the techniques. Some participants considered that the structured approach provided concrete results, while others felt turn taking, selecting three cards, and building the idea from a seed card blocked their creativity.*

In general, they report PLEX Cards as a useful tool especially in regards to rapid idea generation, but also mention that it can be used in the beginning of the design process to analyze a problem and can guide the evaluation of a resulting design.

3.3.6. Tangible Interaction Framework Cards

Hornecker (2010) has taken a similar approach to PLEX Cards and converted a framework for tangible interaction (Hornecker and Buur, 2006) into a deck ideation cards, the Tangible Interaction Framework Cards. She motivates this by saying *frameworks tend to be systematic and abstract, which makes them hard to use in creative practice*. There is a total of 26 cards separated by four categories: tangible manipulation, spatial interaction, embodied facilitation, expressive representation. Each card features an image, one or two questions, and a subcategory.

Examples cards include:

- *Is there rapid feedback during interaction?*
- *Can users experience the interaction straight away, from the start?*
- *How can the human body relate with the space?*
- *Can users be proud of skilled body movement? Can they develop skill over time?*
- *Is there a physical focus that draws the group together?*
- *Can all users get their hands on the central objects of interest?*
- *Are physical and digital representations of similar strength? Can they augment and complement each other?*
- *Can users think or walk with / trough objects, using them as props to act with?*

Hornecker briefly discusses the content design of the cards and emphasizes the usefulness of colour coding the cards by category as participants are used to colour or icon-based rules in other games. In addition, colourful cards make it easier to finding a specific card back. She has chosen the images in order to *illustrate and allude to the question's meaning, providing inspiration, while leaving space for interpretation*.

Using the cards is relatively easy. Participants gather having a concrete idea, design, or theme that they want to explore. The cards are shuffled and handed out to participants. They then take turns in playing cards and explaining whether and why they deem them as relevant or irrelevant for the design at hand. The group negotiates the final verdict on the card and will often end up clustering them into "very relevant cards", "somewhat related" and "irrelevant ones".

Hornecker has used the cards in a variety of studies and provides some interesting observations regarding the effects of the cards on the ideation process. She notes for example that the relevance alone is not a metric for how fruitful a resulting discussion will be from playing a card. Often times "clearly relevant" cards were seen as too obvious and therefore non-interesting and little engaging while irrelevant and partially relevant cards sparked intense debates. An example for this is a card being labelled as "irrelevant" with a resulting discussion of whether to "make the card relevant" by introducing the card's theme to the design.

She also discusses the timing on when to use the cards. If a problem was well understood or core goals were identified before the start of a session these would turn out to be most successful. A lack of initial constraints would create unguided sessions with a lack of focus. Too many constraints would likewise negatively affect the following card session due to *the 'ideation space' being closed off*. Overall Hornecker defines the "sweet spot" of using her cards as such:

> *The brainstorming exercise seems the most fruitful at such a midpoint, when a good understanding of the problem is reached, use situation and core goals are decided upon, but there is still space to flesh out details. This understanding constraints and anchors conversation.*

Hornecker advocates to implement "soft" rules for using the cards. Instead of for example strictly enforcing turn-taking participants should be allowed to temporarily break the rules as otherwise ideas might be held back when it is not a participant's turn. The cards also helped structuring the session naturally. Participants would for example play cards related to the previous one and physically place them close to each other. Cards were also shuffled, handed over, turned around, or discarded. This way they *invite and support spatial interaction, allowing for meaningful spatial arrangements that enable the group to exploring relations, while manipulations are visible to the rest of the group*. These arrangements provide both a physical focus as well as a record of discussion. Perhaps unsurprisingly the cards also played an important role as orienting devices. They act as *conversation starters* and *pacemakers*. The topics on the cards kickstart discussions around them, and work as a means to leave unproductive discussions behind and instead go to the next card. According to Hornecker the cards *provide triggers for feedback, allow participants to creatively interpret the project, bring in new ideas, and foster divergent thinking*.

3.3.7. Exertion Cards

Müller et al. have created the Exertion Cards (2014) that are also based on an existing framework. The Exertion Framework (Mueller et al., 2011) explores the role of the body and interactive technologies in exertion experiences. The deck consists of 14 cards divided into four categories:

> *The Responding Body (how the body's internal state changes over time as a result of exertion, e.g. heart rate)*
>
> *The Moving Body (how body parts are muscularly repositioned relative to one another)*
>
> *The Sensing Body (how the body is sensing and experiencing the world)*
>
> *The Relating Body (how bodies and people relate to one another*

Each card consists of a main question, a title, and a "dimension". The dimension allows designers to place their answer within a spectrum. Each end of the spectrum is represented by an image and a brief positive example.

Some example cards include:

- *Secondary Performance (question: "To what extent can players use their bodies to communicate outside the rules of the game?"; spectrum from "Focus on play" to "Convey emotion")*
- *Haptic Feedback ("To what extend does the virtual world offer feedback on the body?"; "Adaptability <> "Direct feedback loop")*
- *Integrated Communication ("To what extent does communication affect the virtual world and vice-versa?"; "Players can always easily communicate" <> "Communication forms part of play")*
- *Exhaustion Management ("To what extent is managing exhaustion part of the game?"; "Allows breaks for socializing and tactics negotiation" <> "Focus on fitness, less on tactics").*

Müller et al. evaluated the use of the cards in three workshops. The cards were generally seen as useful and inspiring, and workshop participants used them in groups to create new exertion game design ideas. In addition, they also identified several more poignant qualities of the cards. They report for example that the cards *helped fine-tune ideas*, *offered guidance*, and *expanded horizons*. The cards supported the participants in making their ideas more concrete and allowed them to view it from

different perspectives. The cards broke down the design space of exertion games into smaller, more manageable topics. These topics also gave more breadth to the ideas as some of them would not have been considered by the participants otherwise as they introduced previously overlooked elements. The spectrum on the cards both gave the participants fresh ideas as well as were seen as a good guideline of the important elements of an exertion game. Furthermore, the cards also enabled participants to focus more on the goal of making a game and kept them on topic.

Müller et al. also discuss some of the challenges they observed, especially related to the phrasings on some of the cards. When participants had difficulty understanding a card, they naturally started focusing more on how to correctly interpret the card and less on evolving their design. Participants also remarked that some cards were too similar to each other.

Overall however, the Exertion Cards the cards were seen as *useful for idea generation, idea improvement and articulation*.

3.3.8. Sound Design in Games Deck

Alves and Roque have developed the Sound Design in Games Deck (2011a). It is based on a design pattern language (Alves and Roque, 2010) and contains 77 double-sided cards. Each card summarizes a different pattern. One side of the card shows the title and three to four screenshots from games as example uses. The other side of the card repeats the title and gives a short explanation. It also puts the card in context within the pattern language noting how other cards relate to it.

The card Diegetic Music for example is explained as *Music happening in the game world* with the following connections to other patterns:

- *Context: Narrative, Emotional Script*
- *May relate to: Contextual Music, Musical Outcome*
- *May use: Radio*
- *Makes use of: Music, Acoustic Ecology*

In one workshop, they invited participants to use the cards as an ideation tool to develop a new game design idea (Alves and Roque, 2011b). The space between the participants on the table was divided into the following areas:

***Deck**: the starting position, i.e., the set of cards not yet considered during the session;*

***Hand**: set of cards still in discussion, i.e., the cards that are no longer in Deck but did not yet reached Solution or Graveyard;*

***Solution**: set of cards that participants consider to have discussed and for which tangible ideas of exploration have been specified;*

***Graveyard**: set of cards that participants have discussed and opted not to explore.*

Alves and Roque meticulously tracked the movement of the cards between the different areas. Typically, a card would move from Deck to Hand and then either to Solution or Graveyard. They also noted that some cards skipped the placement in Hand altogether going directly from Deck to their final destination as the decision was made very quickly. Very few times the participants moved cards already placed in Solution or Graveyard to the other final destination area, or back into hand for further discussion. Participants did not always use the areas in the anticipated ways. Some participants would place a card into Solution in order to start a discussion on how it should become part of the idea (instead of moving it into Solution after the idea has been discussed). Graveyard also attracted two different interpretations. The anticipated one of when participants did not want to explore a concept. Other participants placed a card into Graveyard to explore the literal absence of the concept as part of the idea. In their work, Alves and Roque show the importance of placement when using ideation cards as it can convey interesting additional meaning to the participants.

3.3.9. Inspiration Cards

Halskov and Dalsgaard have developed Inspiration Cards that are used in ideation workshops (2006). The Inspiration Cards consist of two types of cards, Technology Cards and Domain Cards. However, unlike the other card decks these are not static and identical for each workshop. Instead, workshop participants create these in preparation to a workshop. Both card types follow the same structure: a title, a description, an image, and an empty space for comments. An example Technology card is The All-Seeing Eye (*A camera tracks the movements of an object. A videostream showing a close-up of an eye is adjusted to make it seem that the eye focuses on the object and follows it around.*). For a project about interactive exhibits relating to Norse mythology comes an example for Domain Card Blood:

Balder, son of Odin, has recurring nightmares about dying and the end of the world. He envisions his name is written in blood, and the mountains cracking open like bloody wounds.

During the workshop, designers and domain experts come together and first introduce the specific cards to be used in the workshop. This creates a joint understanding of all of the concepts. Participants are then left free to select cards however they please and together create a poster by mixing and matching the cards they find interesting and/or want to combine.

Halskov and Dalsgaard report on mainly two phenomena when using the cards. On the one hand the cards are a source of inspiration, by slightly adjusting the content of a single card, combining two cards, or drawing an idea from the synergy between several cards. This is both true for cards that are obviously related to the theme and ones that are not:

> *Both Technology Cards close to the design domain and ones with a larger conceptual distance seem to play important roles, the former making it immediately easy to acknowledge the usefulness of inspiration sources, and the latter having a greater innovative power.*

The second observation they make in regards to the focus shifts that the cards enable. Cards would be used by participants when only slow progress was being made. Playing a new card (or suggesting to play a new card) would introduce new perspectives and, as a result, new ideas.

3.3.10. Video Cards

Buur and Soendergaard (2000) have created Video Cards that allow the (ideally) seamless integration of videos of user activity into a user-centred design process. In preparation for a workshop mediated by the cards, 60 to 70 short sequences from eight hours of video recording were selected. Each clip was then turned into a card by giving it a descriptive title and using a snapshot of the video as an illustration. Workshop participants were divided into pairs and got a randomly selected share of the cards. Participants then spent time watching the videos and annotated the cards with their observations. An example card from a workshop about the development of a new pump for domestic heating systems had the title "Lars mounts the motor" and a participant wrote down the following on it:

> *he screws the ring one way, then the other*
> *he looks concerned about it*

Afterwards, participants came back together and were tasked to sort the cards into thematic families. The final step in the workshop then consisted of going through the different families with each participant introducing "their" cards and explaining why they found them interesting and fitting into this theme. During this phase, participants were also free to watch the video clips repeatedly.

Buur and Soendergaard briefly allude to the physical properties of the cards when discussing the workshops:

> *It is beyond any doubt that the players associate meaning to each card. They finger them as reminders of things to say and show, and they wave them to attract attention to particular arguments.*

In a next iteration of the cards they created a dedicated table setup with screens embedded into the tables in order to overcome some of the challenges they identified in using the cards. To this end they defined the following design goals:

> *Players should be able to discuss face to face without obstructions in the line of sight.*
>
> *All players should have equal access to cards, video displays, and card family overviews.*
>
> *Players should be supported in pointing out things on video, cards, and family overviews.*

Participants could then use the cards to control the videos by placing and moving them around a slider next to the screens. However, their overall setup was not successful. They reported that participants spent too much time focusing on the screens instead of watching each other and this way missing gestures, facial expressions and other clues. These are important elements that make a face-to-face discussion so valuable.

3.3.11. Moment, Sign, and Trace Cards

Brandt and Messeter (2004) have developed four design games with two of them utilizing three different types of cards. The User Game uses two types of cards: Moment and Sign Cards. Moment Cards are similar to the aforementioned Video Cards. They represent a video clip of a user activity taken in the field, with usually 20 to 40 of them in a deck. The card itself only shows a still of the video clip. The Moment Cards have RFID tags attached to them so that they can be scanned to trigger the appropriate video to be played on a screen. During a session, a first participant selects at least five Moment Cards and creates a story out of them by

placing them in a horizontal line. A second participant then takes between two and four cards and creates another story vertically while incorporating one of the already placed cards into it. This continues and consecutive stories always need to pass through an existing one slowly creating a crossword-like structure. During the process Sign Cards are used to label the stories. Sign Cards consist of a single word like "despair", "pace", "vibrant", "closeness", or "ones" and the base set consists of 30 cards. The session end when the participants agree that they have created a sufficient number of stories that describe the user. Participants then create a summary either consisting of short stories or keywords.

The Landscape game builds on the people created within the User Game. It uses the same Moments Cards but the game starts by looking at the Trace Cards. These cards depict physical surroundings from the field and can be outdoor areas or building interiors like office rooms. Participants select these Trace Cards and interpret them in relation to the user stories. They can also choose an abstract game board which represent how physical space is used, e.g. several radial circles symbolizing a place for group work in small teams. Participants then put the chosen cards into standees and place them on the game board to visualize their ideas and to discuss the role of the different users in the chosen space.

In their observations about the design games Brandt and Messeter stress the positive effect that physical props have on the design process. They *allow stakeholders to become more fluent in the language of expressing design moves*. By being able to manipulate objects with their hands the process is made more efficient and it supports participants to focus. Brandt and Messeter also emphasize the importance of having game pieces that *are rich enough in content to span the gap between different understandings and/or interests of different stakeholders*. They also observed that the restrictions put on the participants by the rules helped them being more creative by providing them with some initial boundaries an idea can be built on. Lastly, they comment on the fact that design games reduce the power relations between participants which makes participants more willing to contribute freely to an idea.

3.3.12. Other Cards

Apart from the aforementioned ideation card decks there exist several other card decks. I will only briefly summarize these here as these decks are mostly interesting for their specific content but do not contribute much to a wider discussion about the properties of ideation cards.

The Envisioning Cards (Friedman and Hendry, 2012) promote value-sensitive design in order to *raise awareness of long-term and systemic issues in design*. The deck consists of 28 cards with each card describing a relevant concept and a related design activity. The Privacy Ideation Cards deal with privacy issues surrounding modern technology (Luger et al., 2015). 35 cards cover regulations, systems, users, and constraints. The Ideation Decks method describes how to create cards for different domains (Golembewski and Selby, 2010). New decks are created by first identifying important Category Suits who are then populated by creating Instance Cards. Concept Cards (Vines et al., 2012) have been used in a participatory design session with elderly people about their banking experiences. The content of the cards was intentionally provocative to create criticism and debate. The Design Heuristics Cards (Daly et al., 2012) consist of 12 cards that can be used to design new products based on a problem statement. The Instant Card Technique is used in user-centered design session (Beck et al., 2008). They consist of six types of cards: User Cards, Location Cards, Time Cards, Technology Cards, Activity Cards, and Goal Cards. The PictureCARDs (Tschudy et al., 1996) are based on the CARD Method (Tudor et al., 1993). The latter was developed to support collaborative analysis and critique of a software system, while the former engages cross-cultural participants with more visual card designs.

3.4. Comparing Ideation Cards

Having taken a look at the overall design space of ideation cards themselves, we can note several commonalities but also important differences. As a useful first step to understand the reasons for this, I will take a look at the main purpose of these different decks of ideation cards. While by nature all of them are created to support the ideation process, there are clear differences that allows us to separate the cards according to when they are being used in the design process: in the beginning (to generate an idea), or later (to develop an existing idea).

3.4.1. Idea Generation and Idea Development

In order to motivate the separation into idea generation and idea development, we can take a look at the work by Wölfel and Merritt (2013) who have conducted a survey of 18 card-based design tools. They classified the decks according to five dimensions: purpose and scope, duration, system, customization, and formal qualities. From this they identified three broad categories of ideation cards: general purpose / repository cards, customizable cards, and context specific cards. The first group of cards is design space agnostic. A good example for such a deck are the Method Cards that describe methods on how to structure a specific session. The content of the cards itself does not directly influence the content of any resulting design discussions. Examples for customizable cards are the Inspiration Cards, Video Cards as well as Moment, Sign and Trace Cards. These cards are tailor-made for a given session. In the case of Inspiration Cards they collect domain specific concepts and interesting technological solutions. The latter cards are likewise highly specific for a given session as they make tangible existing data (e.g. video clips of users). The session then revolves around inspecting this data and using it as a base for design decisions. The last group of cards on the other hand is statically encapsulating existing design knowledge that then builds the backbone of the design sessions. The remainder of the discussed ideation cards falls into this group.

However, when looking at the cards within this group, it is easy to notice rather strong differences. VNA Cards only consists of single words while a card from the Deck of Lenses provides much more textual content. When looking for a reason for this disparity it becomes clear that both cards are also being used for different purposes in the design process. VNA Cards support the rapid generation of ideas, while the Deck of Lenses clearly states that they should be used to develop an existing idea further. PLEX Cards also are being used for idea generation, likewise the Sound Design in Games Deck. On the other end of the spectrum we have the MethodKit Cards, Tangible Interaction Framework Cards, and Exertion Cards that all mainly serve as reminders and discussion prompts for the development of ideas. Of course, most of these cards can also be used for the other purpose. One could for example use the PLEX Cards to methodically investigate the playful elements of an experience. The Exertion Cards have been used in workshops where

participants did not bring any existing ideas and therefore the cards played an important role in the initial generation of an idea.

Based on this reflection, we can broadly identify two main purposes for ideation cards: **idea generation** and **idea development**.

3.4.2. Content, Appearance, Rules

What makes some cards more suited for idea generation and others more for idea development? The authors of the different decks do not discuss this question in great detail if at all. An obvious clue is the **content** found on a card. VNA, PLEX Cards and the Sound Design in Games Deck all provide very little actual text, and the text is presented in a factual matter. The cards from the idea development group on the other hand generally utilize questions. These require that users reflect on the relation between the card and their idea which arguably fosters idea development.

The type and amount of content at the same time influences (and is influenced by) the physical **appearance**. On the one hand this includes the graphic design: How is the text formatted? What are colours being used for? In addition, this also includes the materiality of the cards, i.e. the card dimensions and used card stock. A small card has less space for content; cards that have only little content (e.g. VNA) can be made physically smaller. Cards that are mainly used for idea development need to find the right balance between card size and legibility of the content as e.g. a small font size might make it hard for participants to read.

Cards that are used for idea generation also seem to have stricter or at least more detailed **rules** than their idea development counterparts. Where the first group instructs users how to draw and reveal cards, the ones belonging to the second group have much softer rules that can often be condensed to "look at and discuss all the cards you find relevant".

All creators of ideation cards report on the usefulness on their cards, and several of them also describe the design process on how they arrived at the final version of the card decks (including content, card design, and rules) in more detail. This is especially interesting when the various steps of an iterative design process are being described with a reflection on why certain things were changed between version (e.g. PLEX Cards). This typically includes reflections on the layout of the cards (e.g. choice of images and phrasing) and to a lesser extend the utilized rules.

3.4.3. Utility of Ideation Cards

Especially Müller et al. (2014) and Hornecker (2010) provide some more detailed insights into how ideation cards shaped the design process. This is crucial to understand as only this way we can design ideation cards in a way that makes them most effective. In their work, for example, we find that ideation cards structure the discussion, create focus, and cause inspiration (see 3.3.6 and 3.3.7). In order to better understand how ideation cards achieve these effects, taking a look at literature outside the field of ideation cards is immensely helpful.

Guildford (1950) has introduced the concept of divergent thinking as the ability to develop multiple solutions to a given problem. This is measured by providing an open-ended stimulus problem with participants then having to generate as many solutions as possible. In idea generation with ideation cards, this is typically done not by using the same random selection of cards over and over again, but instead continuously drawing new cards (and as such new problems).

If we look at ideation cards in this context, then they might qualify as an example for external representations. Zhang (1997) explains this concept as follows:

> [..] external representations are defined as the knowledge and structure in the environment, as physical symbols, objects, or dimensions (e.g., written symbols, beads of abacuses, dimensions of a graph, etc.), and as external rules, constrains, or relations embedded in physical configurations (e.g. spatial relations of written digits, visual and spatial layouts of diagrams, physical constraints in abacuses, etc.).

Based on Zhang and Norman (1994) he then further emphasizes the role of these external representations in the process of problem solving (which design activities can be classified as):

> *First, they provide information that can be directly perceived and used without being interpreted and formulated explicitly. Second, they can anchor cognitive behaviour. That is, the physical structures in external representations constrain the range of possible cognitive actions in the sense that some actions are allowed and other prohibited. Third, they change the nature of tasks: tasks with and without external representations are completely different tasks from a task performer' point of view, even if the abstract structures of the tasks are the same.*

Here, the physical cards themselves take on the role of these external representations thus allowing the designers to e.g. use them as memory aids while embodying the design problem at hand. The images that can be found on the majority of ideation cards in fact also serve as such an external representation. Here, mental images and external pictures give access to additional knowledge and skills (Chambers and Reisberg, 1985; Reisberg, 1987).

During a session with ideation cards, randomness plays a crucial role as the cards do not appear in a pre-defined order. Schön (1983) for example is making a case that practitioners benefit from being *stimulated by surprise*. Dorst and Cross (2001) also stress the importance of surprise:

> *Surprise is what keeps a designer from routine behaviour. The 'surprising' parts of a problem or solution drive the originality streak in a design project.*

The random draw of cards in an ideation session is one example for such surprise. It creates new contexts as well as design constraints that participants have to deal with. Promoting creativity by providing constraints is a concept that for example Finke et al (1992) found beneficial. In one study they observed that a random selection (from which to build a design) resulted in more creative solutions than when participants could choose freely. A follow-up study supported these results: they see creativity as something that has more to do with making something out of a situation in which you are placed than with planning something "from the ground up". When operating under constraints, designers cannot follow the *path-of-least-resistance* or POLR (Ward et al., 1999). Moreau and Dahl (2005) further unpack this concept and introduce the ideas of input restrictions and input requirements.

> *Input Restrictions. One key constraint in a creative task may be the set of inputs available to solve the problem. [..] If consumers are operating without constraints, they can simply collect or purchase each of the identified inputs and, without interruption, execute the well-known plan. [..] Thus [..] input restrictions may force consumers to deviate from their top-down POLR strategy in favour of a more constructive creative processing approach.*
>
> *Input requirements. [..] the requirement to include specific types of inputs in a given solution [..]. In these situations, the identified input(s) may not be consistent with a well-known solution, and the consumer [..] may have to move off the POLR and use more creative processing to explore new meanings and/or roles for that input.*

Dahl et al (1999) have also suggested that basing designs *on previous experiences [PLOR] reduces the diversity of images generated, and therefore the originality of the design solutions*. Based on a study where participants had to construct novel toys based on a variety of shapes, Moreau and Dahl advocate for the inclusion of constraints in the design process:

> *While many creativity techniques (e.g., brainstorming) encourage unconstrained thinking, our results paradoxically suggest placing constraints on the generative task may increase the amount of creative processing. Only when inputs were both restricted and required were participants more likely to process creatively, constructing different forms and searching for possible "toy" interpretations from the fixed set of inputs.*

Apart from surprise and constraints, another important element for creative design is knowledge. Snow (1986) explains:

> *A rich store of knowledge in a field is also required as a base for idea production and evaluation. For this reason, most instances of creativity are field specific; a person acknowledged as a creative producer in art is not likely to be so in music composition, or literature, or mathematics, or science. Creativity is not a light bulb in the mind, as most cartoons depict it. It is an accomplishment born of intensive study, long reflection, persistence, and interest.*

In that sense, ideation cards are encapsulating knowledge (in the form of card content) that participants can then utilize in the design process in order to make up for a possible lack of experience. However, this effect of ideation cards might be limited in scope – it remains to investigate how well extremely inexperienced users might be able to create specific designs in domains unknown to them. Mumford and Gustafson (1988) for example distinguish between the level of knowledge:

> *[..] leads to the expectation that knowledge and experience would be directly related to minor contributions, while yielding a curvilinear relation with the likelihood of major contributions due to the channelling and cuing effects brought about by high levels of experience.*

3.4.4. Card Interactions

In the previous sections we have seen how the content, the physical design, and the accompanying rules all shape the design process. These are all elements that the designer of a deck of ideation cards has under control. However, when looking at reports on the usefulness of ideation cards, the specific way designers interact with them warrants further notice. For example, Buur and Soendergaard (2000), Hornecker as well as Alves and Roque (2011a) all also present observations that attribute some of these qualities to the fact that ideation cards are tangible objects. As such they afford e.g. being spatially arranged on a table (which creates additional meaning) and being used as part of gestures like pointing with or at them. These **tangible interactions** have a clear impact on how an ideation session progresses.

At the same time, ideation cards have been classified as design games (Brandt and Messeter, 2004). Ideation cards resemble playing cards that everyone is familiar with. As such (and supported by the rules), sessions with ideation cards are often perceived as game-like activities by designers. Cards are being played and discarded, just as we do in card games – these **playful interactions** arise naturally and likewise have a noteworthy effect on ideation sessions.

3.4.4.1. Tangible Interactions

The positive effect that ideation cards have on design sessions is often at least in part attributed to their materiality of being physical objects. Gestures with cards as well as placement of cards are commonly reported as part of observations and explanations. However, these results are often not very systematically collected or further explored. Buur and Soendergaard for example observed participants of their Video Card Game and noted that participants *finger them [the cards] as reminders of things to say and show, and they wave them to attract attention to particular arguments*. They also describe physical limitations of the cards. When a card is played on a table any participant sitting opposite of them will naturally also see the card upside down. Perhaps unsurprisingly physical distance towards a card negatively influences their readability in general. Closeness to the cards on the other hand improved the collaboration between the participants as they all had equal and easy access to them. They called this effect a spatial barrier that can prohibit participants from interacting with the cards (e.g. picking them up). Halskov and Dalsgaard (2006) describe the usage of their Inspiration Cards and note how *cards supported focus shifts*

in the process, and made it easier to bring new perspectives, and, by extension, new ideas, into the design process. Participants achieved this by for example picking-up and introducing new cards when the discussion was not going fast enough. In their study about PLEX Cards Lucero and Arrasvuori (2010) note that workshop participants handled the cards by *pointing or taking a card in their hand to refer to specific aspects of the cards*. Furthermore, cards were arranged in clusters to show connections between them and structure the discussion. Hornecker ran several studies with her Tangible Interaction Framework Cards. According to her the participants used the cards in a variety of ways. As her account is perhaps the most detailed, I want to quote the full paragraph of where she talks about the cards' physical qualities:

> *The cards physical and configurable nature is one of their strengths. A participant comments: "I liked the card aspect of it, where you can move and arrange it so you still have some kind of organization". Interaction with the cards could be very physical, being shuffled, spread out, handed over, turned around, and non-relevant cards being tossed away. Several participants remarked on the card game itself as a good example of tangible interaction. The cards are tangibly manipulated, invite and support spatial interaction, allowing for meaningful spatial arrangements that enable the group to exploring relations, while manipulations are visible to the rest of the group. The cards thus support legibility of action as well as performative behaviour. They are expressive representations (this was one of the main aims in revision of text and imagery), and provide a record of discussion. Moreover, they are a form of embodied facilitation as they can be handed over, and do provide a physical focus while having a low entry threshold.*

Combining the observations by the different researchers, there are several ways in which the physicality of ideation cards played an important role in the design process. Cards were touched, waved, picked up, pointed at, clustered, shuffled, spread out, handed over, turned around, and tossed away. What these reports however lack are concrete examples of these occurrences and how they help or potentially hinder the ideation process. How precisely do cards become orienting devices, conversation starters, pacemakers, and discussion prompts? It is crucial to understand how cards are used to inform best practices around ideation card and session design.

In order to answer these questions, we can find clues in literature that is more concerned with tangible interactions in general, and specifically in research around gestures and spatial arrangements.

Kendon (2004) defines gestures as follows:

> *'Gesture' we suggest, then, is a label for actions that have the features of manifest deliberate expressiveness. They are those actions or those aspects of another's actions that, having these features, tend to be directly perceived as being under the guidance of the observed person's voluntary control and being done for the purpose of expression that in the service of some practical aim. Participants in interaction readily recognize such actions and they tend to be accorded the status of actions for which the participants are held responsible.*

Looking at the above reports from other researchers investigating ideation cards, we can find clear indications of how gestures are used for *expression* (e.g. emphasizing a specific card). Placing them in a specific spatial arrangement would, according to Kendon, not qualify as a gesture as this can be seen as a *practical aim*.

McNeill (1992) stresses the importance of gestures as part of human communication as well, going so far as to state that gestures are an integral part of thought:

> *Such an argument helps explain why gestures occur in the first place. Gestures occur, according to this way of thinking, because they are part of the speaker's ongoing thought process. Without them thought would be altered or incomplete.*

According to, him *gestures carry both semantic and pragmatic content*, another quality that allows them to shape ideation sessions. Streeck and Hartge (1992) give one such example for what gestures are being used: *projections*. These are gestures that are being used to e.g. signal one's desire to speak. As these projections are non-verbal, they possess a very low level of intrusion and thus foster harmonic group processes. During a card-based ideation session, it is plausible that participants might use a gesture performed with a card for the same purpose. Using gestures in this way is something that has also been noted by Tang and Leifer (1988). They provide a detailed analysis on the purposes of gestures. According to them, gestures are being used to store information, convey ideas, represent ideas, and engage attention:

> *Store information – preserving information in some form for future recall, typically after attaining explicit group agreement.*

Convey ideas – transmitting ideas to others in some textual, graphic, or gestural form.

Represent ideas – expressing tentative ideas in some tangible form to allow one's self and others to perceive, react to, and build upon them.

Engage attention – directing attention to a region in the workspace, typically to refer to an object or to provide a focus of attention.

At first sight, some of these categories seem non-fitting for gestures, something Tang and Leifer briefly discuss:

Although gestures might not typically be thought of as a medium for storing information (because they do not leave behind any permanent record) we have evidence that information can be effectively chunked and remembered though gestures, especially if the gesture is imitated by others and labelled in text or graphics.

This is an interesting observation and helpful for understanding gestures with ideation cards – due to them being physical objects, initially ephemeral gestures can be conserved by deliberate placement of cards at the end of a gesture. Here, card gestures and placement of cards seem to have a potentially close connection.

Such spatial placement has also been credited with a crucial role in work regarding tangible user interfaces (Sharlin et al., 2004):

Everyday objects typically offer a clear and intuitive spatial mapping to their function—sometimes, so clear that people forget the mapping exists. In human–computer interfaces, the mappings are often much more complex and profoundly limited by the affordances of the physical interface components, resulting in an unintuitive and frustrating interaction experience for the user.

As inherently non-digital objects, ideation cards possess this spatial mapping quality which in turn allows designers to intuitively place them in helpful ways, e.g. as seen in the work by Alves and Roque (2011b) where such behaviour is encouraged by utilizing a place mat. Placing objects in specific locations and in specific relation to each other has also been observed (Kirsh, 1995). Kirsh categorizes the purposes for such spatial arrangements as follows:

- *spatial arrangements that simplify choice*
- *spatial arrangements that simplify perception*
- *spatial dynamics that simplify internal computation*

Choice is simplified by using cues and constraints, reducing perceived actions, eliminating decisions, and offloading heuristic properties. In order to simplify perception, spatial arrangements are used in order to categorize (by e.g. clustering), create symbolic marking, sharpen perceptual acuity (again, by clustering). Lastly, internal computation includes high speed offloading, and externalizing representations and perspective flipping. External representations were already discussed in section 3.4.3 – however Kirsh goes into some detail how the actual placement of them is a crucial aspect. Here, not just the embodiment of concepts in the form of ideation cards is helpful for the design process, being able to arrange them in meaningful relations further strengthens their role and utility. Kirsh and Maglio (1994) count this act of spatial arrangement an *epistemic action* in contrast to pragmatic actions. The define epistemic actions as follows:

> *More precisely, we use the term epistemic action to designate a physical action whose primary function is to improve cognition by:*
>
> *1. reducing the memory involved in mental computation, that is, space complexity;*
> *2. reducing the number of steps involved in mental computation, that is, time complexity;*
> *3. reducing the probability of error of mental computation, that is, unreliability.*

While the aforementioned sources mainly talk about placement in general, it is also worth taking a look at how this would work in a collaborative environment – after all ideation cards are designed to be used in groups. Kendon (1990) has introduced the concept of *F-formations* that describe *shared transactional spaces*. F-formations are a lens to analyse how groups of people arrange themselves when interacting with each other. These F-formations can then be further analysed by breaking up the physical space they occupy into o-spaces, p-spaces, and r-spaces (Kendon, 2010):

> *The shared, inner space, called here the o-space, which the participants actively co- operate to sustain, is the space reserved for the main activity of the occasion. In conversation this is the exchange of utterances organized around a common theme. This space is surrounded by a narrower one, here called the p-space, which provides for the placement of the participant's bodies and also personal things such as briefcases, handbags, and the like, which are typically treated as in some way a part of a person, even though physically separate. [..] Finally, there is the surrounding space, indefinite in extent, which can be identified as serving as a kind of buffer between the F-formation itself and the wider world beyond. This space has been termed the r-space. This is the space which, though not used directly by the*

activities of the interaction, is nevertheless actively monitored by the participants - and also noted by non-participants.

Observations about how p- and o-spaces are being used during ideation sessions might provide insight into how best to set them up from a spatial point of view to encourage interaction between the participants. Scott et al (2004) have taken a look at how collaborative work makes use of different spaces. Here, they distinguish between personal territories, group territories, and storage territories, and how they are used and perceived:

Personal territories allow people to reserve a particular table area (mechanic #1), as well as task resources (mechanic #2) for their own use. Ergonomically, personal territories serve to ease a person's actions related to the group activity, such as reading, writing, and drawing. They also provide a space for people to disengage from the group activity. [..] Areas directly in front of people are typically used as their personal territories. [..]

A group territory provides a space to perform main task activities, such as assembling puzzles or creating product designs. We found that the group territory was also used to assist others in tasks such as creating or modifying particular furniture arrangements. [..]In our studies, the group territory typically covered any tabletop workspace that was not occupied by the personal territories. [..]

Storage territories served as areas to store task resources (e.g., tools, items not currently in use, customized items, reference materials) and non-task items (e.g., food, drinks). Participants used storage territories to organize these items in the tabletop workspace. [..] The storage territories used by our participants were placed at various locations around the workspace, but generally migrated to the table edge as the task progressed. These territories sat atop the personal and group territories and were mobile in the workspace.

Scott et al then provide a set of guidelines based on their findings which might be useful to inform the spatial layout of ideation card sessions as well:

Provide visibility and transparency of action.

Provide appropriate table space.

Provide functionality in the appropriate locality.

Allow casual grouping of items and tools in the workspace.

To fully understand the tangible interactions afforded by ideation cards, we must also investigate how objects (i.e. cards) are placed within these areas. Here, work by Tse et al (2004) takes a closer look how collaboration happens within the above mentioned territories:

> *People coordinate through mechanical actions such as: obtaining the resource (thus excluding others from using it), reserving the resource (by moving closer to it and explicitly or implicitly notifying others of their intentions), and protecting their work (by monitoring other's actions in the area and notifying others when problems are anticipated). They also transfer resources by handing off objects (through verbal or physical give and take) and by placing objects in particular locations and notifying others about the handoff. All the above serve to spatially separate actions, and to coordinate those moments of close interaction.*

Lastly, Kruger et al (2003) also stress the importance of orientation in regards to collaborating in tabletop settings:

> *Orientation for picking up/using objects. People are much more likely to pick up and use objects that are oriented towards themselves or at a compromised angle.*
>
> *Placing oriented objects for availability. The way people place an object suggests personal ownership/access if the object is oriented towards themselves, and shared ownership/access if it is oriented towards others or placed at a compromised angle.*

This is of clear relevance to ideation card sessions as the text on the cards is typically printed in a way that it can only be read from one side.

When talking about the phenomena described in this section, ranging from gestures to placement, it is useful to think about them as examples for tangible interactions. Typically, this term describes how humans interact with physical technological artefacts and objects (Hornecker, 2011):

> *"Tangible and embodied interaction" provides a broad umbrella description for a research field united through an interest in the role of physicality. There is the physicality of our own bodies, the materiality of objects, the physical world in general, and the physicality of space. We touch and feel objects. Our bodies are living, experiencing, and feeling bodies. Tangible objects and our bodies are embedded in a physical space that we experience and interact in and with. These physicalities intersect in interaction. Tangible interaction merges physical form and computation, resulting in interactive and responsive form.*

However, in this section we have seen that work on gestures and placement seems highly relevant for understanding how ideation cards work. At the same time, this work can both be found in "analoge" research fields as well as "digital" ones. In the cited source defining tangible (and embodied) interactions, we have seen the big role that physicality and materiality have regarding tangible interactions. For the purpose of this thesis I will therefore use the term describing all interactions that stem from the fact that ideation cards are physical and therefore tangible objects – even if they do not include technology itself.

3.4.4.2. Playful Interactions

Existing literature on ideation cards has so far not put a lot of attention on the playfulness of the interactions. One exception are Brandt and Messeter (2004) place their work on Moment, Sign, and Trace Cards (see section 3.3.11) into the broader context of design games. They acknowledge (and utilize) the unique properties of games, and their potential effect on especially participatory design. It is easy to see why ideation cards would fall into this category: They combine well-established game objects (the cards themselves) with rules on how to use them during a session. In the previous section we have already seen how this creates a variety of tangible interactions – interactions that are very similar to how people play games. In their work, they point out the following cause and effect of design games:

> *By entering into the game the participants also implicitly agree to play by the rules. Arguably, this plays down external factors like power relations between participants or conflicts in organizations.*

Breaking down existing hierarchies is arguably a powerful way to foster collaborative ideation as it encourages participation from everyone. Brandt and Messeter then continue:

> *[..] we believe that the games also contribute to the leveling of stakeholders with different interest leading to a more constructive dialogue*

In a follow-up to this work, Brandt (2006) also stresses the collaborative aspect of design games and the lack of a "win condition":

> *When we talk about exploratory design games in design work the players seldom compete in order to win a specific game. Participants in exploratory design games often have different interests and preferences but instead of utilizing this by competing the aim is to take*

advantage of the various skills and expertise's represented and jointly explore various design possibilities within a game setting.

Taking on different roles is also not uncommon in games, and, just like games, design is also often a structed process (Brandt and Messeter, 2004):

When playing a game the rules set the boundaries for what is possible and structure the play of the game. In design the designers have various roles and responsibilities. One example is the division between hardware and software design. The design assignment, the resources, the participant's roles and responsibilities and the ways of working establish, like game rules, the boundaries for the work. In both playing games and designing the rules can be subject to negotiation and change.

The elements outlined above all revolve around the concept of following the rules during the design process. This is an idea that we can also find in the work of Suits (2005) when he defines a *lusory attitude* as being essential when playing a game:

To play a game is to attempt to achieve a specific state of affairs (prelusory goal), using only means permitted by rules (lusory means), where the rules prohibit use of more efficient in favour of less efficient means (constitutive rules), and where the rules are accepted just because they make possible such activity (lusory attitude). I also offer the following simpler and, so to speak, more portable version of the above: playing a game is the voluntary attempt to overcome unnecessary obstacles.

We can also find a similar notion to this lusory attitude in the work by De Bono and his Six Thinking Hats (1999). De Bono describes a method for brainstorming that is built around participants putting on coloured hats (metaphorically). In turn, these hats then prescribe how one can interact in the brainstorming session (e.g. only proposing new ideas, or only pointing out problems). De Bono attributes part of the success of his methods to it being rather game-like with participants feeling the urge to follow the rules and thus adjusting their behaviour:

The 'game' aspect of the Six Hats is very important. If a game is being played, then anyone who does not obey the rules of the game is considered uncooperative. If there is a switch from the black hat (caution) to the yellow hat (possible benefit) and a person continues to lay out the potential dangers, then that person is seen to be refusing to play the game. Getting people to 'play the game' is a very powerful form of changing behaviour.

In order to understand why design games have these effects, it is helpful to introduce the concept of the magic circle, originally proposed by Huizinga (1970):

> *All play moves and has its being within a play-ground marked off beforehand either materially or ideally, deliberately or as a matter of course. Just as there is no formal difference between play and ritual, so the 'consecrated spot' cannot be formally distinguished from the play-ground. The arena, the card-table, the magic circle, the temple, the stage, the screen, the tennis court, the court of justice, etc, are all in form and function play-grounds, i.e. forbidden spots, isolated, hedged round, hallowed, within which special rules obtain. All are temporary worlds within the ordinary world, dedicated to the performance of an act apart.*

Whereas Huizinga only uses the term magic circle as an example for a place where play happens, it has since been adopted as the de facto term to describe the special world that one enters when playing (a game). Salen and Zimmerman (2004) define it as such:

> *In a very basic sense, the magic circle of a game is where the game takes place. To play a game means entering into a magic circle, or perhaps creating one as a game begins.*

In turn, being in the magic circle has an effect on players as stated by Apter (1991):

> *In play, we seem to create a small and manageable private world which we may, of course, share with others; and this world is one in which, temporarily at least, nothing outside has any significance, and into which the outside world of real problems cannot properly impinge. If the 'real world' does enter in some way, it is transformed and sterilised in the process so that it is no longer truly itself, and can do no harm.*

According Castronova (2008) the magic circle can be considered a shield of sorts, protecting the fantasy world from the outside world. Players metaphorically enter another place - a place where the rules of the ordinary world do not apply. Instead, the rules of the game take precedence, and all players (should) feel the urge to follow them.

In addition to providing rules that guide the session and level the playing field between participants, perhaps one final important aspect of design games is the effect they have on the general atmosphere: Brandt (2006) describes it as follows:

> *Another important aspect of this framework is the game part illustrating both how participation is staged (and herby how negotiation is supported) and the atmosphere and*

attitude within which the game playing takes place. Exploratory design games are engaging and fun for people to take part in. Game playing creates an informal atmosphere, which is the most productive in creative work.

These observations are supported by Kultima et al (2008a) and their reflections on VNA Cards and other design games:

Typical brainstorming requires someone to shake the participants in the beginning to loosen them up and to guide the session in order to keep the focus. The playful atmosphere for the session is easy to achieve by idea generation games since they refer to the playful conventions familiar to anybody who has experiences of any card games, whereas typical brainstorming sessions seem formally more like serious business meetings. We are used to playing card games by taking turns in an equal setting, usually in a non-serious mode. Business meetings are led hierarchically by bosses and with division of labor. Creativity is found in the settings familiar to the former, not the latter.

Furthermore, playfulness in general has also been attributed to be an indicator and/or facilitator for creativity. Lieberman (1965) for example has identified a connection between playfulness and divergent thinking in kindergarten children:

The results indicate that playfulness in kindergarten children provides clues to ease in functioning in a structured-test situation measuring ideational fluency, spontaneous flexibility, and originality.

The work by Glynn and Webster (1992) is another example that hints at the value that playfulness as a character trait has for creativity:

Playful individuals were characterized by high cognitive spontaneity and creativity; playfulness was related inversely to organizational rank and quantitative functional orientation. No definitive correlations between playfulness and either gender or age were found. More playful individuals showed higher task evaluations, involvement, and performance, as well as more playful perceptions.

Here, it remains to be investigated in what way ideation cards afford playfulness and playful interactions, and in turn what effect these have on the overall design session. Looking back at existing ideation cards, we can observe that some of them are more structured (e.g. VNA Cards, PLEX Cards, Sound Design in Games Deck) than others (e.g. Exertion Cards, Tangible Interactions Framework Cards). While the former group prescribes rather detailed game-like rules for the interaction with

them, the latter utilize less rigid ones. In order to understand this difference, it is helpful to think about it in accordance to the continuum of play as defined by Caillois (1961):

> *At one extreme an almost invisible principle, common to diversion, turbulence, free improvisation, and carefree gaiety is dominant. It manifests a kind of uncontrolled fantasy that can be designated by the term paida. At the opposite extreme, this frolicsome and impulsive exuberance is almost entirely absorbed or disciplined by a complementary, and in some respects inverse, tendency to its anarchic and capricious nature: there is a growing tendency to bind it with arbitrary, imperative, and purposely tedious conventions, to oppose it still more by ceaselessly practicing the most embarrassing chicanery upon it, in order to make it more uncertain of attaining its desired effect. This latter principle is completely impractical, even though it requires an ever greater amount of effort, patience, skill, or ingenuity. I call this second component ludus.*

Where paida is unstructured, free, and without goals, ludus is structured by rules that provide challenges obstructing the goal of the activity. A child playing with a toy is engaging in play, while a chess player is playing a game. If we apply this to ideation cards, we can say that e.g. turn-taking and clear rules on card draw and reveal can be found at the ludus side of the continuum, while the general activity of free card play as it typically appears during idea development strongly leans towards paida. Using these terms by Caillois is helpful as they allow us a more precise language when talking about play and game-like activities. A similar attempt has been made by Deterding et al (2011) in their work on gamification. They have created a taxonomy where they use two dimensions of playing/gaming and parts/whole that allows them to distinguish between:

- games (gaming / whole),
- toys (playing / whole),
- gameful design (gaming / parts),
- playful design (playing / parts).

This distinction between gameful design and playful design maps nicely onto ludus and paida. In that sense, one could argue that ideation cards showcase both playful as well as gameful elements. However, what is missing is a term that encompasses both aspects. This makes it difficult to talk about the overal interactions of this type that ideation cards afford. For the purpose of this thesis I will therefore use the

term play (and playful) as inclusive of games (and gameful) and when appropriate distinguish specific phenomena within this lens as belonging to paida or ludus.

3.5. Chapter Summary

There are different ways to encapsulate design knowledge. While design rules, principles, guidelines, and patterns all provide efficient means to do so, they do not seem well suited to play an active and guiding role while the design process is happening. Instead, their strengths seem to lie in using them before (or after) a design session. Ideation cards on the other hand are purposefully designed to be used (in groups) throughout the design process, and thus heavily influence its composition and structure. They actively shape the design dynamics that occur. Several different ideation card decks are either commercially available or have been developed as part of academic research. These cards have taken different approaches for turning existing design knowledge into tangible ideation cards, and have then been successfully used in various workshops and studies.

Casting a closer look at their usage, ideation cards seems to roughly fall into two different groups distinguished by their purpose: idea generation and idea development. Idea generation has as the goal to rapidly create new ideas from scratch that might still be raw and underdeveloped. Idea development takes an initial idea and investigates it further to ultimately arrive at a well-rounded and fleshed-out design.

A designer of ideation cards has direct control over the following elements: the **content** and **appearance** of the cards as well as the **rules** on how to use them.

What content is encapsulated in the whole deck and how is it split up into cards? How much design knowledge does each single card convey? How does the content need to be designed with idea generation in mind? What is needed to support idea development?

The appearance includes both graphic design as well as the materiality of the cards. What visual cues are used on the cards? How are text and images laid-out and formatted? What are the physical dimensions and the format of the cards?

How do the rules foster (or hinder) idea generation, and how do they tackle idea development? What modes of interactions are suited for each of the two overarching goals?

What is currently missing from existing literature is a deeper look at why and how specific cards and rules support one over the other, and what the crucial elements are that ascertain the success of ideation cards.

Looking at how session have been described to unfold, two other crucial elements require consideration. These are dynamically emergin during a design session and as such are not within direct control of the ideation card designer. This includes **tangible** (e.g. spatial arrangement and gestures) and **playful interactions**. Both are important additional concepts to keep in mind when designing and utilizing ideation cards as they directly shape design sessions.

Whereas previous work has mostly reported on the existence and importance of these elements, for this thesis I will go beyond the surface layer and instead take a deeper look at the intricacies that make ideation cards such a valuable tool for supporting the design process.

Part II: Design

Next time you're afraid to share ideas, remember someone once said in a meeting 'Let's make a film with a tornado full of sharks'.

(Anonymous)

4. Designing Mixed Reality Game Cards

4.1. Overview

Ideation cards can differ in very many ways from one another as described in chapter 2. They look differently, they include varying amounts of information, some decks consist of only a few cards, they can be prompts for ideas or ask questions. Likewise, the way ideation cards are used also differs between the various decks. Overall we can roughly identify two main means of using ideation cards: for **idea generation** (the initial creation of ideas) and **idea development** (the expansion of an idea). Both of these necessitate different rules for interacting with them, and they also need different types of cards. The design goal for developing the Mixed Reality Game Cards however was to support both parts of the design process. In order to do so, the initial version of the deck was created by analysing existing ideation cards and investigating their salient features. Afterwards I continued to develop the cards (and rules) over a course of seven studies and three development phases.

In this chapter I will give a high-level overview of the iterative design process (and the studies), how they were initially inspired by design patterns, and explain how the cards were inspired by the work of other creators of ideation cards.

This chapter is then followed by a more in-depth look of the different phases of the design, followed by overarching design reflections and a look at the final deck of cards.

4.2. Design Pattern Origins

Before embarking on creating the Mixed Reality Game Cards, my initial approach was perhaps more traditional. Inspired by the existing pattern languages for game design, I first explored if design knowledge about mixed reality game cards could be encapsulated in the form of design patterns. To this end I created an initial set of patterns talking about specific design considerations for mixed reality games. The patterns were created based on related work and my own experienced developing mixed reality games. The goal of these examples was not to create a series of tightly related and interwoven patterns, but instead showcase the breadth of possibilities that a complete pattern language would (have to) cover.

This set consisted of 11 patterns covering a wide range of topics and categories:

- Enforced Speed Limit [measuring the movement speed of players]
- Voluntary Movement Restrictions [social contract prohibiting players from running]
- In-situ Authoring Tool [enabling authoring of game content on location]
- Automated Generation of Interesting Locations [binding game content to real world locations based on algorithms]
- User-created Missions [allowing players to create their own content]
- Large-scale Augmented Reality [using 3D objects of considerable dimensions]
- Audio Replay [allowing players to replay audio content when desired]
- Audio as Main Media [focusing the game on aural content]
- Simulated GPS Jitter [enabling testing of a game under real world sensor conditions while not on location]
- Live Player Tracking [giving the game masters means to observe player actions and locations]
- Ingame Tech Support [using actors to fix technical issues]

Each pattern contained the following information: name, categories, problem, solution, examples, description, and effects (see Table 4 for an example).

Name	User-created Missions
Categories	Content Authoring, User Participation
Problem	The game needs a very specific content for each location it should be staged at.
Solution	Players can create and add their own missions
Examples	Tidy City enables every interested player to create their own set of riddles that are referencing the real environment. Similarly, SCVNGR lets users add to the overall content of the game by adding single tasks or complete routes that others can follow. GeoCaching makes it equally easy for every player to hide their own Cache and publish information about it on one of the various community websites.
Description	One strength of mixed reality games is the close coupling of digital content with the real world environment. While this adds a lot to the enjoyment of the game, it also makes producing new content tedious and impractical. New high quality content needs to be produced for every city (or even neighbourhood) the game should be played in. With easy-to-use authoring tools that do not overwhelm inexperienced users, they can become authors of the game themselves. With their expertise and in-depth local knowledge they become important contributors and enrich the game world.
Effects	User-created missions allow mixed reality games to grow with the help of motivated users (positive). Not all user content might be high quality (negative). If a game only relies on user-created missions, it is difficult for new players get into the game in the first place as content might be lacking (negative).

Table 4. Sample design pattern User-created Missions.

The aforementioned 11 design patterns build the basis for the first iteration of the cards. However, it quickly became clear that it would not be advisable to develop every new concept first as a design pattern and then translating it into a card. It is easy to see the physical limitations of a card (due to constrained space) that a design pattern does not have. This meant that each design pattern would have needed to be condensed down to its core before being translated into a card. This did not only seem impractical, but a design pattern language arguably also has other requirements and priorities than a well-designed deck of ideation cards. Therefore, I decided to abandon the pattern language approach and instead focused on designing the cards from the ground up – a process which the following sections describe in detail.

4.3. Iterative Design Process

The Mixed Reality Game Cards were developed iteratively over the course of seven studies. However, these studies were not only used to inform the design of the cards, but they also build the foundation for deeper explorations concerning ideation cards in general.

The studies were conducted with a total of three different versions of the cards that were iteratively developed in response to findings from these studies. The main differences between the versions are:

- Appearance (card stock, size, graphic design)
- Content (phrasing, amount of text, number of cards / concept)
- Rules (trialling random draw, limited choice, no limitations)

Organizing the studies was done as a mix of seizing opportunities when they arose and deliberately aiming to engage different user groups with the cards. It was important to evaluate and validate the cards with a variety of users, among them game students, experts in mixed reality games (e.g. researchers, artists, developers), as well as members of the public that would usually not engage in game design. This was important in order to investigate whether the cards could support users of vastly different backgrounds, reaching from participants with zero experience to designers with multiple years of creating mixed reality games.

Overall, the studies can be separated into three distinct phases coinciding with the version of cards used:

- **Phase 1**: Initial exploration of ideation cards as a suitable method for designing mixed reality games
- **Phase 2**: Refinement of rules for interacting with the cards
- **Phase 3**: Final validation and in-depth look at phenomena that arose during previous phases.

These phases will be described in forthcoming chapters 5 to 7 that together give an in-depth insight into the design process of the cards. Chapter 8 reflects on the lessons learnt from these studies specifically in the context of idea generation and idea development, while chapter 9 takes observations from them to explore tangible and playful interactions in more detail.

Table 5 gives an overview of the seven studies with an estimate of pre-existing experience with game design and mixed reality, followed by a short description of each study.

Phase 1: Initial Exploration	
Lincoln1	Students of BSc Games Computing Experience (game design): Medium Experience (mixed reality): Low
Magellan	Members of research project Experience (game design): Medium to High Experience (mixed reality): Medium to High
Brisbane Writers Festival	Authors and publishers Experience (game design): Low Experience (mixed reality): Low
Phase 2: Refinement	
Performance and Games	Researchers and artists Experience (game design): Medium to High Experience (mixed reality): High
Know How	Curators and other members of art gallery Experience (game design): Low Experience (mixed reality): Low Mobile app developer Experience (game design): Medium Experience (mixed reality): Medium
Sustrans	Members of charity Experience (game design): Low Experience (mixed reality): Low Artist Experience (game design): Medium Experience (mixed reality): High
Phase 3: Final Validation	
Lincoln2	Students of BSc Games Computing Experience (game design): Medium Experience (mixed reality): Low

Table 5. Overview of the studies conducted with the Mixed Reality Cards.

For **Phase 1: Initial Exploration** I conducted three studies in order to gain first feedback about the Mixed Reality Game Cards and explore whether the chosen approaches in general support both idea generation as well idea development. For this, it was important to engage with a diverse selection of participants with different backgrounds and levels of expertise.

In the first study (**Lincoln1)**, I recruited 15 participants from the BSc in Games Computing degree of the University of Lincoln. This was followed by a workshop as part of the EU-funded Magellan research project where 24 researchers and professionals expanded pre-existing ideas with the cards. The final study in this phase was undertaken at the **Brisbane Writers Festival** with a total of 10 authors and publishers who shared an interest in interactive storytelling.

Phase 2: Refinement consisted of three studies where I introduced and experimented with so-called Theme Cards (to provide domain-extrinsic sources of inspiration) and further explored different approaches to idea generation in more detail. In the **Performance and Games** study I engaged 25 highly experienced academics and artists with the cards. The other two studies in this phase were more intimate. In **Know How** I worked together with three members of an art gallery and a professional mobile app developer to design a game for a photography festival (which was later implemented and staged). The last study involved three members of the charity **Sustrans** who wanted to explore mixed reality games as a means to promote public transport, cycling, and walking. The charity workers were supported by an artist with a track record of creating location-based experiences.

For **Phase 3: Final Validation** I conducted another study at the University of Lincoln. For **Lincoln2** it was important to me to engage a large number of participants in order to be able to finalize my design decisions. Overall, 85 students from the BSc in Games Computing degree participated in this final study

For evaluating the studies, I applied several means of collecting data. I took notes of any observations I was able to make during the study itself. These were a basis for identifying interesting incidents that would then often be discussed during post-session semi-structured interviews. In the majority of the studies I also used questionnaires that participants either had to fill in after separate activities throughout the study or at the end. Questionnaires were omitted in favour of semi-structured interviews in cases where time constraints would only allow one of the

two. During the preliminary studies the questionnaires consisted of Likert-scale questions and open ended ones. I only used the latter type for any later studies as these would allow me to gather more qualitative data about the experience of the participants. I also videotaped sessions in two of the studies in order to take a deeper look at gestures and spatial arrangements during a session. The video analysis plays an important role in section 9.2 when looking at the physicality as one quality of ideation cards.

For analysing the interviews, I transcribed the audio recording and then annotated the transcripts with any emergent themes. Every time I identified such a theme I would go back to older transcripts and see if the same theme(s) were present as well.

I followed a similar approach with the open-ended questions of the questionnaires. I grouped the answers often independently from the questions depending on any underlying themes. This was helpful in uncovering interesting phenomena as conflicting or supporting thoughts of different participants would often manifest themselves as replies to various questions.

For the analysing the videos I likewise annotated interesting occurrences when watching the material. Each time such a phenomenon was observed, I annotated the video and transcribed the scene. This was done over various iterations to spot similarities and differences between the interactions. To validate my findings, the material was then shown to a small group of researchers that were able to confirm or extend on my observations.

4.4. Design Focus: Idea Generation

Idea generation requires ideation cards to serve as a source of inspiration. Interesting examples for such decks are VNA (Kultima et al., 2008a), PLEX Cards (Lucero and Arrasvuori, 2010), and the Sound Design in Games cards (Alves and Roque, 2011a). They all provide users with triggers that these then turn into abstract or concrete ideas. The resulting ideas are often not very elaborate or well-thought out. In fact, a typical idea generated with VNA cards might just be two or three sentences long. As such these cards try to allow users to create a rough concept as opposed to a fully-fledged design specification. VNA and PLEX Cards also instruct users to repeat the process several times in order to create a rich variety of ideas

from which the designers can then later choose from. The approach is to not get bogged down in minutiae of an idea but instead focus on positive creativity without worrying about feasibility or details too much.

In the following I will take a look at these decks from a content as well as rules perspective.

4.4.1. Content

VNA are arguably the simplest of the three examined decks. VNA stimulates idea generation by providing one-word prompts that the designers use to build up an idea from them. While these prompts are derived from an analysis of existing games, they themselves do not provide something like game mechanics. For this, the designers need to draw from their own experiences.

The Sound Design in Games Deck approaches the task from a more mechanical-driven point. The cards depict various ways in which sound could play a role in a game. Designers then pick and choose from these elements and use them as building blocks for their design.

PLEX Cards take a different approach. Instead of listing elements that designers should incorporate into their idea, they give them a combination of design goals. These design goals are the different types of experiences, so the task of the designers becomes to create a concept that includes exactly these.

When looking at this surprising variety of card designs for idea generation, it became clear that I had to make a choice of which one to follow. All three of them had been successfully deployed, so all were valid options.

VNA does not provide any background of the design space itself and as such seemed unsuitable for mixed reality games. After all, one motivation for creating the cards in the first place was the fact that too few people have a thorough understanding of the possibilities that mixed reality games offer.

Taking inspiration from the PLEX Cards seemed unsuitable for very similar reasons. Again, designers are left to their own experiences. While the cards certainly push them into new directions, they do not provide any guidance on how to actually reach this point.

The Sound Design in Games Deck on the other hand encapsulates existing design knowledge about sound in games, very briefly explains each concept and provides references to examples should a designer want to find out more about a specific card. Having domain-specific content seemed to be the most promising approach for designing mixed reality games. After all, it was to be expected that many potential users only know very little about this particular design space.

4.4.2. Rules

In addition to the make-up of the cards itself, each of the decks of ideation cards also prescribes how they should be used. VNA and PLEX Cards do this very explicitly while the Sound Design in Games cards take a more hands-off approach. How much these different decks allow the users to choose cards freely results in three distinct approaches.

These are:

- **No limitations** (the users are completely free and unlimited in what cards to use)
- **Limited choice** (the users can select from a few hand cards)
- **Random draw** (the users are restricted to randomly revealing cards)

These different approaches are described in more detail in the following. Finding out which of these would be most suitable for the Mixed Reality Game Cards was one of the main motivators for several of the studies.

4.4.2.1. No Limitations

When using the Sound Design in Games deck, users are not restricted by any detailed rules on how to select cards and build an idea. Instead, a visual aid is put on the table between them which designates different areas for placing cards (Deck, Hand, Solution, Graveyard). Deck designates the area of cards that have not yet been discussed, Hand is used for cards under discussion, Solution are cards selected for the final idea, and the Graveyard holds discarded cards. However, users are free to use as many cards as they like to build their idea (and are perhaps even encouraged to go through the whole deck). Users can pick up as many cards as they like, they can discuss various combinations, they can discard cards they do not like, and also resurface cards from the discard pile.

Overall this rules light approach is very reminiscent of how cards are used in decks that are more leaning towards idea development. The idea is gradually build and can change its shape quite a bit throughout a session. This also in effect creates one rather long idea generation process for just a single idea which arguably could be seen as one of the drawbacks of this approach.

4.4.2.2. Limited Choice

PLEX Brainstorming is one of the two variants that PLEX Cards recommend. It is designed for two users and starts with one card being randomly revealed. Then both users draw three additional cards each into their hand. The first user then starts describing an idea based on the initially revealed card. In response, the second user eventually plays one of their cards and extends the idea with this card. The first user gets the same chance to add a now third card, further elaborating on the idea. At the end of the process both users can jointly discuss the idea and finalize their idea. While this approach starts with a randomly revealed card and randomly drawn cards into the hand, during the rest of the session the two users have limited choice. They see how the idea is developing and can select a card from their hand that they think is able to meaningfully extend the idea that has so far been developed.

In contrast to no limitations, limited choice requires a shorter amount of time per idea, so that multiple ideas can easily be developed during one idea generation session.

4.4.2.3. Random Draw

PLEX Scenario is the second variant for using these cards. At the beginning, three cards are randomly chosen and revealed. The two users now need to place these cards on a paper template and develop an idea out of them. The positions in the template are:

Card 1: Beginning. Who are the people in the story? How does this category launch the story?

Card 2: Continuation. How does this category cause the story to continue in a new direction?

Card 3: The End. How does this category bring the story to closure?

In VNA, one user first draws and reveals a random card (a verb) and then articulates a game design idea based on the single card. The next user then reveals a second randomly chosen card (a noun). This time the user has to incorporate the new card into the already existing design based on the first card – the idea evolves. In the final turn of the game a third random card is revealed (an adjective) which then leads to a game design idea based on all three cards. The final game design ideas are then noted down without going too much into detail.

Random draw forces a certain set of cards onto the users. With any choice taken away, some truly unique card combinations might appear that the users arguably might not have selected themselves. Like limited choice, this approach lends itself well to rapid iterations so that multiple ideas have been created at the end of an idea generation session.

4.5. Design Focus: Idea Development

Idea development happens after an initial idea generation phase during the design process. After having generated a rough idea, designers using the Mixed Reality Game Cards should be able to develop it further into a coherent and fleshed out design concept. While this certainly also requires inspiration (like idea generation), it also makes it necessary to support designers by letting them focus on specific elements of an idea. The cards should guide them along the design process, confronting the designers with aspects they might not have necessarily thought about or considered. This way, the idea will be explored from different angles, ultimately resulting in a (hopefully) well thought out idea. Like for idea generation, I will take a look at existing card decks and explore how they tackle this part of the design process. For this, I have chosen the Tangible Interaction Framework Cards (Hornecker, 2010), the Exertion Cards (Mueller et al., 2014), and the Deck of Lenses (Schell, 2008a).

4.5.1. Content

The Tangible Interaction Framework Cards stimulate idea development by having each card ask a question to the designers. The questions force the designers to reflect on the design aspect depicted on the card, and by utilizing questions a discussion is created. Table 6 shows two of these questions.

Question	How can the human body relate with the space?	Can users grab, feel and move "the important stuff"?
Category	Inhabited Space	Haptic Direct Manipulation

Table 6. Two examples from the Tangible Interactions Framework Cards.

Exertion Cards are also using questions as the main driver behind the design activity. Again, each card talks about a specific concept and then invites the designer to think of the answer within a spectrum of possibilities (Table 7).

Question	To what extent does the game encourage bodily synchronization?	To what extent can the player master the control of objects (like a ball)?
Title	Bodies in Harmony	Physicality
Answer (-)	Tactical Change of Rhythm	Adaptability
Answer (+)	Facilitates co-operative pacing	Direct feedback loop

Table 7. Two examples from the Exertion Cards.

Lastly, the cards from a Deck of Lenses also utilize questions to prompt reflective discussions. Each card introduces a theme which is then explored with a selection of questions. Two examples can be seen in Table 8.

Lens	**The Lens of Venue**	**The Lens of Technology**
Justification	The places that we play exert tremendous influence on the design of our games. To make sure you aren't designing in a vacuum, ask yourself these questions:	To make sure you are using the right technologies in the right way, ask yourself these questions:
Questions	What type of venue best suits the game I'm trying to create? Does my venue have special properties that will influence my game? What elements of my game are in harmony with my venue? What elements are not?	What technologies will help deliver the experience I want to create? Am I using these technologies in ways that are foundational or decorational? If I'm not using them foundationally, should I be using them at all? Is this technology as cool as I think it is? Is there a "disruptive technology" I should consider instead?

Table 8. Two examples from the Deck of Lenses.

The established best practice to support designers in the idea development stage therefore clearly seems to be to ask questions of them that highlight different important elements of the design. This makes designers aware of the overall design space and forces them to evaluate and expand on the current state of their idea.

4.5.2. Rules

Overall, the decks focused to support idea development do not prescribe very detailed rules on how to best use them. Hornecker for example describes the rules as follows for the Tangible Interaction Framework Cards:

> *At the start, cards are mixed and distributed as in a normal card game. Taking turns, people play a card they consider relevant or irrelevant, and explain their decision and thoughts. The group negotiates whether the card is relevant before the game moves on. With smaller groups, the card set is split up so that everybody had a subset as 'a hand'. With larger groups, two to three people share a set. Usually, cards will be sorted into a cluster of very relevant cards, one of 'somewhat related' ones and an 'irrelevant' stack.*

Almost identical approaches are also used by the Exertion Cards and by Schell's Deck of Lenses: Cards are divided between users, and if they feel a card is relevant for the current design discussion, then they are free to play it. They usually have to explain why they played this specific card and how it relates to the overall idea. In some instances, a turn-based order is enforced, while at other times users might be allowed to play a card whenever they think it is most relevant.

Overall this approach ensures that all of the cards will be inspected over the course of a session by at least one user. It is then the responsibility of this user to decide whether a card is useful or not.

When comparing idea development to idea generation it becomes clear, that the latter employs much stricter rules to guide the design process. The former on the other hand gives more freedom to the users by employing a method rather similar to what was called **no limitations** in the context of idea generation.

4.6. Opportunities, Questions, Challenges

Based on the evaluation of related work it seemed clear to me that a single type of card could not provide both a satisfying way of supporting idea generation as well as idea development. Whereas idea generation seemed to require building blocks for an idea (e.g. mechanics), idea development was more driven by cards that cause reflection (i.e. questions). Therefore, I initially decided to develop two types of cards: **Opportunity Cards** and **Question Cards**. The former would introduce the users to the design space in general and consist of an overview of established elements of mixed reality games (and some not-yet established ones). The latter

would complement these cards and ask a variety of high and low level questions about the game design idea. Opportunity Cards would be used for the initial idea generation and then supported by Question Cards for the idea development stage.

While developing this first deck of cards it quickly became clear that I was actually creating two distinct types of Question Cards. Some of them were asking neutral questions about the design ("What role are locations playing in the design?") while others implicitly warned of "bad" design ("How are players led through the game, so that they do not get lost?"). This second type of question was a manifestation of design issues that often plague mixed reality games. As such it was important for me to include them into the card deck as I wanted to make inexperienced designers aware of them (and remind experienced designers of their existence). At the same time, they felt different enough from the neutral questions to warrant their own type – therefore the third type of card was created: **Challenge Cards**.

Looking closely at existing ideation cards I noticed that some cards from other decks could in fact be seen as examples for a "warning" by the card designer. IN that sense they resembled the newly created Challenge Cards. One example comes from the Tangible Interaction Framework Cards. A card asks *Can users grab, feel and move 'the important stuff'?* This implies that the lack of being able to do so is negative and should be avoided.

Highlighting common design issues is also not unprecedented in e.g. design patterns. Björk and Holopainen (2005) describe several design patterns that are should ideally be avoided by designers (or they should at least be conscious of the effects). A popular example in board games is analysis paralysis. If players have perfect information about the game state, and their moves are not greatly affected by elements of chance, then they might be enticed to calculate all possible moves to find the best option. This obviously slows the game down and often negatively affects engagement by the other players.

Focusing on negative aspects of an idea is also not necessarily new in ideation in general. There exists some similarity between the proposed structure of the Mixed Reality Game Cards and the Six Thinking Hats method for brainstorming (De Bono, 1999). De Bono proposes a (flexible) structure for ideation sessions based on the titular six hats. Each hat stands for a different type of input into the brainstorming sessions seen in Table 9.

One participant is "wearing" the blue hat during the session and uses it to control the flow of it, e.g. when the different hats should be used. The goal of the other hats is to structure the process in a way that e.g. allows for new ideas to be proposed (with everyone wearing the green hat) without fearing negative feedback (as this is only allowed during the "black hat phase"). The opposite of the black hat is the yellow hat which encourages people to focus on the things that are positive about the current idea, again without thinking (or mentioning) any disadvantages. The red hat on the other hand allows participants to state their opinion without the need to defend or justify their position. Lastly (but often first in the process) is the white hat that provides the "facts", i.e. everything that is known about the situation and within what parameters the idea will have to operate. A session can go through the hats in different order, and can jump back and forth between them. The core idea behind the hats however is that this way participants can better focus on the different elements and thus result in a more productive session in general.

Hat	Purpose	Description
The blue hat	Moderating	Keeping the session on track and makes sures everyone follows the guidelines.
The green hat	Creativity	Proposing new ideas, exploring alternatives, and expressing new concepts.
The yellow hat	Positivity	Stating just the positive elements of the current idea(s).
The white hat	Facts	Describing the known elements and conditions the idea has to work in/with.
The black hat	Negativity	Pointing out flaws and weaknesses of the current idea(s).
The red hat	Emotions	Voicing one's feelings about the current idea(s) without having to justify it.

Table 9. De Bono's Six Thinking Hats and their function.

I would argue that Opportunity Cards correspond with the Green Hat whereas Challenge Cards take on the role of the Black Hat. Question Cards are most similar to the White Hat. However, instead of referring to facts from before the idea was generated they should aim to let participants find the boundaries established by the idea itself. Red and Yellow Hats have no direct counterpart, but could be added as soft phases throughout the session. A Blue Hat moderator could however be very valuable. For inexperienced groups for example it might not be easy to know when to transition from using the Opportunity Cards to the next type of card.

Overall, while other ideation card decks were not made up of different types of cards, I was confident that the structural separation would be beneficial for the overall ideation process. In summary, the Mixed Reality Game Cards consist of these types of cards:

- **Opportunity Cards** encapsulate the design space of mixed reality games. The present game mechanics and other game elements that are typical for mixed reality games, and also some that are less typical but could create an engaging experience.
- **Question Cards** talk in high and low level terms about mixed reality games. They require designers to think and reflect about their design, and cover the broad design aspects that are necessary to define a fully fleshed out concept.
- **Challenge Cards** are a collection of the design issues that occur in mixed reality games. These need to be taken into account by the designers in order to not suffer from their effects. They further define the game idea and ground it in reality.

4.7. Content Creation

Having decided on the underlying structure of the cards, the next step was to create the actual content. For this I drew from the following sources:

- Related academic work about designing mixed reality games
- Analysis of existing mixed reality games
- Reflection on personal experiences of designing, developing, staging, and playing mixed reality games.

Using these sources to derive concrete cards was in part an intuitive design decision, and in part a systematic look at any concepts that these games and guidelines surfaced. This overall approach is very similar to for example how Björk and Holopainen (2005) created their collection of design patterns. However, in their case they were interested in mapping the existing design space and surfacing existing and common practice. In order for a pattern to be valid it had to appear in a substantial amount of the investigated games. Mixed reality games however are still a niche genre, and a restriction to only include well-explored concepts might result in the lowest common denominator. Therefore, I decided to also include

concepts that for example had so far only appeared in a single game – something which would disqualify them from being classified as a pattern.

It is important to note that this activity continued throughout the whole process of developing the Mixed Reality Game Cards. As such I would often revisit games to investigate whether there were additional salient features that might be worth extracting as a card. Likewise, several cards were created as a response to user comments and behaviour from the conducted studies. These instances are covered directly in the study related chapters.

In the following I present some example games that inspired several cards, as well as listing cards that were derived from reflective works. As it is not always possible to trace back a specific card to a specific source, I have chosen some of the most salient examples. The outlined games and sources have been described in more detail in chapter 2.

4.7.1. Concepts Derived from Existing Games

Geocaching (Neustaedter et al., 2011; O'Hara, 2008) uses simple Passive Tracking via GPS. Everybody can participate in the Open Authoring and add caches to the game. The Main Mechanic of the game is really simple, and players generally enjoy the Exploration aspect. Because players can prepare by scouting the destination of a caches on a map, they can avoid Bland Locations. Geocaching is only successful because it has reached Critical Mass.

Can You See Me Now? (Benford et al., 2006) combines Online Players with Actors on the street. The latter engage in Exergaming while the others are recruited Worldwide. The game utilizes Passive Tracking and Inaccurate Sensors as well as Unstable Connectivity were two of the most salient features they had to overcome.

Feeding Yoshi (Bell et al., 2006) and **Insectopia** (Peitz et al., 2007) both make use of the Public Infrastructure and use Collecting as the Main Mechanic. The Duration of the game is infinite and the game can be played Worldwide.

Shhh! (Linehan et al., 2013) and **Blowtooth** (Kirman et al., 2011) play with the Real World Rules and are Subverting Locations by asking players to commit acts usually unacceptable at a library and airport. This contrast is the main source of Fun and Joy of the game.

TimeWarp (Blum et al., 2012) is an Augmented Reality game that uses Collaboration. Players engage with the Strong Narrative and have to succeed in Mini Games. The two players have Different Roles, and the game utilizes Fitting Locations matching the digital content. The Duration of the game was influenced by considerations concerning the Battery Life of the devices used. Locations were carefully placed to avoid Long Distances, Accidents, and Dynamic Places. A previously Confusing Interface and Unclear Instructions were improved for the final version of the game.

Tidy City deliberately uses a very simple Main Mechanic in order to avoid Phone Zombies. The Core Concept of the game is to solve Riddles as part of a Scavenger Hunt. The game avoids Time Pressure to not turn it into an Unintended Race. Instead, the casual Exploration aspect of the game allows for Collaboration, and Open Authoring let's all players create their own missions. Missions need to take into account the Size of Area to not create Long Distances between game objects, and should be wary of Dynamic Places.

The Monitor Celestra is a larp that uses Roleplaying and Costumes to convey Theme and Story. Players have Different Roles and play the game at an Unusual Location that has been transformed into a space ship by Set Construction. Terminals are placed around the ship in a way to avoid Overcrowding, and special precautions have been taken to avoid Accidents. The systems on the Terminals cannot have Unclear Instructions or a Confusing Interface as players will not have time to learn their use. Unstable Connectivity would have ruined the game, and Testing could not be performed beforehand.

In **Fortnight**, the creators took great care in thinking about the Experience Flow and Beginning and End of the overall performance. They increased accessibility and engagement by using Telephony as a simple way to interact and also allowed Online Players to participate. They tried (but not always succeeded) in finding Fitting Locations as well as Unusual Locations. Players were given simple Costumes in the form of badges that they could also use at Stationary Sensors. In case there were problems, a Wizard of Oz was observing the players and helping if need be. The performance consisted of Episodic Content and encouraged the participants to show Creativity. One typical challenge they could not overcome was Overcrowding of places.

4.7.2. Concepts Derived from Design Compilations

In addition to the aforementioned games, I also harvested concepts for cards from academic work that reflects on mixed reality games in general and is not limited to the analysis of one specific game.

Pervasive Games – Theory and Design (Montola et al., 2009) was a rich source not only for Opportunity Cards but also for Challenge Cards as the authors give design advice on issues arising while staging a pervasive game.

Example cards include: Scavenger Hunt, Roleplaying, Alternate Reality, Exergaming, Performative Play, Public Display, Exploration, Unusual Locations, Set Construction, Technical Artifacts, Worldwide, Beginning and End?, Critical Mass, Real World Rules.

Game Design Patterns for Mobile Games (Davidsson et al., 2004) goes into depth about basic game mechanics that mixed reality games employ. As such, cards derived from this source mainly cover gameplay elements.

Example cards include: Augmented Reality, Exergaming, Collecting, Peer-to-Peer, Weather Input, Passive Tracking, Manual Interaction, Suitable Sensors?.

Designing Mobile Augmented Reality Games (Wetzel et al., 2011a) puts the focus on best practice design and common pitfalls of designing augmented reality games and as such was a rich source for Challenge Cards.

Example cards include: Augmented Reality, Compelling Audio, Mobile Soundtrack, Useful Props, Different Roles, Actors, Seamful Design, Suitable Sensors?, Nothing Digital?, Nothing Physical?, Gimmicky Tech, Long Distances, Accidents, Dynamic Places, Overcrowding, Confusing Interface, Inaccurate Sensors.

4.8. Appearance

At first sight, most ideation cards share a similar physical design which is unsurprising as they all make use of playing cards as the basis. However, under further inspection a variety of differences become apparent. Distinguishing attributes include but not are limited to: size, format (landscape / portrait), one-sided / two-sided, colour coding, and general visual appeal. Amount of text and use of images are at the same time a choice for appearance but predominantly based

on considerations from a content perspective. Lastly, the type of card stock obviously also has a big impact on the look and feel of a card – however as the majority of card decks were only available for self-printing no assessment can be made if the card creators where favouring a specific quality or thickness of paper.

Only two of the inspected decks made use of both sides of the card. One side of the Sound Design in Games cards displays a selection of game examples (pictures and short text) while the other briefly explains the concept and then lists connections to other cards as well as a QR code. The IDEO Method Cards also use two sides: one with the textual information the other just with an illustrative image. While using both sides certainly has the advantage of twice the available space, it also comes with the drawback that such a card would then have to be turned around in order to access the additional information.

The majority of cards is designed in a portrait format and is about standard Poker card size. The VNA cards for example are much smaller and in landscape which is possible as they only feature one word on each card. However, they also display this word twice (once rotated by 180 degrees, so that it can be read from the opposite side as well). The other two landscape cards are the Exertion Cards and the Tangible Interaction Framework Cards. Choosing a landscape format makes it more difficult to hold the cards in your hand together with other cards which is necessary when e.g. employing limited choice as a rules variant. They are also much larger in size and feel less like playing cards rather than cue cards.

The cards from these decks also have a rather simplistic graphic design, and are in fact visually not very appealing. With IDEO Method Cards and the Deck of Lenses being commercially available, it is no wonder that both of them are well designed. VNA Cards, PLEX Cards, and the Sound Design in Games Deck however also manage to look rather professionally in their design.

The Exertion Cards and the Tangible Interaction Framework Cards both use colour-coding to signify different categories of cards. This should make it easier for users to distinguish between them and e.g. find a specific card in a pile. The Sound Design in Games Deck also uses a variety of bright colours as the base for each card. Interestingly enough, in a personal conversation with one of the creators it was stated that these colours were applied randomly to the cards – the colours do not signify additional meaning.

As discussed previously, cards that are being utilized for idea development in general feature more text than the ones mainly used for idea generation. This is very evident with the cards from the Deck of Lenses that require a good amount of reading. Here, the amount of text required a rather small font size in order to fit everything on a card.

For the Mixed Reality Game Cards the following choices about appearance were made based on a reflection of existing cards:

- Typical playing card size and portrait format (for holding multiple cards)
- One-sided (to prevent need for turning cards and enable surprise reveals)
- Incorporate appropriate amount of text and illustrative image (to fulfil content requirements while keeping e.g. readability in mind)
- Professional looking graphic design (for visual appeal)

4.9. Chapter Summary

This chapter laid the groundwork for the following chapters that describe the iterative design process in more detail. The design goal of the Mixed Reality Game Cards was to support both idea generation as well as idea development, two related but distinct elements of the design process. Where idea generation is concerned with the (rapid) creation of (multiple) ideas, idea development revolves around the refinement and exploration of a single idea in more depth.

The Mixed Reality Game Cards tackle this issue by not consisting of a single type of card like other ideation decks but instead three distinct ones: Opportunity Cards, Question Cards, and Challenge Cards.

Opportunity Cards are the building blocks of an idea and are the only cards used during idea generation. Unlike VNA and PLEX Cards they provide domain-specific design knowledge that aims to inspire designers.

In addition to Opportunity Cards, Question and Challenge Cards are used during idea development. Existing other ideation cards have successfully stimulated the desired reflection of an idea by prompting the designers with questions, which is also the underlying principle behind the Question Cards. Challenge Cards go a step further and confront the users with explicit problems and issues that might arise

when staging their designs. While not directly present in other ideation cards, several of them have utilized similar "warnings" on some cards.

The iterative design process will investigate if the proposed distinction into these three types of cards is beneficial for the design process. At the same time, the rules for interacting with the cards will be put under scrutiny. This is especially relevant for idea generation where rather diverse approaches have been used in the past that restrict the freedom of the designers (no limitations, limited choice, random draw).

5. Phase 1: Initial Exploration

5.1. Overview

In this chapter I will describe the first phase of the card development and evaluation. As such, this phase can be understood as an initial exploration to investigate whether the chosen separation into Opportunities, Questions, and Challenges is appreciate by users and if the cards support idea generation as well as idea development.

The chapter starts with an overview detailing the cards that together made up the first iteration. Afterwards I will present three studies conducted with the cards: Lincoln1, Magellan, and Brisbane Writers Festival. Each of these studies has a slightly different framing and purpose. A summary of the studies can be seen in Table 10.

Phase 1: Initial Exploration			
Study	**Lincoln1**	**Magellan**	**Brisbane Writers Festival**
Participants	15 Games Computing students	13 researchers 11 members of SMEs	10 authors and publishers
Set-up	4 groups (simultaneously)	5 groups (simultaneously)	2 groups (sequentially)
Idea generation	25 minutes	N/A	45 minutes
Technique	Limited choice	N/A	No limitations
Theme Cards	None	N/A	None
Outcome	3-6 game ideas / group	N/A	1 game idea / group
Idea development	50 minutes (Questions) 25 minutes (Challenges)	60 minutes (all cards)	10 minutes (Questions)
Brief	Game to implement prototypically	Refine existing game idea	Game to be played at Brisbane Writers Festival
Data	Video recordings, photos, notes, questionnaire (post session)	Photos, notes, questionnaire (post session)	Video recordings, photos, notes, questionnaire (post session), semi structured interview (post session)

Table 10. Studies conducted during Phase 1.

Lincol1 was the first study conducted and took place at the University of Lincoln. Participants were recruited from the BSc in Games Computing degree. The students had a general interest and some experience in game design. However, apart from one exception none of them had any previous knowledge of mixed reality games. The participants tried both idea generation as well as idea development with the cards as part of the study. At the end of two weeks some student groups had created a playable prototype of their idea.

The **Magellan** study introduced the cards to a group of researchers and designers from the European research project of the same name. Here it was interesting to expose the cards to participants that had substantial experience with mixed reality games and application. As part of the research project, the participants had already brainstormed initial game designs that were to be fully developed over the course of the project. In the study they used the cards for developing these ideas further.

Lastly, I recruited participants at the **Brisbane Writers Festival**. These participants included authors but also publishers, and they had little to no previous experiences in game design or mixed reality. However, they were overall interested in interactive storytelling as a new form of entertainment, and mixed reality games had sparked their interest. In the study the participants created a game idea and further explored it with the help of the cards.

5.2. Card Version 1

Version 1 of the Mixed Reality Game Cards consisted of a total of 69 different cards: 36 Opportunity Cards, 13 Question Cards, and 20 Challenge Cards. An overview of the cards can be seen in Table 11. Each type also had additional "blank" cards that allowed users to note down their own ideas in case something they deemed important was not covered by the cards.

Each card contained the following elements:

- A memorable title
- An illustration
- A short description
- Examples
- Further considerations

Card Type	Cards
Content Opportunity (green)	Dominant Audio, Enabling Serendipity, Invisible Infrastructure, Large AR, Replayable Audio, Subverted location, Technical artifacts, Unusual Locations, Useful Props, Weather Input
Techniques Opportunity (red)	Asymmetric Gameplay, Automated Speed Limit, Chat Channel, Immobile Devices, Mini Games, Online Players, Peer-to-Peer, Player HQ, Seamful Design, Shared Devices, Simple costumes, Time limit, Time Triggers, Voluntary Speed Limit, Weekly Episodes
Organization Opportunity (blue)	360 Illusion, Algorithmic Locations, GM Intervention, In-situ Authoring, NPC actors, Pausing GPS, Simulated GPS, Tech Support, Tracking Players, User-created Missions, Wizard of Oz.
Question (turquoise)	Amount of Players?, Amount of Running?, Duration of Game?, Game Server?, Inside or Outside?, Location Dependency?, Location Selection?, Main Mechanic?, Multi- or Singleplayer?, Observation of Players?, Sensor Choice?, Size of Area?, Target Group?
Physical Challenge (yellow)	Location Dependency, Long Distances, Noise, Rain, Sunshine, Traffic, Uncontrollable Places, Uninteresting Locations, Worldwide Game, Wrong Direction
Digital Challenge (purple)	Bad Content, Battery Life, Complex Interface, Effortful Testing, GPS and AR, GPS and Buildings, Orientation Loss, Unengaging AR, Unreliable Sensors, Unstable Connectivity

Table 11. Overview of all cards from version 1.

The title would ideally be sufficient for experienced designers to fully grasp the concept of a card, and would then also be used as a shorthand. A description was added to further explain the card in a little more detail. The examples and further consideration provided more depth to each card, showing its breadth and how it might have been applied in any existing games. The illustration conveyed the concept of the card in a non-textual way. Apart from the examples and further considerations, these elements are rather standard for ideation cards. I added the latter two to make sure that inexperienced users would be able to understand and apply the cards as well by giving them more canonical information. This created cards that were rather dense with information (Figure 9).

I also divided the cards further into categories to increase to make it easier to distinguish the cards from each other. Opportunity Cards were split into three categories (Content, Techniques, Organization), Question Cards had no specific categories, Challenge Cards were divided into Physical and Digital. The background colour of each card was dependent on its category. Opportunity Cards had text in black on white background whereas the other two types had white text on black.

The cards were printed on normal printing paper and protected with transparent card sleeves. The cards were 10.5cm tall and 7cm wide.

Figure 9. Examples for cards from version 1.

5.3. Lincoln1

5.3.1. Study Overview

Lincoln1 was conducted at the University of Lincoln. The goal of the study was to explore whether the Mixed Reality Game Cards in their current form were suitable for idea generation as well as idea development. The study took place over the course of two weeks, and participants were recruited from the BSc in Games Computing degree. For the students, this was a completely mandatory extracurricular activity that ran in parallel to their normal semester workload. Due to this, not all of the 15 students participated in all sessions. Overall, the students were tasked with first designing a mixed reality game (week one) and then prototypically implementing it (week two). Overall, students were exposed to the

Mixed Reality Game Cards at three different occasions during the first week. As an introduction to the design and development task, I first familiarized the students with the broad concepts of mixed reality games via a 30-minute presentation as well as a play session of Tidy City (see section 2.3.6 for a description of the game).

5.3.2. Rules

For the first session with the cards, the participants were separated into four groups and got handed the Opportunity Cards. The goal for the students was now to generate several potentially interesting game ideas. In order to do so, I employed the limited choice approach. Students were instructed to first draw three cards each. One of them would then start by playing a card and explaining how this could make for an interesting game. Next it would be the turn of the next student in line to add a second card and explain how this extends the idea. Lastly, the third student would play a final card thus "finishing" the design. Students then had to write down their idea and would start the process all over to create another idea. The participants were encouraged to discuss their ideas at each stage as a group. Students were also allowed to pass and adjust rules if they preferred. This activity lasted 25 minutes, and each of the groups created three to six game ideas. A sample arrangement of cards from the end of the session can be seen in Figure 10.

Figure 10. Assorted Opportunity Cards after the first session.

At the second session, the students developed one of the ideas from the previous session further. They did this by utilizing the Question Cards. Interaction with these cards was not prescribed in any way following the no limitations approach. Instead, students were encouraged to go through the whole deck by either dividing the cards between each other, or by revealing one card after the other, whichever method the group preferred. This session took a total of 50 minutes.

The third and final session exposed the students to the Challenge Cards. Again, no specific guidelines for how to interact with the cards were given (no limitations). The interaction with the cards lasted 25 minutes.

5.3.3. Design Outcomes

At the end of the two weeks all four groups had created a design for a mixed reality game. However, only two of the groups developed a playable prototype.

5.3.3.1. Radioactivity

In the design of this game all WiFi networks are emitting radiation. When players get in reach of such a network they continually lose health levels. However, in order to gain points, players have to enter these contaminated areas as valuable virtual items are hidden inside of them.

5.3.3.2. Wizards of the World

According to the game design players take on the role of wizards trying to collect magical ingredients for spell. These ingredients spawn at different locations depending on their type, e.g. mana sources can be found at schools and gold mines are placed at banks. When players encounter each other they can use the spells to battle each other.

5.3.3.3. Wireless Cheater

This game reached playable prototype stage. It has an asymmetric setup: One player is a teacher while all others are students. The students are trying to get into range of a WiFi hotspot that is being emitted by the teacher's phone. This enables them to "download exam results" when spending enough time in the vicinity of the teacher. If they are spotted, however, the teacher calls them out and they are eliminated from the game.

5.3.3.4. Museum Game

The students from this group also achieved a playable prototype. This group was also given to work together with the Museum of Lincolnshire Life, a local history museum. They had access to the site and were in contact with one of their experts. The envisioned Museum Game consists of several mini games to be played in different parts of the museum – two of which were developed for the final presentation. In the first one players have to carry an explosive charge between vehicles showcases in a large exhibition space. Players are timed, however if they do not move carefully enough they cause an explosion which means they have to start over. The second mini game is played in a historic class room. Printed markers are hidden inside of school desks, showing partial augmented reality objects. Players then have to identify all matching pairs and combine them to complete the objects.

5.3.4. Observations

5.3.4.1. General

The overall feedback from the study participants was positive. Table 12 gives an overview based on the Likert-scale questionnaire data.

Overall, students clearly enjoyed using the cards as illustrated by their answers to Q7, Q14 and Q21 with arithmetic means of 4.17, 3.93 and 3.90 respectively. Three different types of cards were used: Opportunity Cards, Question Cards and Challenge Cards and the students were confronted with them gradually over the course of the different brainstorming sessions. While different in type, workshop participants saw them as working well together (Q11 with ∅ 3.73 and Q18 with ∅ 3.90). When looking at the Opportunity Cards, they were rated as easy to understand (Q1, ∅ 3.92) and very helpful for brainstorming (Q4, ∅ 3.92) – but the students would have liked more of them (Q6, ∅ 4.5). The Question Cards helped students to focus (Q9, ∅ 3.47) as well as fleshing out their designs (Q8, ∅ 3.73) and introduced new aspects not yet covered by the Opportunity Cards (Q10, ∅ 3.87). In contrast to the amount of Opportunity Cards not being sufficient, students thought there were enough Question Cards (Q12, ∅ 3.2). The Challenge Cards were seen as relevant for the specific games (Q15, ∅ 3.8) and even more unambiguously as educational (Q16, ∅ 4.3). Most students however thought that the Challenge

Cards were introduced too late in the overall process. (Q19, ⌀ 3.6). In general, the cards also sparked design discussions between the group members as can be seen in Q5 (⌀ 4.75) and Q20 (⌀ 4.5).

Question	1	2	3	4	5	n	⌀	σ
Q1: The cards were easy to understand.	0%	8%	17%	50%	25%	12	3.92	0.90
Q2: I would have liked more information on the cards.	17%	42%	0%	42%	0%	12	2.67	1.23
Q3: The examples on the cards were not detailed enough.	33%	8%	33%	25%	0%	12	2.50	1.24
Q4: The cards were very helpful for brainstorming.	0%	8%	25%	33%	33%	12	3.92	1.00
Q5: The cards encouraged discussions with my other group members.	0%	0%	0%	25%	75%	12	4.75	0.45
Q6: I would have liked to have more cards.	0%	0%	0%	50%	50%	12	4.50	0.52
Q7: I enjoyed using the cards.	0%	0%	25%	33%	42%	12	4.17	0.83
Q8: The cards were very helpful in further fleshing out the game design.	7%	7%	27%	27%	33%	15	3.73	1.22
Q9: I think the Question Cards helped me focus.	7%	20%	13%	40%	20%	15	3.47	1.25
Q10: The Question Cards made me think about things I hadn't considered previously.	7%	13%	13%	20%	47%	15	3.87	1.36
Q11: The Question Cards worked well together with the Opportunity Cards.	0%	0%	53%	20%	27%	15	3.73	0.88
Q12: I would have liked more Question Cards.	7%	27%	20%	33%	13%	15	3.20	1.21
Q13: I would have liked more detail on the Question Cards.	33%	27%	27%	13%	0%	15	2.20	1.08
Q14: It was fun working with the cards.	0%	7%	33%	20%	40%	15	3.93	1.03
Q15: The Challenge Cards were relevant for our game.	0%	20%	20%	20%	40%	10	3.80	1.23
Q16: I learned a lot about typical problems of Mixed Reality Games by using the Challenge Cards.	0%	0%	10%	50%	40%	10	4.30	0.67
Q17: The information on the Challenge Cards was sufficient.	0%	0%	0%	40%	60%	10	4.60	0.52
Q18: The Challenge Cards worked well together with the Opportunity Cards.	0%	10%	10%	60%	20%	10	3.90	0.88
Q19: I would have liked to use the Challenge Cards earlier in the brainstorming process.	10%	0%	30%	40%	20%	10	3.60	1.17
Q20: The Challenge Cards led to productive discussions in the group.	0%	0%	10%	30%	60%	10	4.50	0.71
Q21: It was fun using the Challenge Cards.	0%	10%	20%	40%	30%	10	3.90	0.99

Table 12. Lincoln1 questionnaire data. Q1 to Q7 refer to Opportunity Cards, Q8 to Q14 to Question Cards, and Q15 to Q21 to Challenge Cards. Rating system: 1 = "I disagree"; 5 = "I agree".

Concerning the amount and detail of the information presented of the cards, not all students agreed with each other. Q2 shows that about half of the students wanted more information on the Opportunity Cards while the other half wanted less. The level of detail for the game examples was deemed appropriate however (Q3, ⌀ 2.5). When asked whether they wanted more information on the Question Cards the students rated the amount as appropriate. (Q13, ⌀ 2.2). Similarly, the amount of information on the Challenge Cards was seen as sufficient (Q17, ⌀ 4.6). This strengthens the impression that the students did not have problems with understanding the concepts presented to them on the cards – despite their relative inexperience with the domain.

5.3.4.2. Idea Generation

In their response to an open question about what they liked about interacting with the Opportunity Cards, participants explicitly noted the positive effects:

> *It simplifies brainstorming and makes it* ***more fun***
>
> ***Inspired*** *discussion.*
>
> *They allowed for good brainstorming and discussion without having to spend lots of time coming up with ideas from scratch. They helped* ***provide a framework to build ideas off of****.*
>
> *Allowed for* ***snappy discussions*** *about how that card changes the general game idea, also allowed for iterative changes to the game idea as ideas came in.*

Some participants reflected on the way the limited choice in particular affected the idea generation session:

> *It garnered a lot of discussion within a group and* ***allowed strange combinations to appear*** *that might not of otherwise.*
>
> *Made me have to think using constraints, which* ***forced some interesting ideas*** *to come out.*

These odd combinations however, were not always seen as positive. Some participants saw the restriction as a negative element:

> *Having three cards in my hand* ***made me feel restricted*** *to what I could put down.*

Felt sometimes as if I wasn't able to put forward a really good idea because ***I'd didnt have the card in my hand****.*

Sometimes they ***felt limiting****, especially with the number of cards in a game limit, and some cards that would of gone well with later cards had to be abandoned because of a* ***bad hand****.*

By studying the video recordings of the session, I was able to identify one instance where these different viewpoints on limited choice caused a minor argument as part of a design discussion. The situation and how it played out is reported in the following vignette:

The first group member plays Dominant Audio from his hand, and in turn suggests a game where the players perhaps have to follow an audio trail. After some deliberation, the second group member plays the card Large AR (that talks about large-scale augmented reality objects). The first and the third group members however are not convinced that this card works well with Dominant Audio. They argue that augmented reality puts the emphasis on the visual senses which runs contrary to the current idea of having an auditory game. After a short discussion, the second group member finally relents and removes the card from the game. As a replacement, he plays Peer-to-Peer which is accepted by the other members of the group.

While this is only one example, it illustrates the tendency of some participants to look for *fitting combinations of cards*. Here, a new card seemingly in conflict with another one was disregarded by two participants, opting for an *easier* card instead. It stands to argue that both of these participants would have never selected Large AR from their hand to add to the game if given the chance.

5.3.4.3. Idea Development

The Opportunity Cards were already discussed as part of the idea generation process. Feedback about the Question and Challenge Cards were however likewise rather positive.

The Question Cards let users consider their ideas in more detail:

Helped ***refine*** *the idea.*

Helped ***clarify*** *ideas.*

They helped get the ***initial idea padded***

The Question Cards achieved this by exposing the participants to topics that they otherwise might not have thought about:

> *They allowed us to consider things that* ***we wouldn't consider straight away***
>
> *They helped further ideas for the game, and the question cards helped you* ***think about things you may not have previously considered****.*
>
> *They allow you to think about* ***potential missed subjects*** *or issues.*

This naturally led to design discussions about their ideas:

> *They did* ***inspire debate*** *on problems.*
>
> ***Sparked more discussion*** *with the questions added in*
>
> *Prompted other ideas,* ***kept the conversation flowing*** *and were a good starting point.*

The participants had similar things to say after the session with the Challenge Cards.

> *It gotta few* ***more ideas refined*** *for our game,*
>
> *it made us* ***recognise what could be challenging*** *about our game.*
>
> *They helped* ***answer the last few questions*** *that you probably might miss out on*
>
> ***raised a lot of potential issues*** *and then led to* ***productive discussion***
>
> *The* ***discussion that resulted was productive*** *and suggested counters to possible problems.*

Likewise, the criticisms of both types of cards were also similar. Several students noticed a certain redundancy of the cards or rather some cards not being relevant for their game.

> ***Too obvious*** *sometimes. Like target audience.*
>
> ***Too generic*** *and similar. Not many were applicable.*
>
> ***They weren't specific to the game*** *and therefore a lot didn't apply(not a lot can be done about that though)*
>
> *Some problems were* ***a little obvious*** *such as sunlight.*

Some of the groups also reported that they failed to keep focused on the task. In part this might have been the fault of cards, other students acknowledged that they should have forced themselves to properly discuss them in more detail.

The debate of the problems on the cards ***shifted away from the focus on the cards*** *on top more general problems.*

it was ***easy to ignore them****. we didn't acomplish a lot*

5.3.4.4. Card Design

Looking at the feedback directed at the actual card design, the participants had mixed opinions. Most of them appreciated that the structured and simplified approach to the design:

It was ***simple*** *and* ***made sense***

Sufficient space, not cramped. ***Organized****.*

Easy to follow the structure *of the card*

Looked like Pokemon cards so there was a ***familiarity****. Clear position of examples and descriptions.*

Simple, ***clear to understand*** *Colours made the different types distinctive.*

However, the graphic design itself received some criticism, along with some suggestions on how to further improve the structure:

Could do with some better graphics, they seemed ***a little bland****.*

Could have a nicer design ***to be friendlier to the eye****.*

Maybe ***add logos for the type of card*** *to make it easier to note which is which.*

When reflecting on the amount of information provided, not all participants agreed with each other. Some of them appreciated the examples and further information about each of the concepts on the cards.

The amount of content on the cards was a good amount. It ***wasn't too much*** *so it wasn't too heavily detailed, but it* ***wasn't so little*** *that there wasn't enough detail. It allowed for discussion and adaptation of the cards subject.*

The cards provided ***a lot of information*** *about their respective topics.*

Clear and short description *of the cards given mechanic, ideas of games that corporate it and some advantages to using the stuff on the car.*

Other participants felt overwhelmed by the content on the cards.

Overload *of information.*

Too much information *in bullet points (we mostly used the titles).*

The amount of information did in fact slow-down the design process in some instances:

It took some members a ***re-read to fully take in the meaning*** *of the card.*

Have a better explanation of the questions and have questions that are more helpful by ***making them slightly larger so they can be seen across the table***

5.3.5. Conclusion

The first study can be considered a success. The groups were able to generate several ideas during the first session, and then developed these ideas further with the help of the cards. The students did not have noteworthy experience with mixed reality games beforehand, and the cards supported them in understanding the design space. Participants felt inspired by the Opportunity Cards and reported that Question and Challenge Cards made them reflect upon their game design and surfaced issues they had previously not thought about. The graphic design and the amount of content of the cards were seen more critical by some of the participants while others thought both were adequate.

5.4. Magellan

5.4.1. Study Overview

For the next study, I wanted to expose the cards to professionals with more experience of mixed reality games than the students from Lincoln1. This would enable me to validate the cards with a second perhaps more demanding group of users and see if they would for example find them too obvious and therefore unhelpful. I was able to find such a user group as part of the EU-funded research project Magellan. The goal of the project is to create an authoring tool for expert and non-expert designers of location-based experiences. A total of 24 international professionals participated in the study. 11 of them came from five different companies (SMEs) with design, game and/or mobile app development background. In the weeks leading up to the study they had each developed an idea for a mixed reality game that they were planning to develop over the course of the project. For the study the members of each company stayed together and formed five different groups. The groups were completed by 13 researchers from different

institutions consisting of experts in HCI, computer vision, location-based applications, tangible user interfaces and augmented reality.

5.4.2. Rules

To start, the participants were given a quick introduction about the cards and the ideas behind them and then had 60 minutes to further develop their existing game designs with the help of the cards. The following rules were suggested to the participants in accordance with the no limitations approach:

- Start the session by having everyone draw three cards
- Take turns
- Select a card to play and say how it is relevant for the game
- Discard the other cards
- If you don't have any card you think is relevant, just discard all and draw new ones
- You can also use a Blank Card and write on it
- Draw three new cards

In addition to this, participants were encouraged to change the rules if they saw fit: do out of turn actions, draw more cards, etc. Participants were then left unsupervised with only occasional check-ins inquiring about any problems regarding the process. Figure 11 shows a typical scene from the session. Towards the end of the session, two groups abandoned their hands of cards and instead started to go through the deck of unused cards trying to find some that were useful for their current design.

At the end of the session participants were asked to arrange the cards they used and found relevant on a large sheet of paper to present the results to the other groups. All of the groups utilized Opportunity, Question, and Challenge Cards.

Figure 11. Participants of the Magellan study interacting with the cards.

5.4.3. Design Outcomes

5.4.3.1. The Collector

This group was led by two members of a SME specializing in Rich Internet Applications as well as web and mobile games. They had conceived The Collector, a team-based game to be played at music festivals. Each team needs to find musical records that are hidden on the festival grounds (based on GPS) to create the best collections. Game masters are able to trigger events manually and can trigger new tasks for the teams.

For their poster, the participants placed a few cards separately and had one group of four, one of three and one of two cards (see Figure 12). The standalone cards were highlighting different elements of the game, while the grouped ones were concerned with specific topics: how to track players (and repercussions of their tracking), the fact that the game is played outside at a very specific location (and thus is heavily influenced by weather and requires manual authoring) and that the event (a music festival) will be very loud and thus requires consideration on how to include (or exclude) audio. The group mostly selected Opportunity Cards.

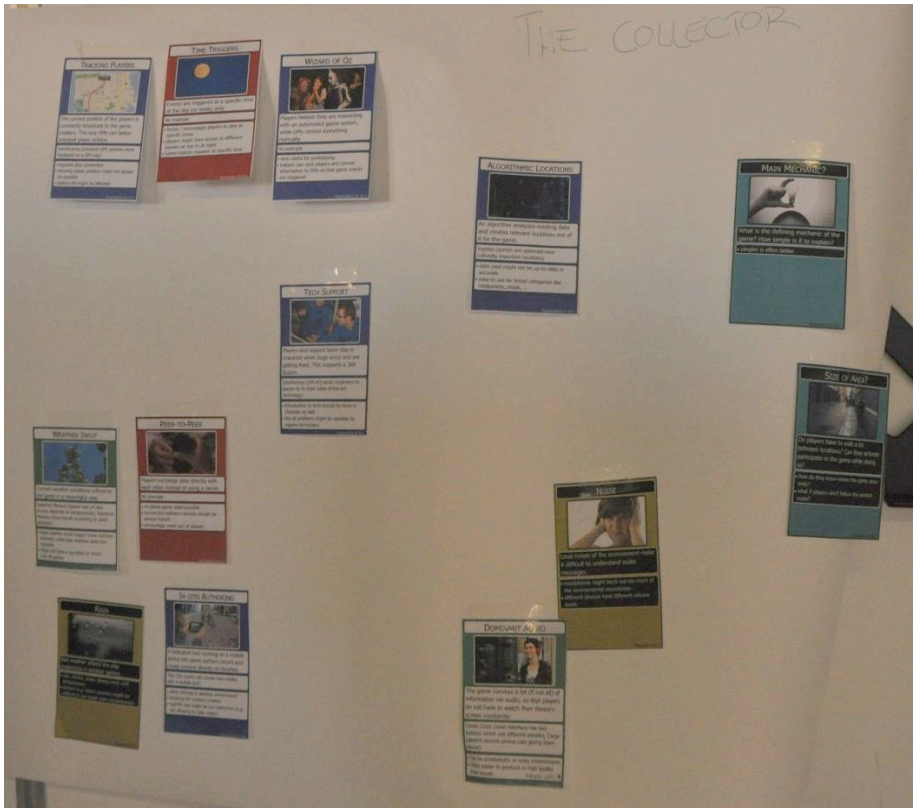


Figure 12. Cards used to represent the game The Collector.

5.4.3.2. Environmental Detective

Three participants of this group came from a SME focusing on user-centric and innovative projects in the areas of mobile apps and services, interactive video, websites and gaming. In Environmental Detective players have to fulfil small missions to clean up the environment from garbage and pollution with the help of augmented reality.

The group's poster consisted of several small groups of cards, and each grouping was annotated (see Figure 13). Several times the group used Challenge Cards and presented their answers to these issues as hand-written notes, e.g. when thinking about long distances the players have to travel, they decided that the game should generate new quests automatically and close to the player's current position. The group also explicitly chose one Opportunity Card to emphasize something they did not want to do: manually authoring locations for the game. Furthermore, the group reinterpreted Opportunity Card NPC Actors: They did not want to have real actors in the game, but instead include AI controlled virtual NPCs.

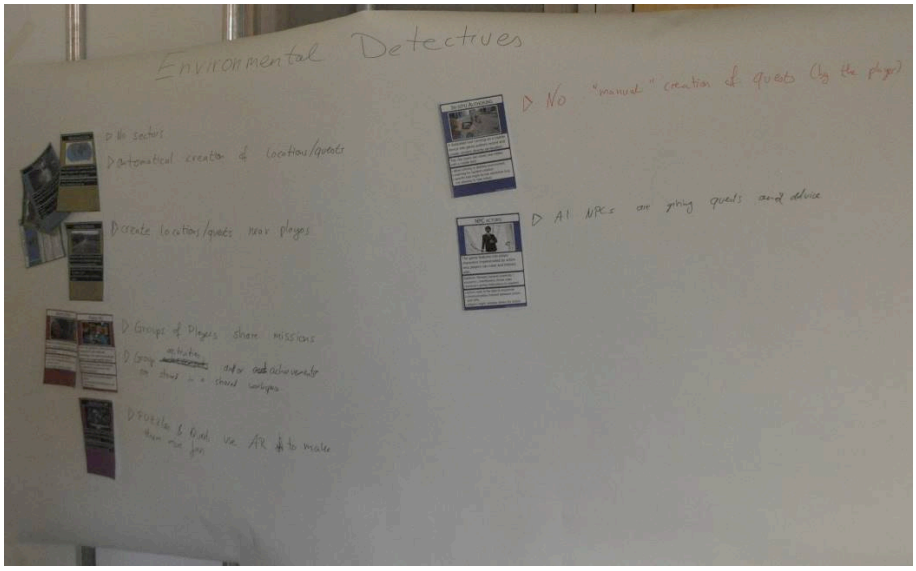


Figure 13. Cards used to represent the game Environmental Detectives.

5.4.3.3. Respot

Two participants of this group were sent by a publishing house running a popular web portal. In addition to this the company is also operating a recreational city guide in print, online and app form utilizing modern technologies like Augmented Reality. The game Respot was conceived to support their guide and encourage players to visit events and interesting locations in the city and solve small missions there. Collaboration and close connection to social media were also important aspects for their game.

On the poster the group created clusters of cards consisting of combinations of Opportunity and Questions Cards and one cluster for Challenge Cards (Figure 14). In addition, the clusters were labelled. One cluster showed "important features" that they game must have, another one showed features that they would like to use. Another cluster dealt with elements that were time related (duration, triggers, time limits, ...). This was crucial for them as the game is on the one hand long- running but on the other will be played in relation to specific events happening in the city. Lastly they gathered Challenge Cards in one cluster that they deemed important to think about when continuing the design and development of the game.

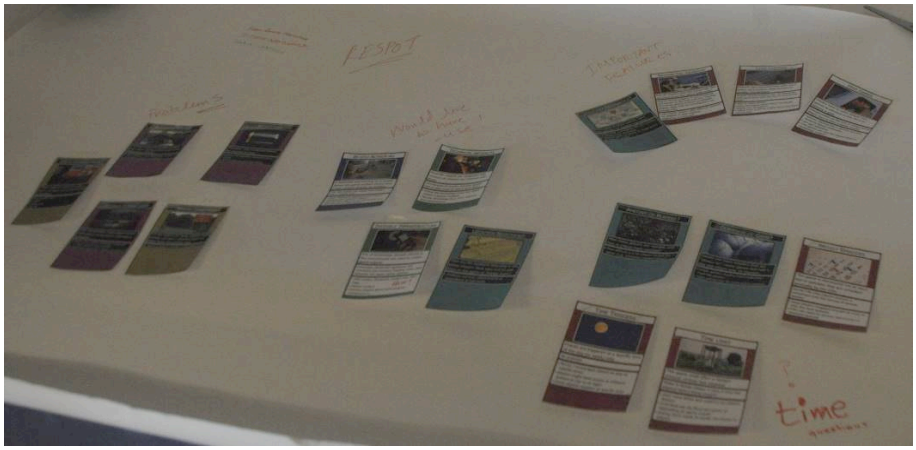


Figure 14. Cards used to represent the game Respot.

5.4.3.4. Tribal

Two members of this group came from an artist-driven SME producing games and playful experiences for different media like web, television and smartphones. In their game Tribal, players would have to create their own virtual tribe which then can be placed at different locations of the city, producing food, growing and competing with tribes of other players.

In this group the participants chose to sort all cards by type and thus arrived at 6 different groupings: two groups of three and four groups of four cards as seen in Figure 15. This group was the only one that used Blank Cards. They created three new ones that they deemed very crucial to their game design. They emphasized the need for a "Consistent State" (Organization Opportunity Card) to keep all game actions synchronized between all players. A Physical Challenge they saw their game facing was the questionable "Location Precision" that GPS provides and could cause problems along the way. Lastly, they created a Digital Challenge called "Scalability" as the underlying game infrastructure needs to support a potentially large amount of players acting in close vicinity to each other. The group members also scribbled notes on the back of several of the cards that they used.

Figure 15. Cards used to represent the game Tribal.

5.4.3.5. Interactive Castle

The last group was headed by two members of an international SME dealing with user experience design. Interactive Castle is designed for a historical museum and is aimed at families. During a museum visit the family plays together on several devices and collaboratively solve augmented reality challenges while learning about the historic background of their current location.

This group selected by far the largest number of cards to visualize their game (Figure 16). They also used way more Challenge and Question Cards in relation to Opportunity Cards than the other groups. They created seven clusters that were all labelled. Two groups dealt with different types of Challenges: "External Factors" like rain or sunshine and technology related issues they labelled "Problems". The group put a lot of effort into thinking about "Location" where they combined

Question and Challenge Cards and "Tech" (combining all three type of cards). They also identified important "Game Elements" (Opportunities and Questions), considered how to be able to test the game ("Good for Testing": Challenge and Opportunity Cards) and started defining the type of players and how they interact ("Participant Type": Question Cards).

Figure 16. Cards used to represent the game Interactive Castle.

5.4.4. Observations

Based on the Likert-scale questions the overall reception of the cards was positive. Table 13 shows how participants answered the questionnaire.

The participants clearly had fun using the cards (Q1, ⌀ 4.25). They also found that the cards gave them new ideas (Q6, ⌀ 4.00), and that they supported discussions in a good way (Q8, ⌀ 4.29). At the same time, they did not feel overly restricted by them (Q7, ⌀ 2.08). In regards to the specific cards, participants attributed usefulness for brainstorming to Opportunity (Q2, ⌀ 4.17), Question (Q3, ⌀ 4.33), and Challenge Cards (Q4, ⌀ 4.33). The blank cards however were not seen as particularly useful (Q5, ⌀ 2.41). The majority of participants thought the amount of information on the cards was "about right" with only one participant thinking it was "too little". Seven participants thought of it as "too much" (Q9, ⌀ 3.52).

Question	1	2	3	4	5	n	⌀	σ
Q1: It was fun using the cards.	4%	0%	13%	33%	50%	24	4.25	0.99
Q2: The OPPORTUNITY cards were useful for brainstorming.	0%	4%	21%	29%	46%	24	4.17	0.92
Q3: The CHALLENGE cards were useful for brainstorming.	0%	0%	17%	33%	50%	24	4.33	0.76
Q4: The QUESTION cards were useful for brainstorming.	0%	0%	13%	42%	46%	24	4.33	0.70
Q5: The BLANK cards were useful for brainstorming.	32%	23%	27%	9%	9%	22	2.41	1.30
Q6: The cards gave me new ideas.	4%	8%	8%	42%	38%	24	4.00	1.10
Q7: I felt restricted by the cards.	42%	25%	21%	8%	4%	24	2.08	1.18
Q8: The cards supported discussions in a good way.	0%	8%	0%	46%	46%	24	4.29	0.86
Q9: The amount of information on the cards was:	4%	0%	65%	0%	30%	23	3.52	1.08

Table 13. Magellan questionnaire data. Rating system: 1 = "I disagree"; 5 = "I agree". Q9 allowed participants to choose between "too little", "about right", and "too much". These values are represented by "1", "3", and "5" respectively.

This overall impression is also reflected in the answers to the open questions. Positives that were explicitly named were the cards creating discussions, bringing up new topics, and generally inspiring the participants.

good points for ***starting discussion***

Help create discussion Help to ***break the ice***

playing cards is a ***good starter to have everyone involved*** *at some point*

Thought provoking *ideas*

A lot of new ideas *and different points of view*

casued questions to be asked which previously hadn't *made us describe in more detail some things which weren't well defined*

Thought provoking ***enough different subjects*** *to address most of the game aspects*

useful to promote discussion ***Brought up questions etc which had never thought about*** *i.e. comprehensive*

overall very useful especially in stage of design after overall design is conceived i.e. to ***bring up issues and slight changes in game design***

Some related to another ***just by being played after each other****. This made me think.*

Several of the participants suggested improvements to the graphic design of the cards which was perhaps not surprising as there were a few designers under them. In addition to improvements to the visual design, participants also wished for more clues concerning the categories and types of cards.

> *The graphic design makes the* ***content feel cramped****. The different categories could be defined with icons.*
>
> ***not visually distinctive*** *as to what category they belong to Kind of confusing coloring*
>
> *The* ***colour code was not obvious enough*** *-> cheat sheet what color means what A boarder of colour around the cards might be better?*
>
> ***Not clear what the categories were*** *- it needs to be written in big font on the cards*
>
> *I understand the cards are in the development phase - so the* ***visual appearance will be imoproved***

Another point of critique voiced by the participants revolved around the amount of content on each of the cards. Here, participants would have preferred slightly less text as it made interpreting the cards more difficult and also slowed down the overall process.

> ***too much*** *information*
>
> ***less information might improve*** *interpreting the cards*
>
> *After playing the card, everybody* ***needed some time to read it****.*

Only one of the groups made use of the blank cards. The group wanted to represent their game with the cards but were lacking the ability to express that all players would interact in one consistent world. Therefore, they created their own card by writing "Consistent State" on one of the blank ones. This was exactly the reason why the blank cards were added in the first place: To allow participants to go beyond the existing cards and adjust the deck to their own needs. The same group also created a new Challenge Cards. "Scalability" described the issues for the server infrastructure to be able to sustain a multitude of players.

5.4.5. Conclusion

It was interesting to see how more experienced designers and technologists would handle the cards. In the instance of this study, the participants already had pre-existing ideas, but they reported that the cards helped them flesh-out their ideas in

more detail. Like during Lincoln1, the participants also stated that the cards uncovered design elements that they had not considered previously. The participants were especially positive about the fact that the cards created and facilitated discussions within their groups. Several participants had comments about the graphic design of the cards and suggestions on how to improve it and the general structure of the cards.

5.5. Brisbane Writers Festival

5.5.1. Study Overview

For this next study, I wanted to engage with participants without previous experience in mixed reality or games, i.e. users that can be classified as domain experts. I was given the opportunity to do so as part of the Brisbane Writers Festival.

The Brisbane Writers Festival is an annual conference that has been organized since 1962. I was invited to the festival as a panellist for interactive storytelling and seized the chance to organize a study as part of it. Here, I was especially interested how members of the public with no noteworthy previous experience of mixed reality and games would be able to utilize the cards. 10 participants, among them writers and publishers, signed up for the study. I ran two sessions with five participants each back to back, and each session lasted 1h which included a short introduction in the beginning and questionnaires and a semi-structured interview at the end. For additional data collection, I took notes and photos, and also had both sessions video recorded.

Both groups participating in my study were given the same brief: "Create a game that could be played during the Brisbane Writers Festival." I did not constrain the participants in any other way, e.g. they had unlimited budget and did not have to worry about technical feasibility.

5.5.2. Rules

Each session started with everybody drawing three Opportunity Cards. Participants were instructed to play cards and explain how that card would affect their current game design. The group would then discuss the idea and decide whether or not it they wanted to adopt it. I used two variants for this take on the no limitations

approach: In the first group, I enforced a turn-based approach for playing the cards, whereas in the second one everybody was allowed to act whenever they felt it was appropriate. Participants could also freely redraw cards to replenish their hands. For building their idea there was no limit for the amount of Opportunity Cards that could be "active" at the same time. The groups however were encouraged at the beginning of the session to remove cards that no longer were relevant for their game idea. Both groups spent 45 minutes interacting with the cards. Towards the end of the session I introduced the Question Cards by starting to play them myself in the role of a moderator. This was done to see how they would affect the (at this time) sprawling idea both groups had developed up to that point.

Due to the introduction of Question Cards and the no limitations approach, Brisbane Writers Festival can be seen as a hybrid study that explores idea generation as well as idea development at the same time.

5.5.3. Design Outcomes

5.5.3.1. Feeling Brisbane

The first group created a game where players need to visit a variety of locations in the city. There, actors will engage them in conversation and ultimately give them a task to perform. These tasks are inspired by the game show "The Amazing Race" and might include expressive activities like creating a graffiti or writing a poem. The locations would introduce players to historical and current developments within the city and serve as an alternative approach to traditional sightseeing. The final collection of cards (and post-its) can be seen in Figure 17.

Figure 17. Feeling Brisbane as seen through the cards.

5.5.3.2. Shakespeare's Journey

In this game two competing teams (good versus evil) are both trying to locate William Shakespeare who has travelled through time and space to present day Brisbane. Teams will have to follow clues scattered around the city in a scavenger hunt in order to first find and then escort Shakespeare to the Brisbane Writers Festival at a specific time. This marks the finale of the game that is part of the official programme of the event. Figure 18 shows the cards that played important roles in the design process.

Figure 18. Final selection of cards describing Shakespeare's Journey.

5.5.4. Observations

The sessions of the Brisbane Writers Festival received slightly less positive feedback than the previous two studies. Table 14 gives an overview of the Likert-scale parts of the questionnaire.

Question	1	2	3	4	5	n	⌀	σ
Q1: Interacting with the cards was inspirational.	10%	10%	40%	20%	20%	10	3.30	1.25
Q2: Interacting with the cards supported creativity.	10%	0%	20%	40%	30%	10	3.80	1.23
Q3: Interacting with the cards was educational.	0%	10%	50%	20%	20%	10	3.50	0.97
Q4: Interacting with the cards was fun.	10%	0%	30%	40%	20%	10	3.60	1.17

Table 14. Brisbane Writers Festival questionnaire data. Rating system: 1 = "I disagree"; 5 = "I agree".

While the activity scored reasonably high on supporting creativity (Q2, ⌀ 3.80) the participants agreed slightly less with it being inspirational (Q1, ⌀ 3.30), educational (Q3, ⌀ 3.50) or being fun (Q4, ⌀ 3.60).

Some of the participants however had a clear positive impression from the cards. They liked that the cards gave them guidance while at the same time being able to freely discuss their ideas.

> *They created parameters and **helped us focus**.*
>
> *Interacting **helped spark creativity** and get my brain thinking about game mechanics and what's important.*
>
> ***Creative nature** - no set order of people contributing, speaking up as they thought of something.*

One participants from the group without turn-order explicitly named the lack of rules as a positive:

> *That it was free-form with **no fixed structure**.*

Other participants struggled with the format of the session. They noted that it was difficult for them to create a single coherent idea out of the many (sometimes conflicting) cards that were used to develop the idea

The cards gave the conversation direction, but at random. I found myself getting lost, as each group member was ***stringing together very different thought patterns****, in constant flux.*

We were limited to what the cards had upon them and ***contradicted each other's cards*** *at times.*

While they appreciated that the cards introduced them to different game mechanics that they would have liked to include in their game, some participants felt that it was challenging to combine all of these into a rich and thematic idea.

*I found the cards *very* helpful as a brainstorming exercise, but moving past the purse of ideas* ***into a more concrete concept proved difficult****.*

They encourages us to speak in ***hypotheticals****. They created* ***bland, uninspired ideas***

This lack of focus is perhaps best illustrated in Figure 19 that shows the ultimately selected cards on the table at the end of the session. It shows 13 Opportunity Cards trying to incorporate too many things at the same time and creating a fuzzy idea.

Figure 19. The selection of cards by one group from the Brisbane Writers Festival: 13 Opportunity Cards and one Question Card.

Overall both groups developed a tendency to include almost every card into their concept – it was difficult for them to boil it down to a manageable idea. This problem is best illustrated with a concrete situation from the Brisbane Writers Festival study where playing a Question Card mitigated the problem:

The second group (B6 to B10) has been developing their idea for about 15 minutes. They have placed a lot of Opportunity Cards in the centre of the table: a total of six Techniques Opportunities and 6 Organization Opportunities.

B6 and B7 wonder about the state of their idea:

B7: We are getting too complicated in such an early stage of the game.

B6: I think we are going alright, but I think we ***may be needing a better sense of what the game actually is****.*

B7: Yes, we haven't really discussed that too deeply.

At this point I decide as the moderator to introduce Question Cards into the session and play the card Main Mechanic?. I briefly explain the motivation behind the card, and then listen in to the unfolding conversation between the participants (Figure 20).

Interviewer: What is your main mechanic? What is the main thing that people are doing in the game?

B6: Looking, I think, from what we said so far.

B9: Searching and following clues?

B10: Also, interacting with each other. But maybe that is secondary.

B6: The main mechanic is trying to find a person.

B8: Yes, but if we step back a bit further from that, how do they know where to look? Is there a mechanic behind that of following clues? Or deciphering instructions? Or is the mechanic 'going around looking'? Because I have to go out, trying to find the stuff myself. Rather than being fed the information to begin with?

B10: I feel like, finding it themselves.

B9: Yep. But that would also mean that there would be clues hidden around rather than just speaking to every random person you come across. So maybe something like Invisible Infrastructure?

B9 then proceeds to read out the content of the card and the group continues their discussion around the main mechanic of the game, now trying to define what players would actually be doing in their game.

Figure 20. Second group of participants discussing the newly played Question Card Main Mechanic?.

A similar moment happened in the first session of that study, and in the post-session interview participants mentioned the positive effect of discussing the card Main Mechanic?:

Interviewer: "Did you think it helped when I played this card, Main Mechanic?"

B3: "Yes."

*B2: "**It brought everything back together.**"*

*B4: "It brought it back to **one product rather than several ideas**."*

These two examples show the positive impact that Question Cards had on the overall process and how they managed to support two groups who had problems creating a coherent game design idea.

5.5.5. Conclusions

The task at hand turned out to be rather challenging for the participants. This is perhaps not surprising as none of them had previous experience with mixed reality or game design in general. However, the two groups did manage to develop a game design idea in the end nonetheless. It was interesting to see how the participants struggled in developing a concise idea – they were generally tempted to include as many Opportunity Cards as possible. This suggests that the chosen approach (no limitations) is not very well suited for idea generation. The Question Cards did prove to be useful as they brought the groups back on track and helped them to concretize their idea.

5.6. Chapter Summary

Phase 1 could be considered a successful first step in the iterative development of the Mixed Reality Game Cards. In general, the feedback gathered from the three studies was very positive and extremely promising. The cards were seen as "fun", they sparked discussions, and allowed participants to work well together – even if they did not know each other beforehand. This was true across all three studies despite their diverse range of participants. Lincoln1 consisted of Games Computing students, Magellan had researchers and other professionals, while Brisbane Writers Festival had the least experienced participants. Nevertheless, the cards seemed useful for all group. Expert users did not see them as "too obvious", and inexperienced ones were not overwhelmed by them and the task at hand.

Regarding idea generation, two approaches were utilized: limited choice and no limitations. Comparing the two chosen approaches (no limitations, limited choice) is certainly somewhat difficult as both studies were conducted with rather different user groups. On the one hand, we had students with pre-existing experience and interest in game design, and on the other hand were professionals for who gaming was a new field for their creativity. Both groups however managed to use the cards to create a variety of ideas for mixed reality games. Perhaps unsurprisingly, the professionals from the Brisbane Writers Festival study seemed to struggle more with the given task. While some of this might be due to different levels of experience, the decision of providing no real limitations to the participants certainly had detrimental effects. For them, it was hard to curb their enthusiasm – each new card sounded highly interesting and they incorporated a high number of them into their concept. In turn, this caused the game concepts to be rather unfocused and overfilled with features and elements. The groups of Lincoln1 in contrast were able to generate several feasible game ideas in a shorter time span. Being limited to three cards per idea meant that these had a much clearer focus while at the same time of course not as elaborate and fleshed out. The latter however would be a goal for an idea development session. Likewise, the no limitation approach had its drawbacks, namely a tendency for participants to shy away from conflicting cards. Instead, participants would be drawn (perhaps intuitively, perhaps deliberately) to card combinations that complemented each other.

While observations highlighting the salient features of the two approaches were expected, especially the Brisbane Writers Festival study also drew attention to an additional challenge. Several participants reported that it was difficult for them to make the jump from an abstract mechanic (as depicted on the cards) to an idea with a strong and interesting theme. Instead, some felt that their ideas where rather bland. During the Lincoln1 study this problem was not as evident. However, when participants described their ideas they would often stay rather vague and not fully explain how a specific mechanic was going to come to life. This seemed to suggest that an additional source of inspiration might further improve idea generation and enable users to take a step away from hypotheticals towards richer ideas.

Some of the other criticism that the cards faced was going to be easy to fix (e.g. the graphic design, structuring of content). It also seemed necessary to reduce the amount of information on each card, so that participants would be faster to understand the cards and not feel forced to read through the whole card before and after playing it. This of course would run the risk of removing too much information that might have been especially helpful for inexperienced users.

Overall however, the division into Opportunities, Questions, and Challenges was well received by the participants. This way, each type of card added something unique and likewise important to the design process. Opportunity Cards were used to create an initial idea whereas Question and Challenge Cards would then further refine and elaborate on the initial idea. The importance of Question Cards became rather evident during the Brisbane Writers Festival study – they helped the groups defining what their game was about and gave the design process more focus. Likewise, Challenge Cards were appreciated by the groups for grounding their idea in reality and drawing attention to aspects they would have otherwise perhaps overlooked in their designs.

The studies also surfaced some additional topics that seemed appropriate to add to the overall deck of cards. One group in the Magellan study for example was staging a game with a consistent state that was played worldwide, while both groups during the Brisbane Writers Festival study were very concerned with the theme of their game and basing it on a strong narrative – perhaps unsurprisingly considering their professional background.

6. Phase 2: Refinement

6.1. Overview

The general feedback from the study participants from Phase 1 were positive: The division between Opportunities, Questions, and Challenges worked well. It allowed them to gradually inspect and develop their design. With the content of the cards generally in a good position (apart from adding additional cards and reducing the sheer amount) it now seemed appropriate to focus on the development of the rules. Especially the aspect of idea generation needed further scrutiny in order to be able to make an informed decision about the amount of constraints and randomness that should be recommend when interacting with the cards. Additionally, I had also observed difficulties for groups to create ideas that were rich in theme and decided to introduce (and evaluate) Theme Cards in order to mitigate this problem. Overall, the following emerged as the main goals for this stage of the development:

- Improve the graphic design of the cards to make them visually more appealing and also use card stock for printing
- Reduce the amount of content on the cards to prevent a slow-down of the design process while assuring that inexperienced users can still make sense of them
- Explore how Theme Cards affect the design process (and refine their use)
- Further explore the differences between random draw, limited choice, and no limitations as techniques for idea generation.

Consequently, Phase 2 consisted of three studies that are summarized in Table 15 and briefly outlined below.

At a meeting of the **Performance and Games** network I engaged a diverse group of established and experienced researchers and artists with the Mixed Reality Game Cards. The study was part of a two-day hackathon where groups of participants spent parts of the first day generating and developing ideas with the cards which they would then prototypically implement on the second day.

Know How is a Nottingham-based event to support cultural institutions to enhance their digital portfolio. As part of it I worked together with a group that were about to host a large photography festival and wanted to create a mixed reality

game to go along with it. This allowed me to closely observe the group and how the cards guided them along from an initial concept to a finalized idea.

The last study in this phase was undertaken with members of UK-charity **Sustrans**. They had teamed up with an artist who was advising them on how to create location-based experiences to promote public transport as well as walking and cycling (which were the main goals of their charity). We used the cards in an idea generation session to explore the design space of mixed reality games, and it was interesting to see the members of the charity engaged in the creative design process, something they would normally not do as part of their daily responsibilities.

Phase 2: Refinement			
Study	**Performance and Games**	**Know How**	**Sustrans**
Participants	25 researchers, academics, artists	3 art gallery employees 1 mobile app developer	3 employees of charity 1 artist
Set-up	5 groups (simultaneously)	1 group	1 group
Idea generation	25 to 60 minutes	30 minutes	40 minutes
Technique	Limited choice Random draw	Random draw	Random draw
Theme Cards	Bespoke Theme Cards	VNA and Dixit	Dixit
Outcome	Several game ideas	6 game ideas	6 game ideas
Idea development	2 hours	2 hours	N/A
Brief	Design game to be implemented the next day	Design game for photography festival	N/A
Data	Photos, notes, semi structured interviews (post session)	Photos, notes, semi structured interview (post session)	Photos, notes, audio recording of session, semi structured interview (post session)

Table 15. Overview of the studies during Phase 2.

6.2. Card Version 2

Version 2 consisted of a total of 82 different cards: 44 Opportunity Cards, 17 Question Cards, and 21 Challenge Cards, again supported by additional blank cards for each type. The cards are summarized in Table 16.

As before, categories were used to make the cards more colourful, and this time the same categories were applied to all types of cards (audio, environment,

locations, technology, time, sensors, orchestration, objects, gameplay, and players). Several new cards were added to the deck, especially based on observations from the Magellan study (e.g. Opportunities Global Gamestate, and Worldwide) and from the Brisbane Writers Festival study (e.g. Opportunity Strong Narrative, and Questions Core Concepts?, Theme and Story?, Challenging?, Experience Flow?, and Fun and Joy?).

The difference between Opportunities, Questions, and Challenges was emphasized further by using white (Opportunities), grey (Questions), and black (Challenges) as a background colours for the text. In addition to this each card also had a symbol in the upper left corner to denote its type (+, ? or - for Opportunities, Questions, Challenges respectively). These changes were a response to some of the criticism from the Magellan study.

Perhaps the major concern about the design of the cards was the amount of information on each card that became especially apparent during the Magellan and the Brisbane Writers Festival studies. In comparison to other ideation cards the previous version was rather text-heavy, thus often causing participants to read out aloud the whole card when they played it, or for example picking it up to read it themselves when someone else played it. In general, this "information overload" caused several breaks in the flow of a session. The major design change therefore was to drastically reduce the amount of text: While title and description remained on the cards, considerations and examples were removed. This also allowed for a streamlined and improved graphic design that likewise (and unsurprisingly) had been criticized.

Examples for the redesigned cards are displayed in Figure 21. They were printed on cardstock paper with dimension of 8.2cm x 6cm.

Category	Opportunity	Question	Challenge
audio (yellow)	Dominant Audio Mobile Soundtrack		Noise
environment (dark green)	Performative Play Set Construction Weather Input	Nothing physical? Size of Area?	Getting Lost Limited Resources Long Distances Rain and Snow Safety Hazards Sunshine
locations (light green)	Fitting Locations Generated Locations Headquarter Subverted Locations Unusual Locations	Indoor or Outdoor? Locations?	Bland Locations Relocation Uncontrollable Places
technology (blue)	Augmented Reality Global Gamestate Peer-to-Peer Public Display Telephony	Game Server? Nothing Digital?	Battery Life Confusing Interface Gimmicky Tech Phone Zombies Unstable Connectivity
time (light pink)	Episodic Content Time Pressure Timed Events	Duration?	
gameplay (red)	Collaboration Collecting Exergaming Exploration Mini Games Riddles Seamful Design Social Contract Strong Narrative Worldwide	Core Concepts? Main Mechanic? Theme and Story?	Feature Creep Speed Disadvantage
sensors (cyan)	Automated Tracking Existing Technology Manual Tracking Stationary Sensors	Suitable Sensors?	Flawed Sensors
orchestration (brown)	Actors Puppet Masters Wizard of Oz	Observing Players?	Testing
objects (orange)	Low Tech Technical Artifacts Useful Props		
players (purple)	Alternate Reality Different Roles Online Participation Roleplaying Simple Costumes User-created Content	Amount of Players? Challenging? Experience Flow? Fun and Joy? Target Group?	Critical Mass Unclear Instructions

Table 16. Overview of all cards from version 2.

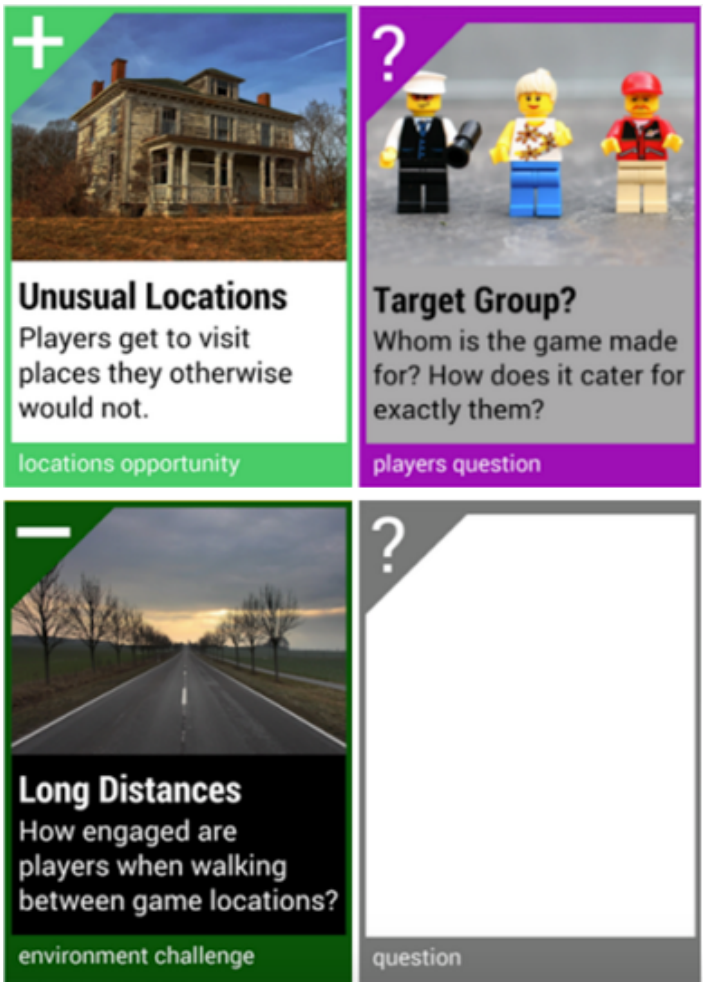


Figure 21. Version 2 and Opportunity Card Unusual Locations, Question Card Target Group?, Challenge Card Long Distances, and a blank Question Card.

6.3. Performance and Games

6.3.1. Study Overview

This study took place during a workshop as part of the Performance and Games Network. The network was founded in March 2014, and was a collaboration between the Universities of Lincoln, Exeter, and Nottingham, Tiga (non-profit trade association representing the UK's games industry), and Arts Queensland (Australia). Members of the network included commercial game developers, researchers, and students. The workshop itself took two days and had 25 participants. On the first day participants were divided into five groups and were

tasked to create a design for a mixed reality game. This game was then implemented in prototype form by each group on the following day.

6.3.2. Rules

The study participants used the cards for about 3 hours in their groups. I had prepared a small booklet for each group that included the rules for interacting with the cards. The first card-related task was idea generation with the Opportunity Cards. The booklet instructed participants to try three different methods for generating their ideas that represented random draw, limited choice, and no limitations.

1) Draw three random Opportunity Cards and reveal them -> Develop a game idea based on these cards
2) Everybody draws three Opportunity Cards -> Take turns with each one playing one card and describing how this creates / affects a game idea
3) Everybody draws three Opportunity Cards -> Everybody can play as many cards as they like and in any order to create / affect the game idea

For each new idea, the groups were instructed to also draw a random Theme Card as an inspirational seed for their idea. The Theme Cards consisted of a single word or phrase (Figure 22), and participants were told to interpret them in any way they felt was right in order to include them in the design idea. I added the Theme Cards in order to provide a source of non-domain specific inspiration in order to overcome some of the issues identified during Phase 1.

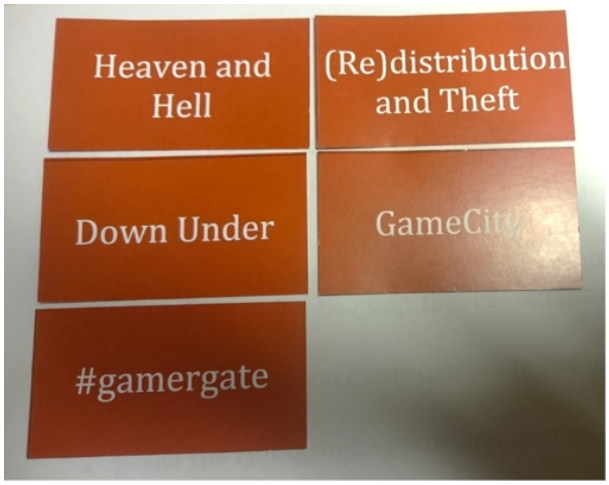


Figure 22. Theme Cards from Performance and Games study.

In the next stage of the process, the groups had to choose one of the brief game design ideas. They would then continue to develop this idea further, first with the help of Opportunity Cards, then Question Cards, and finally Challenge Cards. Participants were encouraged to document the process by taking pictures, videos, audio recordings, and tweeting any design ideas they had come up with. At the end of the day all groups presented their ideas before developing them the next day.

6.3.3. Design Outcomes

6.3.3.1. Every Dog has its Faraday

This group designed a game and which the players take on the role of a dog. The dog has escaped from a research facility and the player has to reach the home destination. This is made difficult because due to the experiments the dog has been exposed to, it has become very susceptible to all kinds of electronic signals. As such the players needs to avoid WiFi networks, Bluetooth devices, iBeacons and similar emitters. An overview of the game can be seen in Figure 23.

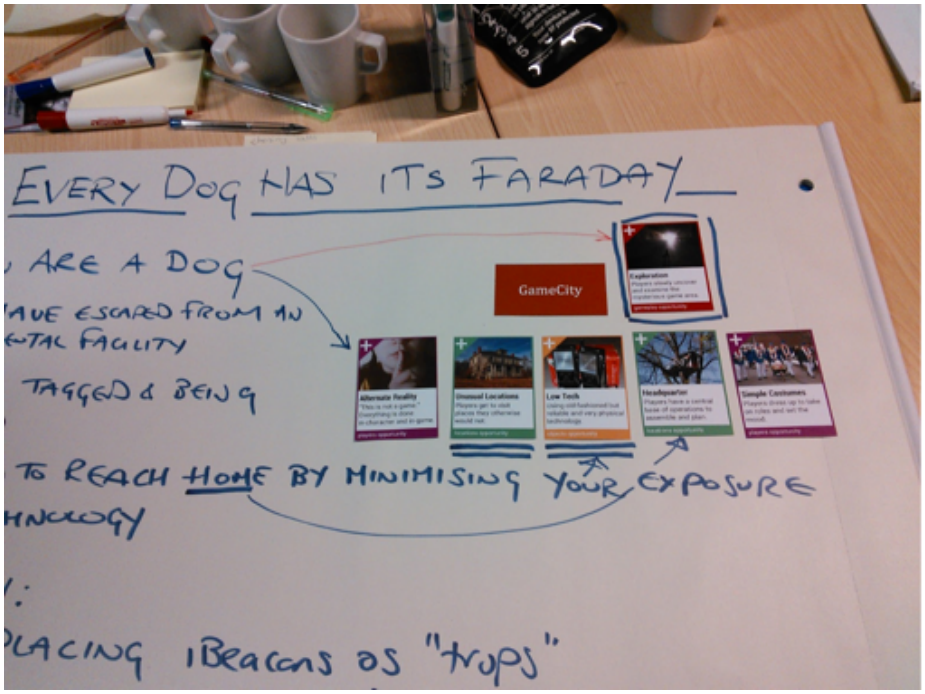


Figure 23. Poster showcasing the design of Every Dog has its Faraday.

6.3.3.2. Restickulous and Grand Push Auto

The second group actually created two games. One of their first designs was called Restickulous. In it, you need to sneak behind someone about to take a selfie photograph. You then hold up a long stick with a cardboard Eiffel Tower attached to it. You score points if you manage to place the Eiffel Tower in a way that it is captured on the selfie without the other person noticing. As the game did not require any technology, the group created a quick prototype of it during the first day already before they started designing another game. This game, Grand Push Auto, was an equally humorous exergame (Marshall et al., 2015). In order to play the you need a smartphone - and a car. The player (or players) now need to push the car forward and reach a certain speed and overall distance (measured by the phone) in order to progress to the next, more demanding, level (see Figure 24).

Figure 24. Driver with smartphone (left), and other player pushing the car forward (right).

6.3.3.3. Taphobos

The participants in this group created an "immersive coffin experience" which was developed into a full game after the workshop and has been widely exhibited since then (Brown et al., 2015). A player is lying in a real coffin (or a large cardboard box during the workshop) and wearing a VR headset. The virtual reality shows the inside of the coffin with a map engraved to its lid. The map shows the location of the coffin - and the player now needs to communicate this to a second player who is outside the coffin to be found in time by using a walkie-talkie. Figure 25 shows a prototype Google Cardboard and chairs for the coffin.

Figure 25. Low-fidelity prototype version of the coffin in Taphobos.

6.3.3.4. Phone Thief

This group designed a multiplayer game that is played casually over e.g. a lunch or dinner break. Participants put their phones on the table. The game is running in the background and tracks any phone movement. The players are now trying to "steal" each other's phones without the owner noticing - and without causing the alarm to go off in case the phone is moved too fast or erratically. Figure 26 shows the group in an early stage of the design.

Figure 26. Participants exploring the role of locations in their game.

6.3.3.5. Man vs Building

In this game the players need to cross through different rooms of a building. The building is equipped with several different surveillance technologies. Cameras detect QR codes that the players are wearing, and hidden iBeacons detect the phones of the players. During the game, players have to carefully observe the environment while trying not to be registered by the surveillance system. In order to get from one room to the next they have to search for clues on how to open the locked door that is stopping their progress.

6.3.4. Observations

6.3.4.1. Theme Cards

In general, the Theme Cards received mixed feedback after the session. Participants liked the idea of having Theme Cards as such, but were not necessarily convinced that the ones they were given were perfectly suited.

> *P1: That really fit well. I guess that was after we went through the theme cards. The theme cards were kind of...* ***I don't think the theme cards really helped us think of the game at all.*** *But when we looked back we caught some theme, with the Heaven and Hell and Down Under. But that was just coincidence I think.*

> *P2: The themes were ok. Not particularly the kind of themes I would have chosen but* ***they were good starting points for discussion****, which is what I think the purpose is.*

One group designed Grand Push Auto in which a player sits in a car while another player (or players) push the car forward. They reach a new level when they hit a certain speed or distance which is measured by a phone inside the car. While pushing, players are encouraged by the song "Eye of the Tiger" by Survivor, whereas in between levels an Enya song is played for relaxation. During the post-session interview the group discussed the game and mentions the effect the theme card Heaven or Hell did or did not have on their design. While they agreed that the actual topic of the Theme Card is not very well represented in the final game, they appreciated that it gave them some form of guidance in their ideation process.

P3: We had the Heaven and Hell theme and we were kind of constantly going 'Do we actually include that at all or not?' What does it even mean? We negotiated about Heaven and Hell. I think it is still kind of in it.

P4: I was gonna say, don't you be negative. It has sorta made it.

P3: Survivor and Enya. Yeah. Heaven and hell, yeah.

P4: Which is our definition of heaven and hell.

Interviewer: Do you think it was helpful to have these themes or...?

P3: Yeah.

P4: I don't think in the second one the theme was that helpful.

P4: Yeah, I don't know if the theme card made a lot of difference on the second one. But then again, it is really hard to track back, isn't it? ***We did think about Heaven and Hell for a while before we got bored with that item. And it did get us a fair way along with this idea.*** *That's not a useful answer but it is actually quite too hard to pull apart the process.*

P5: Yeah, ***it helped us give a bit of context and focus****, didn't it? Because otherwise we'd just be shouting out game ideas randomly.*

P4: Yeah.

P5: You do that; we'd still be doing it now. You'd come up with anything. I mean we'd come up with a million things that were all unusable.

Another participant from a different group echoes their opinion, pointing out the value that themes have for e.g. game jams or game ideation sessions.

P6: I think the topics are essential for making a game jam, or making a game ideation event, because ***without the topic people would very much difficulty to come up with a game idea****, so in my opinion the card set should include a number of 30 or 40 topics plus the possibility of course for the participants to create their own topics. But I would include topics into the card set.*

One participant compared the experience with the Mixed Reality Game Cards to previous experiences of ideation session. In one of them, quotes from a book written by Lewis Carroll were used as a source for inspiration. Comparing the

quotes to the Theme Cards the former were seen as more open, allowing (and needing) more interpretation.

> *P7: Yeah, Lewis Carroll. It's called The Jabberwocky. So he had a quote from Jabberwocky which is a children's book. So there was framing but there was interpretation as well. Whereas I guess* ***with the Theme Cards that you gave us there wasn't a lot of interpretation****. It was like very 'bam, that's what it is' and so the themes were quite restrictive but the cards were very open. So you had to take this open thing and fit it to a restrictive thing. Whereas I think a little bit more of a dynamic play between how you articulate the theme or provocation or cause. Maybe theme isn't the right word.*

This latter observation is a very crucial one when thinking about the qualities that a good Theme Card needs to possess. The participant calls for a balance between framing and interpretation. On the one hand a Theme Card needs to restrict, needs to provide a topic. On the other hand, it must not be too restrictive but allow for creative and diverse interpretations.

6.3.4.2. Random Draw, Limited Choice, No Limitations

During the post-session interviews I asked the participants if they preferred any of the methods for idea generation.

Some participants had a clear preference for the random draw:

> *P8:* ***I didn't like the way people could lump through and pick and choose.*** *I actually preferred it when it was a bit more: "Here you are, go deal with it". I thought that was a nicer way to approach it, but that's just my opinion.*

Another group was much happier with the limited choice variant however. They discuss the reasons for this quite extensively during the interview. For them, having choice was so important that they actually decided to draw five cards instead. This allowed them to have more control over the idea.

> *P9: We tried three different cards to begin with but I think we got to a point where we got a bunch of ideas that didn't go that well together because everyone was just quite restricted, or you had a certain hand,* ***we all had certain hands that didn't seem to work that well together*** *so then we tried again with five cards. So it gave us all a bit more choice and then we kind of basically had the idea that we got now, the makings of it. So they're all laid out on the table, so that's quite handy, to see it all.*

P7: I think it is interesting how this is syncing with the "happy coincidences" of the cards. What P9 is saying. Sometimes you get cards... There was one... I think it was probably the last one that we had where it just seemed like ***there was a really nice flow of continuity through the cards that everyone got to put down****. Depending on what they had in their hand, and what the person had put who started the process. Like it's interesting with the luck element like in any card game where, you know,* ***sometimes there is a really nice continuity****, isn't it. Other times it's like "****Oh no, this shit doesn't go together****". So you know from a design point of view I guess that kind of having to kind of keep putting those away, and starting again, and starting again. I don't,* ***you are kind of waiting for your lucky hand****.*

P10: And we had that moment, definitely, hadn't we? Between us, or between somewhere or on the table somewhere. Somebody played Social Contract, and somebody else said "Oh and I think User-Created Content ***really fits nicely to that****". That was a game-y moment, like putting the right card on the table. And also vice-versa, we had the moment of "I think I played the wrong card, I should take it back and I think* ***that's a better idea for the moment****." So it did help facilitate the process somehow.*

P7: But definitely there's some, like the first couple where just like "shit doesn't go together" and you know, ***the cards seemed like a block rather than facilitation****.*

P11: I think P9, you made a good comment about that yesterday, I think it was when we had two or three cards each, and one round it felt a bit forced. And then I think we had five or something. And it felt like instantly there was a lot more choice and ***you could really sculpt out a strong connection between the cards that instantly seemed to make sense.***

While this is a rather long snippet it illustrates very well why some participants preferred the variant that gave them limited choice: Because it is easier and there are "natural connections" between different cards. Some cards complement each other really well, while others stand in opposition to each other. Creating a coherent game idea from such a contradiction arguably requires more creative effort.

In addition, when a participant has a choice of which card to play, it increases their agency. They just made a contribution to the game design that can be traced back to them. This attitude becomes rather clear during another part of the interview when I asked the same group to directly compare the two variants:

Interviewer: What do you think is the difference between 'draw three cards and make a game out of them' and 'play whatever you like'? Any opinions on the differences between.

P10: I'm a technical background guy and I feel if we can play any card we like ***it's much easier*** *because* ***I can decide*** *what we are going to build. If we are just playing some cards that we have been forced upon by the process –* ***I don't really want to*** *hypothesize a social media based game with gps and augmented reality and stuff just because the cards told me so. I don't believe in fortune tellers. And* ***I don't believe in the cards telling me what to do****, because I still have to do it afterwards, so I would like to have the feeling of control. I would like to have the random glimpse of ideas from the cards which I think they give me very nicely. But I also - it's a thing that we want to build afterwards so* ***we have to be in control.***

P9: I think it probably works better when you've got the degree of choice because you can sort of ***guide it in a direction you want****. Whereas when it's, you know, you got the three cards down there and there it's telling you exactly what to do. It's just more down to the* ***luck of the draw****. Well, in both approaches to some degree. Like it's certainly less so when you've got a number of cards and you are choosing which ones.* ***But when it's just the cards down there it could turn out really brilliantly because the cards could design something for you, or give you the seeds for something really cool.***

P10: That's a good point.

P9: But there's probably more chance that they're gonna be ***random things that don't go very well together*** *and* ***it's gonna be hard*** *to create something out of.*

Towards the end of this snipped, one participant makes a very interesting observation, stating that the randomness of the cards also has the chance of creating something very unique and unusual – while certainly being more difficult overall.

An excellent example of this can be seen in another group. The group used the random draw method and revealed the Opportunity Cards Seamful Design, Low Tech, and Augmented Reality as well as GameCity for their theme (Figure 27).

Interviewer: What do you think? Did anything work well about the process yesterday? And if so, what?

P3: Yeah, so, you know, the stick thing

P4: Restickulous.

P3: Yes, Restickulous. ***That game is exactly the three cards that we got****. It was like low-fi... What was it? Seamful Design?*

P5: Augmented Reality.

P4: Seamful Design was in there too, I tweeted the three pictures. And P3 is exactly right. ***We made those exact three cards into a game****. We didn't deviate I guess is the thing.*

P3: So that's the three there. So it was 'Augmented Reality - 3D models are placed in real time into environment', 'Seamful Design - Flaws are embraced and made a substantial game element' and then 'Low Tech'. So it was literally us thinking about those three things, and we thought it'd be funny and that's where that came from.

Interviewer: So having been forced to use these cards, that was good?

P3: ***Well, we would have never come up with that otherwise.***

There is a very obvious and strong contradiction between the cards Low Tech and Augmented Reality. If we envision a participant deliberately playing Low Tech after Augmented Reality had already been played, it is not a stretch to imagine how the other participants would protest. Even more likely, the participant would arguably not play Low Tech in the first place. In this instance, however, the group was forced to figure out a solution. The game the group came up with was called Restickulous. Players of the game are equipped with a long stick on which end there is a cardboard cut-out of a famous sight (for the prototype version they used the Eiffel Tower, Figure 28). The task of the player is now to walk up behind someone who is taking a selfie (but is not a player). They score points if they manage to sneak their Eiffel Tower onto the picture - and even more points if that picture is then later uploaded to Facebook, Twitter, or Instagram.

Figure 27. Cards that inspired Restickulous.

Figure 28. Playing Restickulous at GameCity 2014.

As the group put it, *That game is exactly the three cards that we got* and *we would have never come up with that otherwise*. In fact, they even went so far as attributing the game idea directly to the cards:

P5: No, I think Restickulous just came almost fully formed, sprang fully formed from the cards.

P4: Yeah.

P5: With no... ***We were just the midwives****.*

P4: Which I think was an excellent... The cards did their job. They ideated design ideas very well.

The group continues reflecting on the other game ideas they tried to develop. In these instances, they were not as "lucky" with the cards and struggled more.

P4: I think the second one, I don't know that I'd say the cards didn't work as well but ***we ignored the cards a bit more in the second one****. Brought cards in and out and* ***tried messing about with them a lot more****.*

However, the group realized they were not making any progress and decided to abandon the drawn cards instead.

P3: Yeah, so we definitely kind of like went 'ahh'. At one point P17 was like ***'these cards are rubbish'****, threw them away, got new cards and then we were like,*

Another time, the group decided to keep working on an idea which ultimately turned into Grand Push Auto (see section 6.3.3.2). Here, the group was trying to develop an idea with the play-as-you-like method. Initially, they had played the card Mobile Soundtrack which was then expanded upon with Exergaming:

P3: It is funny because we were already talking about having it based around a car, but it had to with music and stuff. Before the Exergame card...

P5: It was Exergame, it had something to do with mobile audio.

P4: Mobile Soundtrack or something.

The next card (Wizard of Oz) that the group played was much harder for them to integrate into their idea:

P3: The Wizard of Oz card caused us a lot of trouble. Basically cost us like half an hour, trying to figure out how to have Wizard of Oz in the game. ***We kept kind of feeling that it was breaking the game.***

In the end, the participants gave up trying to include the concept into their game. While employing the limited method, members of this group would however often

play a card that was intentionally unfitting to the cards already placed on the table. This was done in order to challenge the other participants (and themselves) to come up with a unique game design from a seemingly contradictory combination of cards.

6.3.4.3. Opportunity Cards

After the warm-up activity, participants used the remaining Opportunity Cards to further explore their idea by adding features and adjusting game mechanics. This extends the initial idea generation and allows participants to dive deeper into their designs and creating a more rounded idea. As such, they were still looking for inspiration from the cards.

One of the groups was able to trace back their idea of the immersive coffin experience, Taphobos, to a flash of inspiration gained from an Opportunity Card. They describe how they were mulling about a somewhat vague concept until a picture from the card Unusual Locations triggered the idea.

> *P12: At first we started, we didn't actually have an idea. But we combined these elements, then you came up with one idea and...*
>
> *P13: Added to it, using cards. But you came up with it. Something about coffin.*
>
> *P1: Yeah, the haunted house. There is a* ***picture of a creepy looking house*** *on one of the cards, and that was actually what made me think of like a survival horror. And I think a couple of new cards came up, and* ***they kind of helped to build what I was thinking of with the coffin****. And then once I'd told everybody that idea then we started like kicking more of the cards afterwards and like building on it and stuff.*

The group was positive in their assessment of the cards and thought that they were especially good for starting a discussion as they provided them with inspiration as well with a guiding framework:

> *P13: It definitely seemed to help when we were doing our ideas,* ***so without them I don't know if we would have gotten some good idea or not****.*
>
> *P12: Especially for the start it's good. Because when you sit together and you have no idea what you are doing,* ***it is good to pull in an idea****.*
>
> *P1: Yeah,* ***it gets people talking****.*
>
> *P13: Otherwise you'd be just sitting there, "What do we talk about?"*
>
> *P12: What are we doing?*

The design discussions where guided by the cards. One group member describes how the cards achieved it in more detail:

> *P1: When somebody put down a card they would kind of talk about why they thought that card was interesting, so* ***that kind of gave it like a voice****.*

6.3.4.4. Question Cards

It was left to each group when to transition from the Opportunity Cards to the Question Cards. In some groups this worked well, while others switched too late.

One group reported such issues about their design process. For their final game they combined two ideas they had developed separately from each other during the initial warm-up exercise. This lead to an already extensive and complex idea that even increased in scale when participants added more Opportunity Cards to the design. In the interview, one of the group members reflects on this issue and remarks how the Question Cards somewhat helped alleviate it (although they were not 100% successful).

> *P6: This is when we would have needed the minus cards. To eliminate things and to ask ourselves what exactly we are doing. That's why the Question Cards came in handy that said: 'What is your core mechanic etc?' But actually that was* ***not enough to reduce our bloated idea*** *to something sensible. To a coherent process. We left with some kind of hybrid, based on two ideas, that did not fully work.*

I had previously observed the tendency of participants to not restricting themselves when choosing Opportunity Cards. While this could be attributed to a lack of experience within the group for example during the BWF study, the report from this group seems to suggest that this can also pose a challenge for expert designers. The ability to select from so many different Opportunity Cards that all "could make the game better" leads designers to select more than they perhaps should. Question Cards can mitigate this effect and work towards making the idea more realistic and, as part of that, more streamlined.

Another group became stuck in their design process which until then had been driven solely by using Opportunity Cards. Wanting to try something new, the group used the Question Cards hoping they would provide a fresh angle.

P3: We were looking at them [the Question Cards], trying to see if that could break us, cause ***we got in a deadlock really****. We couldn't figure out how to make it a game. And we were using those to try and help.*

However, it was hard for the group to point to any tangible influence the Question Cards had on their overall design - although they did agree that the resulting discussions were a strong contributing factor for arriving at the final idea.

P3: It helped us work through the things. I don't know... So yeah, it probably did help.

P4: I remember at some point Frank and I were talking about the game mechanic in response to one of the Question Cards. ***Because I think we got to the point where we thought the car game was not working, so we pulled them out****. But I don't know that they necessarily led to any changes. Which is maybe what you did say. But it's hard to say that's not useful in itself, because you sort of do that and you go 'hey, that didn't work', and the conversation flows on.*

The cards however did not just provide a trigger for discussions as such. Instead, the Question Cards were also seen as being very helpful in general to give the idea more focus and help the group to stay on track.

P4: My overall feeling is the cards kind of worked, like Bruno was saying. ***The cards stopped us from going too broad and being just crazy****, and helped us* ***narrow our focus quickly****. In a group where there was no shyness about putting ideas out and saying crazy shit and laughing like morons.* ***Having some structure that pulls you back****, I think,* ***was really useful****.*

Another group likewise stressed the ability of the Question Cards to provide focus to the design process. They explicitly mentioned three cards and the positive effect they had.

P9: We had three ones, didn't we?

P10: Theme and Story, Core Concept and Main Mechanic.

P9: They were handy, ***they helped us focus everything*** *cause before it was quite...*

P7: We did not necessarily answer them, but ***these were the right questions to think about****.*

The Question Cards gave them a focus point for their discussion which helped them to further refine the idea. As such the cards did not push them into a certain

direction but instead became a starting point for discussions around the game idea itself.

However, this group also started to engage with the Question Cards quite late in the process. In retrospect they agreed that introducing them earlier would have been beneficial. When interacting with the Question Cards the group realized that their previous brainstorming had been too off-target and not producing any definite design. The Question Cards however enabled them to concretize the idea and shape it into a coherent game design.

> *P7: I think they should have come in earlier. I think we spend a lot of time fapping around before we kind of got to like 'what the fuck actually is it that we are actually doing?' Because I think we spent a lot of time just swirling around. Whereas these three cards really made us go 'wah, what's it gonna do, what's it gonna be'. You know,* ***way kind of conceptually over here and coming up with something quite concrete. Those cards really got us to the concrete part quickly.***

This notion is also reflected by another participant that describes the role that the Question Cards played in refining the idea.

> *P2: I think once we got an idea for the game the cards that were the Question Cards* ***asked some good questions about amplifying the idea*** *or I think it was the Question Cards, I'm just looking. Yeah. These cards I think. Duration. Why the game is challenging. It was quite good in the group context because* ***we were all kind of talking about the idea and we needed to tighten it up****.*

6.3.4.5. Challenge Cards

Due to issues of time, not all groups were able to utilize the Challenge Cards. One of the groups responded rather positive to the topics that the Challenge Cards brought into the design discussion:

> *P2: And the thing about having them within a group as opposed to someone like for instance somebody you might work with all the time. Where you already have in-built kind of general understanding of how you work together. Working with a group what I found was really good was that* ***these kind of were objective questions about problem solving and around the idea of the game. They worked well. Because they grounded the game into some sort of reality in order to***

get it. *Something done by a particular time-scale. That is how, I think they worked quite well.*

Interviewer: When did you start using them? Did you think you should have used them earlier or from the beginning or?

P2: Personally? I mean, you know, that's just my opinion. I think they were used at the right time. I think ***getting the idea is another process****. And* ***then refining the idea is a separate process*** *to getting the idea.*

The participant recognizes that the different cards should be used in different phases of the idea development process. However, while it worked well in this group, another group struggled more and reported that the Challenge Cards did not support them much in their design process.

P1: The Challenge Cards didn't really help us very much.

P13: Oh yeah. ***Because I think we discussed it quite a bit before we moved on to the Challenge Cards. We kind of had already thought of a lot of them.***

P1: And the idea was already very detailed.

Apart from exploring the Challenge Cards seemingly to late, their usefulness might have also been diminished by the fact that the group members were rather experienced with mixed reality games and thus were aware of the particular design issues that these games can potentially suffer from.

P1: I don't think the Challenge Cards helped that much either. ***I guess just maybe we had enough experience****. Some of the challenges on the cards that we just thought about them.*

P13: But ***maybe for people who are less experienced*** *might.*

P1: Yeah, I can see that would be really really helpful for people.

Elaborating more on the timing issues the participants agreed that the cards would have been more helpful earlier in the design process, before their idea was already well-formulated and thought-out.

Interviewer: What do you think, how to describe the moment where it would make sense to use them or the Challenge Cards?

P12: ***When you are starting to have a direct idea what you want to do, then we have to start with the questions.*** *Directly after this.*

Interviewer: So really early in the process?

P12: Yeah.

P1: But I think doing the plus cards only at the beginning was really good for us.

P13: Yes, because it's a lot of positive.

P12: ***But after we came with the idea, then we needed the cards.***

For these participants, the timing of when to use the Challenge Cards (and also the Question Cards) is rather crucial for them being useful. They strongly advocate to also not introduce them too early:

P1: ***I think if you looked at the negative and the plus together, I think you would ruin part of the creativity that the plus cards are bringing up.*** *Because then all of a sudden you are like taking down your own ideas before they even get started.*

Interviewer: So you think in general the order plus cards, Question Cards, negative cards?

P13: But maybe they should be close together. ***You shouldn't develop the entire idea before you get on to them.***

The participants agreed that the current order of using the different cards does indeed make the most sense, and that it is a matter of finding the right moment to switch to the next type of card. For this they do not envision an easy "catch all" guideline but instead believe that the right moment will be different for each individual group.

Interviewer: Do you have any other ideas how to change or add to the process? Like for example we had this 'The Question Cards should be used at the right moment.' Do you have any idea how to figure that out?

P13: I guess that depends on each group. ***Sometime after you've done the plus cards and you've talked about an idea or multiple ideas.*** *And then, yeah.*

Finalizing their thoughts, the participants reiterated that they believed each card type does indeed fulfil an important role in the overall design process.

P1: Yeah, I think ***coming up with the idea****, the plus cards are really good. And then to figure out which of your multiple ideas that you want to take out the Question Cards are really good. Cause* ***that's when you start like really thinking about a lot of the stuff.*** *And then* ***the Challenge Cards are really good for that like final project****.*

6.3.5. Conclusion

Overall, the cards were rather positively perceived by participants who had substantial experience designing and developing mixed reality games in the past. The inclusion of Theme Cards turned out to be a good idea – however their actual incarnation was not rated overly favourable by the participants. Theme Cards that are a little more open to interpretation should work better. Comparing random draw and limited choice as methods for idea generation, both seem to have their advantages. Some participants preferred to choose from cards in their hand as it gave them greater agency over the idea. Other participants attributed sparks of creativity to the fact that random draw forced them to deal with unusual combinations of cards that did not fit well together. In general, the cards also helped the participants to focus and stay on track. In regards to Question and Challenge Cards, especially one group did not see them as very helpful. This was mainly due to the fact that they were introduced too late in the process, and this experienced group had already discussed most of the concepts that they then found on the cards.

6.4. Know How

6.4.1. Study Overview

This study took part at the Know How event organized by Broadway cinema in Nottingham. Know How is a programme for the cultural sector in the East Midlands, and its goal is to help organizations brainstorm, design, and prototype ideas and concepts by utilizing digital technology. Organizations participating were coming from the arts, culture, and heritage sector, and the overall event lasted three days. I worked with a group from QUAD Derby who wanted to develop a location-based game to accompany their upcoming international photography festival FORMAT. QUAD is a cinema and art gallery and describes itself as a creative hub that connects people and businesses to art and film. Every two years they organize

FORMAT which attracts over 100,000 visitors over the course of a month. The three members of QUAD participating in the Know How event were: a digital participation curator, a digital technical officer, and the co-ordinator of the festival.

The group was supported by a mobile app developer that had previous experience in creating location-based services and was responsible for checking the technical feasibility of their idea and guide the development of a prototype.

I participated directly in this study in the role of a moderator. I did not actively promote ideas, instead I answered technical questions that arose and made sure that the group stayed focused on the task at hand and on time. This allowed me to experience the design negotiations while they unfolded, allowing me to gain more insight into the process.

6.4.2. Rules

As a warm-up exercise and to introduce the participants to the topic of mixed reality games in general and the cards specifically, we started with six rounds of rapid idea generation. We employed the random draw method, and the role of the Theme Cards was this time performed by already existing card decks. For one variant, I used VNA cards, i.e. drawing a verb, a noun, and an adjective in addition to the Opportunity Cards. For the second variant, I had the participants draw a card from the board game Dixit (Roubira, 2008), or more precisely from its expansion Dixit Odyssey (Roubira, 2011). The game consists of a large deck of rather surreal drawings with lots of details. Kwiatkowska et al. (2014) report of using Dixit in a study with designers where they were received quite positively, which made me decide to try them as part of idea generation.

In response to the observations from the previous study I also employed another mechanic: The participants were only allowed a limited time to discuss the cards (3 minutes). The motivation behind this was to on the one hand to prevent seemingly endless discussion but also to assure that the ideas would be focused on the core mechanic(s) and not go into too much depth. After all, the task for this exercise was to develop a variety of game ideas in a short overall time span.

After idea generation, we focused on the reason why we participated in the Know How event. The QUAD participants had brought a list of requirements and initial ideas for the game we were supposed to design. These were previously prepared by

the QUAD group leader to serve as an initial point of discussion. As a group, we then discussed which of these points should become part of the brainstorming activity before beginning with the actual ideation process.

In accordance to the no limitations approach, everybody started out with three Opportunity Cards in their hand and was encouraged to redraw cards whenever deemed necessary. There was no formal turn-order. This allowed card play to proceed unrestricted: Participants could react to a new card by playing one of their own. This was usually accompanied with a statement like "I think this fits well with…" or "We can build on this by…" As a guiding structure we set an alarm clock to 7-minute intervals. After each of these intervals we would evaluate the table and the state of the idea to decide whether we should continue or if the idea was sufficiently developed. Overall it took us six of these intervals (so 42 minutes) before reaching a point where the cards seemed no longer to support the development of the idea. This was caused by the idea being rather elaborate at this point as well as having gone through the whole deck of Opportunity Cards.

After engaging with the Opportunity Cards the Question Cards were introduced to the participants. Again, participants drew 3 of these each, and then redrew additional cards when necessary or desired following the no limitations approach. We used this phase of the session as a reflection on the previously created idea.

The participants also used the Challenge Cards to think about their game from another perspective. Again, cards were handed out and participants could play and redraw cards whenever they thought it to be suitable. This phase lasted roughly 30 minutes and the participants inspected all available cards.

As planned the next morning we went through all the cards that had been selected previously and identify the ones that were still relevant.

6.4.3. Design Outcomes

6.4.3.1. Idea Generation

Over the course of about 30 minutes the participants came up with 6 game ideas (3 with VNA, 3 with Dixit) that are depicted in Figure 29 to Figure 34.

Figure 29. iBeacons are used to track where players are and trigger traps. Game masters build a tower that players have to climb, and they can also manually adjust and trigger traps.

Figure 30. In this multilevel game players need to collect physical power cubes and and arrange them in a 3D shape.

Figure 31. Puppet masters control "bad" AR bubbles. Players need to burst them at the right time, otherwise the AR dragon will steal shoes with them.

Figure 32. The game is an obstacle course and basically a game of Chinese Whispers. Players have to climb in order to reach people in different locations.

Figure 33. Players have to balance plates on the antenna of an analogue TV to get good reception.

Figure 34. The player has to deliver a frog to the princess. The princess sends text messages with instructions and riddles about the next location to find.

6.4.3.2. Idea Development

Unlike in the other studies, Know How gave me the opportunity to closely observe the design process. Therefore, I will not only present the ultimate design outcome, but also describe the process on how it was achieved in more detail.

6.4.3.2.1. Preparation

In preparation for the event, the participants from QUAD had already collected some ideas on what could be interesting elements for the game. These are replicated in Table 17 with additional explanations.

We discussed these ideas looking for recurring themes and design constraints that would guide the design process that was about to start. We identified the following topics as most important / salient for the final design:

- Evidence / detective
- Photo art
- 30 venues
- 30 days
- Data visualization

We decided to leave out the proposed gameplay elements for example as we preferred to start with a clean slate and not too many preconceived ideas. We then transferred the themes onto post-it notes to have an appropriate physical representation that would complement the Mixed Reality Game Cards.

Must have (elements of the game that are most crucial)	
Explore city Visiting venues Evidence art work Between venues	The game should connect the participating venues of the festival and entice players to visit all of them as well as explore the city of Derby in general. It is important that the game does not only happen at the venues but also already on the way to them. The artworks exhibited at the venues should be the main game content.
Interactivity (ideas about the gameplay)	
Fun: active/purposeful engagement Game focused: e.g. detective clue hunting - in line with evidence theme Artwork as material - provide the clues Multiple interactions - different clue triggers Narrative driven Photography - camera access Selfie outfit - customisation unlocks - e.g. Greggs	The app should clearly be a game and take up the theme of the festival (Evidence) and provide fitting gameplay, e.g. turn players into private investigators. The artwork itself could then for example provide clues to the players. The whole game should be narrative driven and evoke and interesting and engaging atmosphere. As it is a photography festival, the camera of the phone should be utilized in some way. An example would be the option to reward players with fun accessories for taking selfies (inspired by an app for the national bakery chain Greggs).
Features (additional elements of the game)	
Tracks progress Detective's notebook Image recognition Evidence Venues	The game server should be aware of all players' progress. Players should have access to something resembling a notebook. Image recognition might be an interesting technical feature to incorporate. Further reiteration that evidence and the venues are core elements.
Beyond App (what happens outside of the game)	
Geo tracking: to be also used in data visualization Competition: draw winner	The data collected about e.g. the movement of the players should be collected so that it can then be visualized (either live or after the end of the festival)
Tools (what might be used to implement or prototype the game)	
POP Pixate PhoneGap	Two ideas for creating quick mockups and prototypes (POP and Pixate) and a potentially interesting cross-platform development tool (PhoneGap).
Deployment (questions regarding production, marketing, and installation)	
App store: cost? Time frames? Brochure link NFC tags with QR	It was unclear how much it would cost to deploy the game in multiple app stores. The overall development time frame was relevant as the game should for example be advertised in the festival flyer and other promotional material. Due to different hardware in phones the game should probably use NFC tags as well as QR codes.
Post Festivals (how the game continues after the event)	
Ideals: share after Updateable and editable: What's our contingency? Transferable framework	The game should be extendable and modular, so that it could be reused for other events without much additional implementation effort. This could eventually lead to offering the game as a framework to third parties.

Table 17. The brief provided by participant of the Know How workshop (next page).

6.4.3.2.2. Opportunity Cards

The participants used the Opportunity Cards together with the aforementioned post-it notes to slowly build and expand their envisioned game design. When looking at the cards that make up the core of the experience, it is interesting to note that these cards all came out during the beginning of the session. These can be roughly traced back to the cards that were played during the first two intervals, namely (in order of play):

- Strong Narrative: The game is mainly based on a story that needs to be uncovered.
- Useful Props: Simple objects support the players or add to the atmosphere.
- Stationary Sensors: Players carry smart tags and "check-in" at stations.
- Telephony: Players receive phone calls or text messages (manual or automated).
- Roleplaying: Players take on new personalities and act accordingly.
- Actors: Non-player characters engage directly with players.
- Performative Play: An audience is invited to watch and perhaps participate.
- Different Roles: Players have different abilities and tasks to perform.
- Collaboration: Players are working together in teams and support each other.

Another card turned out to be hugely important for the game design, but was only played at the beginning of interval 3:

- Riddles: Players have to solve puzzles, riddles, and other mysteries

Figure 35 shows a picture from the session with various Opportunity Cards selected for inclusion in the game.

During this initial evolution of the game, the following two aspects clearly became the focus of the game:

- They wanted a strong thematic and atmospheric game (Strong Narrative, Telephony, Roleplaying, Actors).
- They also wanted to go beyond a traditional screen-based mobile phone game (Useful Props, Stationary Sensors, Telephony, Actors).

Figure 35. Post-it notes with design constraints and themes with a first set of Opportunity Cards.

Interestingly enough, there is a strong overlap between these two goals as evidenced by the associated cards. Together, they formed the focus of design with cards like Performative Play, Different Roles, Collaboration, and Riddles going more into detail about the flow of the game (i.e. that teams compete against each other and having to solve puzzles at the different locations). This is a theme that is also evidenced by the additional cards that were played throughout the following intervals: Time Pressure, Public Display, Headquarter, Online Participation, Worldwide, Episodic Content, Automated Tracking, Peer-to-Peer, Exploration, Timed Events, and Mini Games. Like before, these cards were used to further flesh out the idea without actually changing the original idea in a sweeping way.

The participants were very satisfied with the progress that we made. They came in with a rough idea of game elements and a general theme for the idea and over the course of 42 minutes they turned it into a rather elaborate idea. One participant commented: *This writes part of your elevator pitch.*

6.4.3.2.3. Question Cards

Table 18 shows the chosen Question Cards and lists the answers the group came up with (which were written on post-it notes).

Question Card	**Answer**
Fun and Joy? Why is the game fun to play? What is engaging about it?	Narrative
Theme and Story? What is the overall content of the game? How is that conveyed?	Investigators
Challenging? What makes the game challenging? How difficult is it?	More cards than needed More difficult levels
Locations? What role are the locations playing? How important are they?	Riddles match locations
Nothing Digital? How could the game be played without tech? Why is tech needed?	Paper version (like a bingo card)
Target Group? What are the typical players like? How is the game made for them?	Smartphone users Families! Kids!
Experience Flow? How do players journey through the game?	No set path Different days Drop-in / drop-out Facilitated tour

Table 18. Chosen Question Cards with answers from post-its.

6.4.3.2.4. Challenge Cards

They deemed the following Challenge Cards most important for their game design idea and discussed them in more depth:

- Uncontrollable Places. Is it likely that any locations will "change" before/during the game?
- Phone Zombies. Will players be starting at their screens most of the time?
- Gimmicky Tech. Is technology used in a meaningful way or just for the sake of it?
- Confusing Interfaces. Is the interface easy to understand and use for new users?
- Unclear Instructions. How easy is it for the players to understand what they have to do?
- Feature Creep. Does the game try to include too many different elements?

- Limited Resources. What happens when too many people play at the same time?
- Battery Life. What elements of the game are draining the battery?
- Relocation. How difficult is it to move the game to a different location?
- Great Marketing. [This was a card created by the participants in which they acknowledged that marketing the game in the right way would be an important factor for its success.]

6.4.3.2.5. Finalizing

After finalizing the idea, the cards were then rearranged into the following groups as also shown in Figure 36:

- **Core**. These cards encompass the basic idea of the game. [Fitting Locations, Strong Narrative, Experience Flow?, Limited Resources]
- **Examples**. These cards further flesh out the core game idea and provide ideas how the different tasks at the different locations might be implemented. [Mini Games, Riddles, Telephony, Useful Props, Actors]
- **Reminders**. Consisting solely of Challenge Cards, the participants agreed that these were important design considerations that were crucial for the success but also for the desired style of game. [Feature Creep, Phone Zombies, Gimmicky Tech, Confusing Interface, Unclear Instructions]
- **Engagement**. A variety of ideas that were aimed at increasing the engagement with the game and reaching a wider audience. [Headquarter, Public Display, Team Play, Taking Photos, Social Media Engagement?]
- **Potential Elements**. Design ideas that seemed interesting but not necessarily crucial to include. [Timed Events, Time Pressure]
- **Future**. Participants thought that these ideas, while interesting, were too difficult to implement at this point and should therefore be kept in mind for future iterations. [Online Participation, Worldwide, Public Voting, Nothing Digital?]
- **Authoring for other Events**. These cards describe the core considerations when transporting the game to a different city and festival. [Theme and Story?, Fun and Joy?, Target Group?, Relocation]

Figure 36. Final game idea from the Know How study.

6.4.3.2.6. DETECT

The game was ultimately developed and staged during FORMAT15 under the name DETECT. It was browser-based so did not require players to download an app. The QUAD team created a total of 21 missions spread across seven venues partaking in the festival. The design of the game retained many of the salient features that were identified during the ideation session as part of Know How, with perhaps the two most important ones being a focus on tangible experiences and to tightly integrate any riddles with the environment. For example, in one mission players get the clue "We're currently tracing a phone call on the 2nd floor and need you to listen in. Find the silver phone." They then have to locate the phone in question and pick up the receiver in order to find out the necessary information (Figure 37). Figure 38 and Figure 39 show some additional impressions from the game that took place in March 2015.

Figure 37. A DETECT player listening in to a phone conversation (© QUAD).

Figure 38. Two players of DETECT looking for clues inside a book (© QUAD).

Figure 39. Two players have found the missing photo and successfully completed DETECT (© QUAD).

6.4.4. Observations

In the interview transcriptions, K1, K2, and K3 will be the members of QUAD while K4 will be the mobile developer.

6.4.4.1. Idea Generation

Overall the idea generation activity was well received by the participants as it allowed them to "warm-up" and get introduced to the cards in general.

> *K1: "I think this was a great exercise to introduce the ideas we would be working with. This also offered an opportunity for group members who were unfamiliar with game mechanics to be able to share ideas and feel part of the discussion. [..] The time spent in this area was perfect as it focused our thinking to what we needed to work on."*

In regards to the Theme Cards, the participants expressed a clear preference for the Dixit cards. The VNA cards were seen as too specific and as such not a source for additional inspiration. While they certainly work well on their own to develop ideas for games, they did not seem useful as a supportive element. The vague but detail-rich Dixit cards on the other hand were able to inspire creativity.

> *K4: "I thought the VNA cards were clever, but I didn't find them that useful. I found the Dixit cards incredible useful, because* ***they got my creative juices flowing*** *and*

made me open up a little bit and settle into the ideas. When people were talking there wasn't a lot of focus on the VNA."

K2: "I think as inspiration points, ***specifics don't work as well*** *as vague, kind of, you know,* ***just think about the universe****, sort of things."*

One of the participants further defines the difference between the card types as providing context (VNA) versus creativity (Dixit).

K4: I think overall these have been fabulous. And I really do think this is something that is useful more at hackathons in IT. I can totally see this being a useful tool. And instead of having the VNA cards, most hacks would provide that for you. Provide some context. But ***the actual Dixit card would help provide some creativity to the context****.*

Here, the Dixit card enables the addition of a theme to an idea, or forming an idea derived from a theme. The Dixit card works from a different angle and adds another dimension to the idea generation process.

K1: "It also allowed us to be unrestricted in our ideas and ***the Dixit card allowed us to think outside of the box****, especially in relation to theme and its effect on the mechanics."*

6.4.4.2. Idea Development

In general, the participants thought using the cards was a success. They appreciated that each card type helped their design by providing a slightly different angle.

K1: The cards really helped us hone in what this game is about. What are the mechanics of the game? What things that we should really be mindful of, and things for the future. So what things would be nice to look at and explore away from these three days.

The participants agreed that the order in which the cards were used makes a lot of sense.

K3: The order for the first cards is really good because that's the first thing. To figure out, to find out what we have, basically, what the thing is. And then we had the questions. And then at the end we had the negatives. It is a good order.

Another participant agrees with this assessment and goes into more detail of why this order works well:

K2: Yeah. I think it works for the workflow of ***stripping things down as well****. Because starting with the positives, obviously if you, as you should probably go into this thing with* ***blue sky thinking****, you could end up with loads of positives. You probably try and put everything in. Because they all seems like 'Oh yeah, that could be a great aspect, that could be a great aspect'. So then going into the questions then... I meant he questions kind of prompt the problems before you even get to the problems. You know, a lot of the time, looking at the questions,* ***will help you weed out a lot*** *of this, as a first round, and then its specific problems that will explicitly take out other items, you know. And then at the end of it* ***you stripped away so much that you have focus****. At least a vague direction. And then what the group likes, what the group doesn't like. I think the order is right.*

The same participant then describes the difference between the cards and how they affected the design discussions between themselves:

K2: When we first started out it felt like ***we had a very sprawling idea****, kind of, and lots of conversations about the specifics of what these things might involve. Then* ***later on it became a much broader conversation*** *about like 'this could be a problem for that, that, but overall it's not gonna be an issue'. You know I think we had much* ***less specific conversations doing the questions and the negatives*** *than we did with the positives.*

The participant goes on and illustrates the argument with an example:

K2: Which I think is good because ***the positives are inspiring ideas****, they are things like you said, that* ***we didn't really think about before****. You know, like coming up with the TELEPHONY thing. Literally seeing the word TELEPHONY and thinking how would that relate to this project, immediately made me think of the voice mail thing. And* ***that's not an idea I had previously and I wouldn't have arrived at it without having an inspiration card****.*

As was the design goal for the cards, the Opportunity Cards worked as a trigger for inspiration whereas Questions and Challenges grounded the idea and allowed it to become more concrete. This impression is also supported by looking at how the different phases played out. While the Opportunity Cards created the basis for the game idea, the Question Cards and Challenge Cards allowed the participants to focus on the different elements and helped them define which ones are crucial for the idea, and which others had just been added to the idea without actually

enriching the game experience. This is evidenced by the "culled" final selection of cards where the core game idea consists of just 2 Opportunity Cards but also 1 Question Card and 1 Challenge Card with 5 additional Opportunity Cards further fleshing out the idea.

6.4.5. Conclusion

Observing the work closely as part of this study delivered some very valuable insights. During the idea generation phase new Theme Cards were trialled. I repurposed VNA Cards which did not work too well, and had much better success with cards from the board game Dixit. The fact that the latter are rather surreal and include colourful illustrations helped the participants create rich and thematic ideas. During idea development, I employed a timer so that we regularly took a step back from the direct task at hand and instead evaluated the state of the idea. This was immensely helpful in deciding when to switch to the next phases and introduce the other cards. The participants appreciated the difference between the *positive cards* that enabled *blue sky thinking* and the *negatives* that helped *ground the idea in reality*. Participants also noted how the ability to spatially arrange the cards into meaningful clusters improved their understanding of the idea and was always used between card sessions to streamline and reorganise the idea.

6.5. Sustrans

6.5.1. Study Overview

In this final study of Phase 2 I wanted to further investigate the suitability of both Dixit cards as well as a time limit during the creation of initial game ideas. This time the participants came from Sustrans, a UK based charity that wants to reduce car journeys and instead promotes walking, cycling and public transport as alternative means. While these participants had absolutely no previous knowledge about mixed reality games, they were supported by an artist who had created several location-based experiences before.

6.5.2. Rules

The task for the participants was to come up with a variety of game ideas. For this they would draw three random Opportunity Cards and one Dixit card (so in accordance with the random draw approach). They then had 5 minutes to come up with an idea that included all cards, and some additional time to write down their idea on small pieces of cards (to naturally limit the detail they could go into about their idea).

6.5.3. Design Outcomes

The participants created a total of six game ideas that are depicted in Figure 40 to Figure 45

Figure 40. A game at Bletchley Park where teams are competing to crack codes the fastest and advance through the compound. Actors are there to confuse players, so nobody knows who is an actor, another player or just a normal visitor. Recreating the chaos from Blechley Park.

Figure 41. A scavenger hunt game where players have to find miniature phone boxes hidden in the environment.

Figure 42. 3D models of famous staircases can be collected by players in VR.

Figure 43. Visitors of a festival need to keep pedalling on exercise bikes to produce enough electricity to keep the music and lights going.

Figure 44. Players explore the city based on locations from a book. When they arrive at a location they need to find the beauty in it and describe it (and the current conditions) in a positive way.

Figure 45. Players cycle along paths uncovering a narrative that asks them to find a new safe hiding place for the queen.

6.5.4. Observations

Overall, participants expressed their satisfaction with the results during the post-session interview. S1, S2 and S3 are the members of the charity while S4 is the artist.

> *S4: I have to say I thought that was really productive. I didn't think it was gonna anywhere near as productively as that.* ***There were at least a couple of things in there that I will ponder further without a doubt.*** *I thought we might easily, my worry was we were gonna run out of steam, and I don't think we did at all.*
>
> *S1: I think the combination of cards were excellent.* ***The cards were just so off the wall. You didn't know what was gonna come.*** *So rather than all sitting around going "Ooooh, don't know where to start", at least they got us talking.*
>
> *S2: Yeah, I can see that the components of the cards could make quite, quite a… They seem to create the right elements.*

When talking about how the cards inspired the ideas they developed the participants mentioned the role of the Dixit card (without being asked about it explicitly).

S3: I liked the fact that the three coloured cards with the words on them set some rules around the game. And then ***the picture card then kind of takes it off****.*

S2: It's like ***a wild card*** *isn't it.*

S3: So you read the words on the cards, for me I think ***the picture card adds some images****, some imagery, that then* ***takes the idea off in a way*** *that couldn't be achieved if you just had four of the coloured cards and no strange picture card.*

Perhaps unsurprisingly, the exercise was more stressful and difficult for the participants from the charity than for the artist (P4). The latter had previously created similar experiences and was therefore accustomed to the design space as well as creative thinking. This can be seen in the following discussion during the post-interview:

S2: But frankly ***I found the whole thing really hard****. Simply because I don't think like that. I'm not at all... It made me realize how ingrained I am in my thinking. You know.* ***It was quite difficult to think differently.***

Interviewer: Did you manage to think differently?

S2: I'm not entirely sure that I did.

Interviewer: Because I had the feeling that you were also equally participating. I didn't notice anybody who didn't.

S2: Yeah, but ***I found it hard. Really hard.*** *I think you found it easy! [directed at artist S4]*

S4: Yes, but not necessarily for a good reason. I think I found it easy because I had some reference points to draw on because I participated in or constructed a lot of these things. So I was able to copy to some extent what I already had in my head. Whereas what I was amazed about were the things that the three of you were coming up with. ***Which seemed much more original than the reference points I had in my head*** *quite a lot of the time. So that worked, I thought.*

S2: I found it hard though, quite hard.

Here, the lack of previous knowledge allowed the participants from the charity to look at these games from a fresh angle - something the artist confessed he was missing.

During the session the group also negotiated between themselves if they should ignore one of the cards as they had problems incorporating it into their idea. In the end they decided against discarding any of the cards - something they identified as an important rule when reflecting about it during the interview.

S4: I wonder if it is productive to allow people to just put things aside. Because there is potential to take that as a shortcut, whereas actually trying to incorporate all of the cards in the way you just described actually does do that. But you have to stick at it. Rather than saying: 'Here's three that fit and this one that doesn't'. ***Actually the creative bit is making the one that doesn't fit, fit with the three that do.*** *And that's where the hard work comes in generally. Otherwise there's the danger that what the game becomes is just making connections between three of the four. And jettison the missing one. And that becomes the task then.* ***Whereas actually the task should be to allow yourself to say anything. To force you almost to say something different.***

Interviewer: Yeah, I noticed, I think during the second time, you wanted to skip the Dixit card. But then someone said "Nonono, last time we even used the frog." Which was even a more obscure card.

S3: I must admit, I found myself then in another role where I felt that the card with the stairs was gonna be discarded. ***I was kind of quite keen to make sure that they didn't.***

S4: And that worked actually for the stairs one, didn't it?

6.5.5. Conclusion

Three participants had no previous knowledge of mixed reality or game design. Unlike the participants at the Brisbane Writers Festival they were also not working in a creative industry. Despite this handicap, they did a really good job during idea generation. They were able to quickly grasp the concepts of the cards, and the other participants (an experienced artist) was impressed that they were able to come up with rather interesting ideas. They did perceive the whole process as "*really hard*" though. The Dixit cards were used again as Theme Cards, and the participants noted how well they did their job – even if it was difficult at times to include them.

6.6. Chapter Summary

The second series of studies investigated several design concepts of the Mixed Reality Game Cards in more detail, with an emphasis of improving the idea generation process.

The **reduced amount of content** turned out to be sufficient. Even participants without any or much previous knowledge of the design space seemed to grasp the concept and were able to contribute to the ideation sessions. Unlike previously, I did not notice a session slowing down because participants had to read the contents of a card that had just been played. The minimal text created more fluid design negotiations as participants did only very rarely pick-up a card again that had been played to reread the content.

The **Theme Cards** were a great source for additional inspiration, especially when the Dixit Cards were employed for this purpose. Dixit cards seemed to work extremely well in the two studies they were utilized. They are colorful and diverse, and provided the participants with several hooks that inspired ideas. Participants could include the overall concept of the card, or just draw inspiration from one of the many smaller details. The textual Theme Cards used during Performance and Games received mixed feedback with participants criticizing several of them for being too concrete. Instead of providing an inspirational theme, these cards might be seen more as providing a specific topic. VNA cards are stronger if used by themselves – and having to interpret and consolidate six cards is certainly too challenging for most users. In addition, the VNA cards also do no actually provide a theme, but instead are more directly influencing the gameplay.

The **random draw** of Opportunity Cards also increased the (subjective) creativity and uniqueness of the proposed ideas. However, several participants commented on the difficulty of this approach and preferred having more freedom by being able to pick and choose. This also increased their perceived agency over the idea. Where otherwise they would blame the bad card draw, having to play a card engaged them in a different way with the idea.

Where Performance and Games suffered from groups that were spending a lot of time on the different ideas without actually getting anywhere, the **time limit**

introduced in the other two studies for idea generation helped participants stay focused and on track.

Especially during the Know How study I was able to observe the **different impact of Opportunity, Question, and Challenge Cards** during idea development. Opportunity Cards build up an idea (which can sometimes lead to a lack of focus), Question Cards force users to reflect on their idea and as a result the cards help defining and streamlining an idea. Lastly, the Challenge Cards serve as a "sanity check" and users found them helpful to spot potential flaws in their design. In addition, we also conducted a **status check** every seven minutes to evaluate the current idea and decide how to continue. This included switching to the next type of card, but also removing cards that no longer represented the idea, and arranging the remaining ones in a meaningful way. Overall, this gave the idea more structure and helped streamline and focus it.

7. Phase 3: Final Validation

7.1. Overview

The final phase of developing the cards revolved around validating the observations from the previous phases by taking a final, in-depth look at both idea generation as well as idea development. As the so far most promising approach for idea generation I wanted to more directly look at the role of random draw. Why does this method generate (subjectively) more unique and creative ideas? Likewise, I had introduced cards from the board game Dixit as Theme Cards, and I wanted to explore the role of these cards in the design process. Lastly, my goal was to gain additional insights into the different roles that Opportunity, Question, and Challenge Cards fulfil during the idea development process with a large number of users.

For this final phase I conducted one study that is summarized in Table 19.

For **Lincoln2** I again recruited students from the BSc in Games Computing degree at the University of Lincoln. On the first day of the study the students performed idea generation, and on the second day a week later continued with idea development.

Phase 3: Final Validation	
Study	Lincoln 2
Participants	85 Games Computing students (day 1) 47 Games Computing students (day 2)
Set-up	21 groups (simultaneously, day 1) 14 groups (simultaneously, day 2)
Idea generation	60 minutes
Technique	Random draw Limited choice
Theme Cards	Dixit and no Theme Cards
Outcome	4 game ideas / group
Idea development	30 minutes (Opportunities) 30 minutes (Questions) 30 minutes (Challenges)
Brief	Design a game for Sustrans (charity) or Museum of Lincolnshire Life
Data	Photos, notes, questionnaires (mid and post session)

Table 19. The final study conducted as part of Phase 3.

7.2. Card Version 3

The difference between the cards from version 2 and 3 are mostly of cosmetic nature. The graphic design was further improved, new cards were generated, and the phrasings of several cards were made less ambiguous and easier to understand.

Version 3 consists of 93 cards: 51 Opportunity Cards, 18 Question Cards, and 24 Challenge Cards. As with the previous versions, blank cards complement the set. An overview of the cards can be found in Table 20 with sample cards depicted in Figure 46. The complete deck is reproduced in section 10.5.

The cards were professionally printed on high-quality matte card stock paper with rounded edges. Dimensions were changed to match the size of typical Poker cards: 8.9cm x 6.4cm.

The different card types are again recognizable by the text color (black on white, black on grey, and white on black for Opportunities, Questions, and Challenges) and a symbol in the upper left corner (+, ?, -). Categories are audio, gameplay, locations, management, physical, players, sensors, technology, and time).

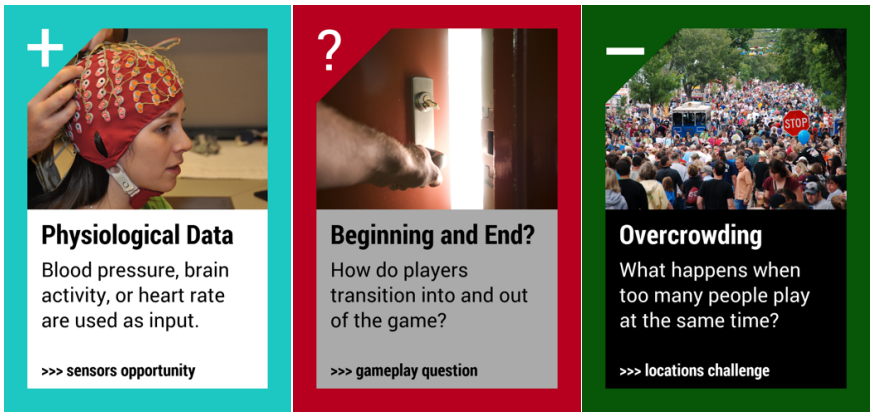


Figure 46. Sample cards from version 3. Physiological Data (Opportunity), Beginning and End? (Question), Overcrowding (Challenge).

Category	Cards
gameplay (red)	Opportunities: Area Control, Collecting, Creativity, Exergaming, Exploration, Mini Games, Performative Play, Riddles, Scavenger Hunt, Strong Narrative Questions: Beginning and End?, Challenging?, Core Concepts?, Experience Flow?, Fun and Joy?, Main Mechanic?, Theme and Story? Challenges: Feature Creep, Unintended Race
players (purple)	Opportunities: Alternate Reality, Collaboration, Costumes ,Different Roles, Online Participation, Roleplaying, Social Contract, Worldwide Question: Number of Players?, Target Group? Challenges: Critical Mass, Real World Rules, Unclear Instructions
locations (green)	Opportunities: Fitting Locations, Generated Locations, Headquarter, Subverted Locations, Unusual Locations Questions: Indoor or Outdoor?, Locations?, Size of Area? Challenges: Accidents, Bland Locations, Disruption, Dynamic Places, Getting Lost, Long Distances, Overcrowding, Relocation
physical (orange)	Opportunities: Actors, Low Tech, Set Construction, Technical Artifacts, Useful Props, Vehicles, Weather Input Questions: Nothing Physical? Challenges: Rain and Snow ,Sunshine
technology (blue)	Opportunities: Augmented Reality, Global Gamestate, Peer-to-Peer, Public Display, Seamful Design, Telephony, Terminals Questions: Game Server?, Nothing Digital? Challenges: Battery Life, Confusing Interface, Gimmicky Tech, Phone Zombies, Unengaging AR, Unstable Connectivity
sensors (turquoise)	Opportunities: Manual Interaction, Motion Tracking, Passive Tracking, Physiological Data, Public Infrastructure, Stationary Sensors, Wizard of Oz Questions: Suitable Sensors? Challenges: Inaccurate Sensors
audio (yellow)	Opportunities: Compelling Audio, Mobile Soundtrack Questions: N/A Challenges: Noise
time (pink)	Opportunities: Episodic Content, Time Pressure, Timed Events Questions: Duration? Challenges: N/A
management (brown)	Opportunities: Open Authoring, Puppet Masters Questions: Observing Players? Challenges: Testing

Table 20. Overview of all cards from version 3.

7.3. Lincoln2

7.3.1. Study Overview

The study took place at the University of Lincoln where I was invited as a guest lecturer as part of their game design module. I had the opportunity to interact with two groups of students from their BSc in Games Computing degree: 1st year and 2nd year students. With each group, I spent two sessions that were one week apart and lasted three hours each.

On the first day, I gave an introductory presentation of approximately 1h about mixed reality games and a brief introduction into the Mixed Reality Game Cards. Afterwards participants were assigned into groups of around 4 students each for the remainder of the session and undertook several rounds of idea generation. After each round, students were asked to fill in questionnaires about the game design idea they had just developed, and at the end of the session one additional questionnaire about their general experience.

In the second week, students were tasked with fully developing an idea with all cards from the deck. Students were once again divided into groups of three to five participants. The groups were given a deck of cards, instructions on how to interact with them, and one of two scenarios. In the first scenario, the students were told to develop a game that could be played at the Museum of Lincolnshire Life, a local history museum. The other half of the groups had to design a game that the charity Sustrans could use to promote the use of public transportation, cycling, or walking.

7.3.2. Rules

In the first week, the participants followed the random draw approach for idea generation by using Opportunity Cards. Every other round they were also told to additionally draw a Dixit card. After revealing the cards, students had a time limit of five minutes to come up with a game design.

In the second week students utilized the whole deck for their idea development task. Starting out with the Opportunity Cards, followed by the Question Cards, and ultimately using the Challenge Cards. This was done in accordance with the no limitations approach: Students were allowed to draw and play as many cards as they liked throughout the session.

7.3.3. Design Outcomes

7.3.3.1. Idea Generation

Students created a total of 85 game ideas during the idea generation phase. Figure 47 to Figure 53 document some examples.

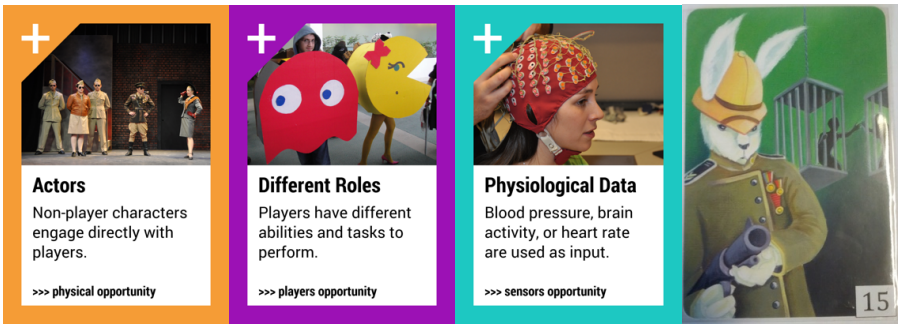


Figure 47. Rat & mouse format, player tries to run away from the guards for a certain time limit. Heart rate is monitored by guards to locate players. Another player can break a player out of confinement with the correct physiological data.

Figure 48. You're a police officer hunting down Jack the Ripper (who's another player). Time Pressure comes in for capturing him, Roleplaying for the characters, and Weather affects crime scenes and destroys evidence.

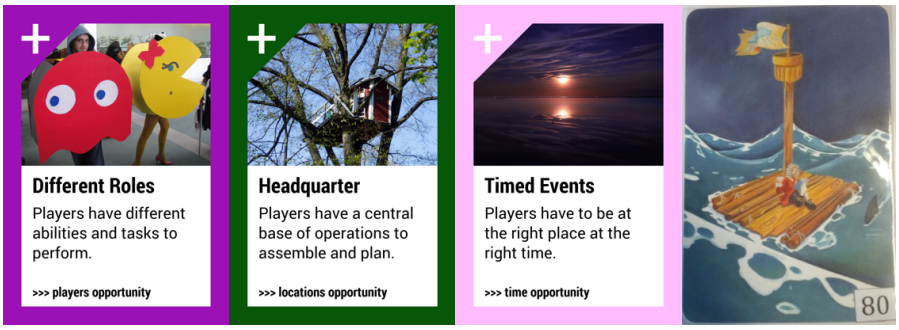


Figure 49. Must be player on a cruise / long ship journey. All players have roles with timed events which players must attend. However, one player is a murderer who must kill all other players over the course of the journey.

Figure 50. Based in Art museums, get a text from the automatic system which gives you a riddle to decode and the decoded riddle leads you to a piece of art which you then have to take a photo with and send it back to the system for the next riddle.

Figure 51. Troll abducting & eating children. Find cure, and sneak inside while troll is gone. Use AR (phone) to find tracks and clues. Try and work out where troll has buried his gold.

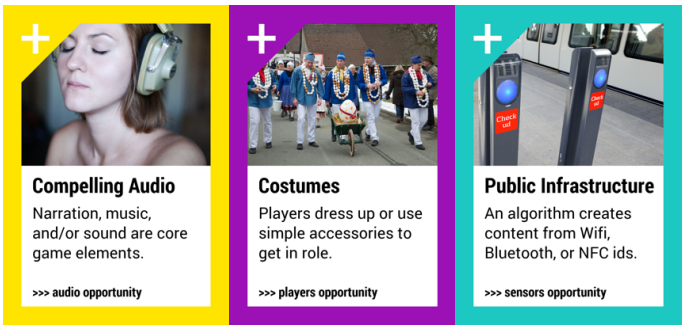


Figure 52. Players dress up in historical costumes and have to tag spots around the city. Each tag has period music and the player needs to find the music that relates to their costume. Could be expanded to not be historically themed (e.g. dress as rock star to find rock music tag).

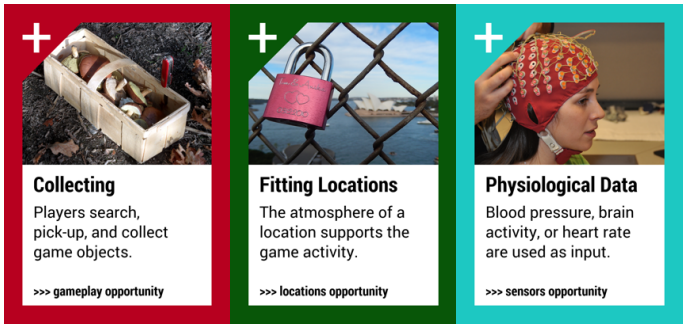


Figure 53. Take player's heart rate as input. The calmer they are, the more accurate the directions to a point. Scary location?

7.3.3.2. Idea Development

A total of 14 games were developed during the two sessions. Example posters are depicted in Figure 54 to Figure 57.

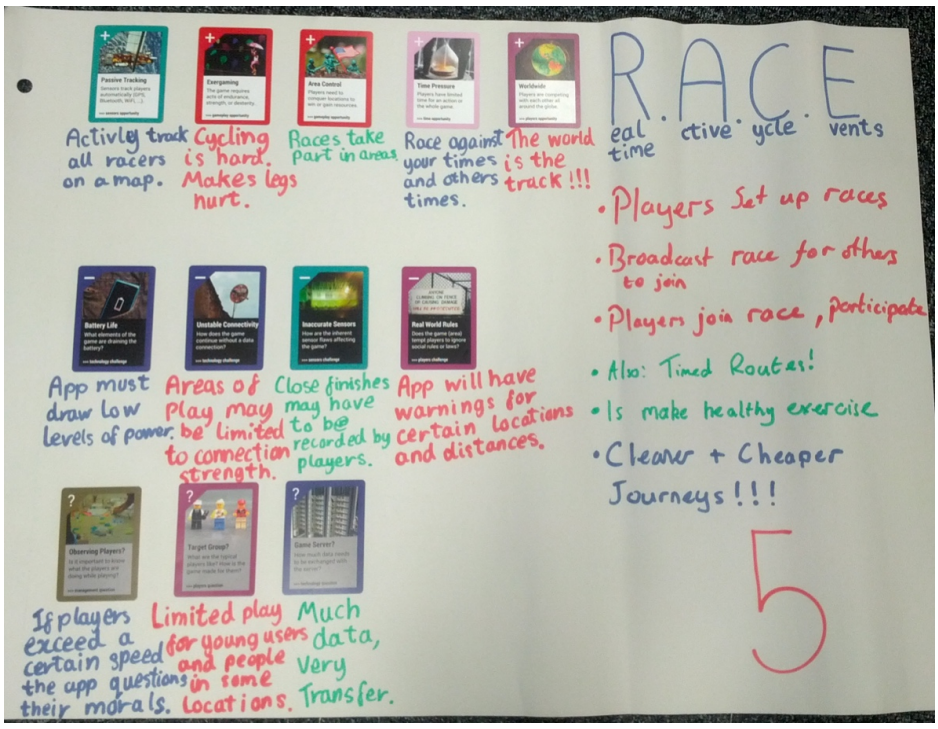


Figure 54. R.A.C.E. – Players can set-up their own bike races that players from all over the world can join.

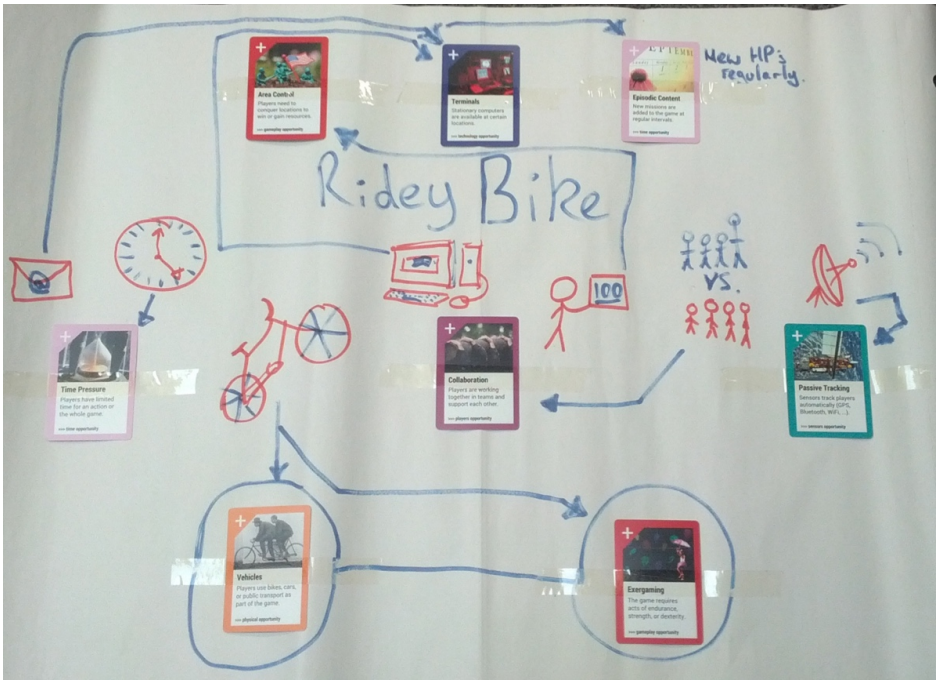


Figure 55. Ridey Bike – A team game where players have to ride their bicycles to specific areas to take control over them.

Figure 56. Foodchain – Players compete in teams and must consume different types of food that spawns at certain locations to level up and advance in the food chain.

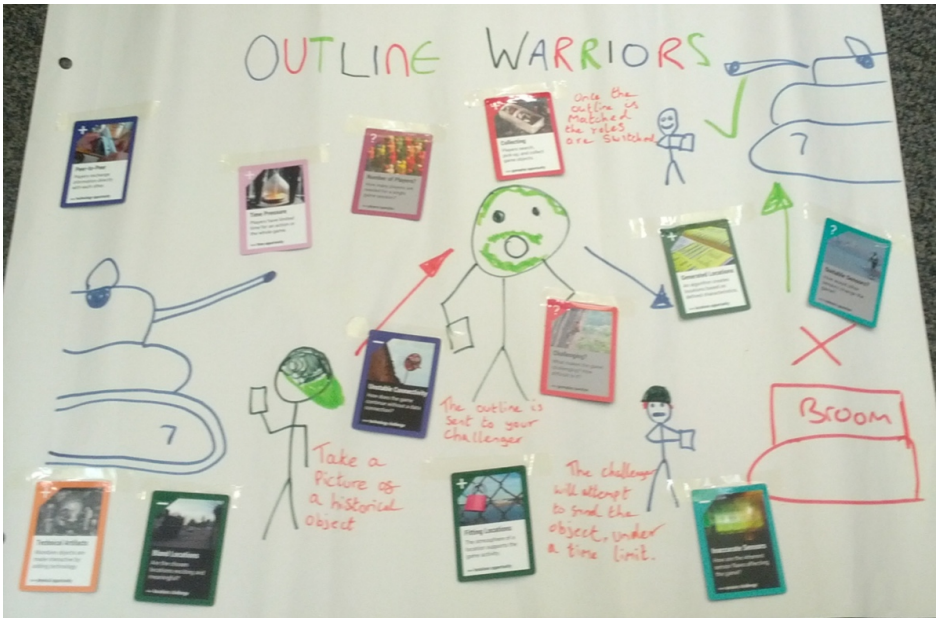


Figure 57. Outline Warriors – Played in the Museum of Lincolnshire Life, a player takes a picture of an object which gets sent as an outline to another player who has to find the object within the museum before time runs out.

7.3.4. Observations

7.3.4.1. Dixit Cards

7.3.4.1.1. General Perception

The Dixit cards were introduced into the activity to provide additional inspiration to the participants and provide a richer texture to the considered games. Reception of the cards was mixed between participants. While some liked these very surreal ideation prompts, others found that they obstructed their design process.

The participants of second cohort were asked whether they preferred using the Dixit cards or not. It was an open question, but when classifying the 44 answers as "preference for Dixit, "no clear opinion" and "preference against Dixit" the majority clearly preferred the Dixit cards (28 out of 44; 64%) and only 9 out of 44 (20%) speaking out against using them (with 7 not having a clear preference; 16%). This sentiment was further strengthened in the second part of the study. Each group could decide whether to use Dixit cards or no - all of them chose to do so.

Dixit cards were named as being inspirational, helping to spark ideas, and providing depth and theme to a game. Negative remarks were concerned with their vagueness, and them limiting ideas as they had to be included.

7.3.4.1.2. Sparking Ideas

With potentially four cards at their disposal, I wanted to find out how the participants went about creating an idea. What cards would be responsible for the initial spark?

Several participants attributed this initial spark to the Dixit card:

> *The **Dixit card immediately had us all thinking about finding chests** and we then slowly worked in the other cards. We came up with loads of different ideas but eventually settled on something simple.*

> *The **picture in Dixit card helped to decide on the game format** - "Cat and Mouse". Different Roles and Actors went hand in hand to provide roles to the participants of the game. Physiological Data gave an extra interaction to the game by using heartbeat location and other data to progress along with the game.*

Other times the participants would start with the Opportunity Cards and only later include the Dixit card into their design.

> *Sometimes the **Opportunity Cards would kickstart the idea**.*

> *Vehicles + Exergaming led to using bike. Idea to bike between terminals. Needed a ruleset + link to Dixit Card*

> *Started out trying to figure out how to include Dixit. Paired Mobile Soundtrack and Fitting Locations together, then worked out how to combine the Collecting. **Finally tried to out the Dixit Card in**, which was the most difficult.*

Dixit cards and Opportunity Cards could also work hand in hand.

> *We started off with **an idea of teamwork between Different Roles and the final objective the Dixit card**. Then we talked about Set Construction and Strong Narratives and how they could improve the gameplay mechanics.*

> ***The Dixit card influenced the group to decide upon the Unusual Locations and the Collecting ideas.** Opting for a forest manor location whilst scanning / collecting the diamonds shown on the card. To incorporate the Telephony card, a mechanic was introduced to receive calls about the locations on the item. One issue was about the method of Collecting, being unable to decide whether to scan the item or to use GPS to correlate coordinates and confirm success.*

In general, groups reported that one or two cards typically would be the triggers for an initial idea. This is supported by feedback from the first cohort. After each round, all participants were asked to note down which cards were used when in the design process, e.g. which cards they discussed during which minute. As an example, one participant might have stated that they focused on the Dixit card in the first minute, then mainly looked at the Dixit card and 2 Opportunity Cards in minute 2, etc. The full data can be seen in Table 21.

	minutes				
Cards	**1st**	**2nd**	**3rd**	**4th**	**5th**
Dixit, 0 Opportunity Cards	36	6	4	10	16
Dixit, 1 Opportunity Cards	33	22	19	3	17
Dixit, 2 Opportunity Cards	9	12	19	16	9
Dixit, 3 Opportunity Cards	7	8	11	16	41
No Dixit, 1 Opportunity Cards	20	34	37	32	27
No Dixit, 2 Opportunity Cards	22	41	32	24	9
No Dixit, 3 Opportunity Cards	7	14	15	15	12
No cards	5	2	2	3	8

Table 21. When were which types of cards the focus of the design process?

While the data is not sufficient for a detailed impression, it does provide a rather clear tendency. In the first minute, the Dixit card was the dominant focus of the design process (with 36 instances of it being the sole card of attention, and 33 instances of a Dixit card together with an Opportunity Card). Likewise, after the initial importance, the focus on the Dixit card decreases only to spike again during the final minute of the design process. This appears even clearer in Table 22 where Dixit cards with any number of Opportunity Cards are compared to no Dixit cards: The usage of Dixit cards is highest in the first minute and during the last one.

	minutes				
Cards	**1st**	**2nd**	**3rd**	**4th**	**5th**
Dixit, any number of Opportunity Cards	85	48	53	45	83
No Dixit, any number of Opportunity Cards	49	89	84	71	48
No cards	5	2	2	3	8

Table 22. Cards separated by type over the course of the design process.

	minutes				
Cards	**1st**	**2nd**	**3rd**	**4th**	**5th**
One card	56	40	41	42	43
Two cards	55	63	51	27	26
Three cards	16	26	34	31	21
Four cards	7	8	11	16	41
No cards	5	2	2	3	8

Table 23. Absolute number of cards in focus during the design process.

Table 23 summarizes the absolute number of cards used per minute. It supports the idea that a group would typically come up with an initial idea based on just one or two of the cards (one of them very likely being the Dixit card). The number of cards used simultaneously would then slightly go up during the middle of the design process. In the final minute a group would then either focus on a single card, or on all four of the cards. This is not necessarily very surprising as one could argue that the last minute is thus either spend on the most difficult card, the most dominant card, or on all cards together to create the final and complete game idea.

As part of their personal questionnaires, the participants also reflected on how a Dixit card would spark the idea. The majority of groups would get their main idea from a Dixit card (often supported by one Opportunity Card):

> *It [Dixit card] immediately brings certain scenarios to mind, and* ***kicks off brainstorming****.*
>
> *I preferred them [the Dixit cards] because even if they slowed the process they* ***helped start us off****.*
>
> *Dixit Cards provided another influence for design, sometimes* ***sparking idea*** *the other 3 cards did not.*
>
> *Dixit (60) and Compelling Audio. Weird outfit / clothes* ***lead us to talk about*** *musical stereotypes.*
>
> *The Dixit Card* ***immediately had us all thinking*** *about finding chests and we then slowly worked in the other cards. We came up with loads of different ideas but eventually settled on something simple.*

In other groups the participants would start with the Opportunity Cards, and then include the Dixit card only at the end of that round, which in at least some instances was due to a certain difficulty of including it.

***Usually combined 2 Opportunities**, found a way to link the 3rd, then tried to interpret and involve the Dixit.*

*The **Dixit Card was hard to work with** because it was very uninspiring and disinteresting. The main spark was the Collecting and Unusual Locations, which gave us a lot of room for ideas.*

*it was **difficult** to make it [Dixit card] relevant to the game idea*

One participant went so far to suggest not including the Dixit card right from the start:

*The Dixit Cards might work better if they remained face-down **until an initial idea has been formed** from the 3 design cards.*

7.3.4.1.3. Effect on Game Designs

One reason why participants preferred using a Dixit card could potentially be found in their perception of the finished games. When asked to reflect on their game designs they were generally satisfied with them, and were also able to identify the effect Dixit cards had in general:

*Some of the game ideas turned out well, **mostly with the use of Dixit Cards**.*

*They were imaginative & unique. **The ideas with Dixit Cards were generally better.***

*As mentioned above, the Dixit Cards proved to be the variable that **decided on the quality of the idea generated**. Some were too vague to be used in the game, whilst others were very beneficial to development.*

*Fairly common ideas that have been had before, **Dixit were more original ideas**.*

*Some of them could be refined into workable ideas. The ideas from the Dixit Cards were **generally more detailed**.*

*I think they are quite good and different from our typical ideas. The ones **without Dixit Cards felt more free, although possibly less fleshed-out**.*

The last quote highlights an interesting observation: Some participants felt restricted (especially) by the Dixit cards, while at the same time they also helped to create more "complete" games.

7.3.4.1.4. Providing Theme

As expected participants used the Dixit cards to find and develop a theme for their game designs.

> *I preferred using the Dixit Cards as it* ***made it easier to come up with a theme*** *for a game.*
>
> *They [Dixit cards]* ***provided a theme to focus*** *all the Opportunity Cards around so gave a bit of focus.*
>
> *They [Dixit cards]* ***helped give a theme*** *to the game. Games were based around the theme which* ***made it more compelling****.*
>
> *It [using Dixit cards] created* ***more interesting / crazy ideas****. Mostly they created the main theme / character for the game.*
>
> *It [Dixit card] gave us a* ***quick visual theme*** *for the game e.g. one had a rabbit with a gun so... evil rabbit chasing you.*
>
> *Yes, they really helped get a* ***general feel for a game*** *as the visuals meant that we did not have to spend long on creating a setting, and more on the mechanics.*
>
> *The Dixit Cards helped when trying to get a theme for a final idea. It was* ***harder without them to come up with something original*** *as we kept referring to previous games.*

Some participants attributed positive effects to using the Dixit cards, while at the same time also noting some negative aspects.

> *Overall, yes, most of the time they helped add another layer to the game and* ***give it more context****, however, sometimes trying to include something from the card was difficult and stretched the game ideas.*
>
> *I found at first they threw off the group, confusing the ideas created, although upon further investigation and understanding they were* ***useful in strengthening the idea****.*

7.3.4.1.5. Vagueness

As seen in the quotes above, Dixit cards were not immune to criticism from the participants. One common complaint was the vagueness of the cards, due to their surreal and abstract nature.

> *Also some [Dixit cards] were* ***too surreal to really work with****.*

I found them to be quite abstract and ***slightly hurtful to the design****. It sometimes felt as though they were forced into the design instead of supplementing it.*

[The Dixit cards] were ***very vague and abstract*** *that it was difficult to incorporate into a game idea.*

The Dixit Cards were fun to include making ideas interesting but they also hindered us when trying to interpret the image on the card. ***Abstract is good but can be too much.***

Other participants saw the vagueness as something positive instead:

Preferred to [use Dixit cards], gave a ***more abstract thing to draw ideas from****.*

I preferred them, they were vague, so you could ***get a lot of different ideas from them****.*

I most enjoyed the picture Dixit Cards as they were ***open to interpretation****.*

Always had something *we could use.*

With these opposing opinions, it is also not very surprising that some suggestions on how to improve the exercise / the cards were contradictory:

The Dixit Cards that had a lot of illustrated and going on where the most difficult to include. It may have sparked better ideas by having more simplistic Dixit Cards. ***The Dixit Card proved to be the most problematic at times.***

Too mechanics focused. Could be improved by having more general mechanics cards or ***stranger Dixit Cards****.*

7.3.4.1.6. Limiting vs Inspirational

Other negative comments concerning the Dixit cards saw them as limiting the idea as participants had to incorporate them into their ideas.

The Dixit Cards do give everyone a set mindset and seems to ***almost restrict people to only think of ideas based around the card*** *which could be a bad thing but also good.*

I think that they ***forced some ideas too much*** *when we have to include them.*

Preferred not to use the Dixit Cards because it limits the ideas you can use for the game to a ***too narrow area****.*

Sometimes, they could help expand on ideas but they could also complicate the process by adding an ***extra thing that is difficult to implement****.*

Dixit Cards seemed only to limit the results - ***shoehorned in a theme*** *to mechanics that was not work with it.*

[Difficulties during a specific round:] Dixit Card. ***Not much you can do with hats.***

The Dixit Cards were, for the most part, a limiting factor. The game cards [Opportunity Cards] helped to steer the game direction very well and were often very inspirational. The Dixit Cards were often used ***simply as plot points*** *if they could not be integrated into the gameplay.*

When looking at the different phases of the design process we could already see that the Dixit card often was the spark for an idea or was part of this spark. Contrary to participants that saw the Dixit card as "limiting" others saw them as rather inspirational instead.

The technical cards were limiting but the picture only (Dixit Cards) were ***inspirational****.*

Some Dixit Cards felt limiting, however others encouraged ***out-of-the-box thinking****.*

Yes, because it gave us ***more options for ideas*** *on our game.*

Yes, it added a random element to the design allowing us to ***add a curve to the game****.*

I prefer to use them as it can give ***small additional details*** *that may not have been thought of otherwise, but even if they don't give an idea, it doesn't have a negative effect.*

I preferred using the Dixit Card as it made the process ***more fun*** *and made us* ***think more about the game****.*

They were ***helpful*** *if someone wanted practice or was struggling with ideas.*

Yes, because it allowed for a bit ***more creativity*** *and possibly including fantasy in game play. The only problem is that sometimes the card didn't always get very well with the other themes and so was interpreted as fully as it could've been.*

At the end of each round, the participants of the first cohort were asked to rate each card on a 9-point Likert scale from 1 = very limiting to 9 = very inspiring. Table 24 gives an overview of their answers.

Rating	1	2	3	4	5	6	7	8	9	⌀	σ
Opportunity Cards	1%	3%	7%	10%	17%	19%	22%	12%	8%	5.95	1.83
Dixit Cards	9%	3%	13%	6%	12%	8%	19%	21%	8%	5.36	2.54

Table 24. Rating for cards (1 = "very limiting", 9 = "very inspiring; n=429 for Opportunity Cards, n=130 for Dixit Cards).

We can see that on average Opportunity Cards have been rated as more inspiring (5.95 to 5.36). The data warrants a closer inspection though. Table 25 displays the same data, however in this instance the results for scores 1 to 3 have been added up, as well as 4 to 6, and 7 to 9.

Rating	1 to 3	4 to 6	7 to 9
Opportunity Cards	11%	47%	42%
Dixit Cards	25%	26%	48%

Table 25. Card ratings, grouped.

The vast majority of Opportunity Cards has been rated as neutral or inspiring to the process – only 11% are seen as uninspiring. Dixit cards however show a different result. Here, a large part of them has been rated as rather inspiring (48%), but at the same time about a third of them has also been rated as limiting (25%). Figure 58 and Figure 59 visualize the data and this difference in reception.

Figure 58. Individual scores of Opportunity Cards and Dixit cards, based on data from Table 24.

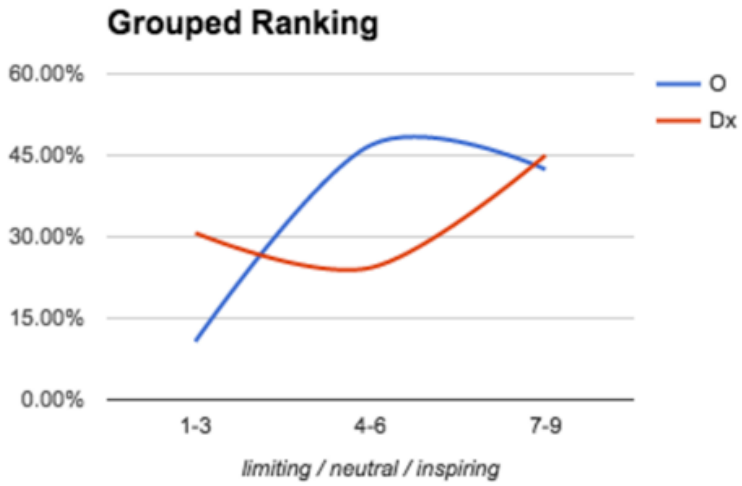


Figure 59. Grouped scores of Opportunity Cards and Dixit cards, based on data from Table 25.

7.3.4.2. Random Draw

7.3.4.2.1. Card Combinations

One very common comment made by participants was about the compatibility between drawn cards.

> *All cards had a positive effect as* ***they all blended well together*** *to create a game.*
>
> *They* ***mesh well*** *and are all relevant.*
>
> *Creating the ideas were real fun and they all seemed really possible to create. When you get* ***3 cards that fit well then it's much easier****.*
>
> *The random choosing of cards worked well as you had to work with a theme you might not have considered. The problem with this is that they* ***don't always blend together*** *and time could've spent better making decisions of what to base the game on.*
>
> ***Some of the combinations don't make sense*** *and limit the ideas a lot.*
>
> ***Certain cards didn't fit*** *and sometimes creating an idea was restricted as we became desperate for a link.*
>
> *Having* ***cards that contradicted each other*** *which made coming up with a general idea to suit them harder.*
>
> *Sometimes the cards we drew* ***didn't particularly fit together****, so making a game idea out of them was a bit of a problem.*

I felt a little limited due to having only three cards (plus the Dixit when applicable). Some cards ***really didn't mix together*** *which made the idea hard to create.*

Some of the cards were inspirational and some were more challenging to get ideas as ***some cards clashed with others****. Card of a dog was limiting and led to the idea of picture and portrait.*

In general participants seem to prefer when the cards could easily be interpreted to fit the same theme. In contrast, other participants noted how "unfitting" cards would actually be beneficial to create new game ideas:

Overall the cards were definitely more inspirational which led to ***some crazy ideas****, but there were moments that required a lot more thinking because the cards didn't seem to have much synergy.*

Some cards don't mix well (at least without a ***"genius moment"****), e.g. Vehicles and Motion Tracking.*

The random allocation of cards ***promoted unusual thought patterns****, and forced us to* ***think outside the box****.*

With a Dixit Card, it was much easier to finalize an idea than without once. Since the cards and themes our ideas were based on, could be interpreted very freely, ideas were easy to produce. However, certain cards could complicate the design process but ***produce interesting and unique ideas****.*

They provided some help by offering random combos, which made the group ***think more creatively****.*

7.3.4.2.2. Card Responsibility

Another interesting pattern emerged while studying the feedback about the game ideas that the participants came up with: the cards were made responsible for the quality of the ideas, and not the participants' own creativity.

Getting ***rubbish cards*** *from the draws which we couldn't swap.*

Sometimes the ***cards weren't very good*** *which could limit your ideas.*

Sometimes we would have a combination of cards that was ***too restricting or vague****, so we would not be able to come up with a good idea for a while.*

Not really, it seemed to ***depend on what combination of cards you got*** *more than anything. We just thought of ideas and picked the best one or the final idea which was quite easy for us because each idea was normally just an expansion on an earlier idea.*

They helped to generate ideas but with ***a bad combination*** *they were quite limiting.*

Often the cards were a great help in coming up with ideas, however if a ***poor card or cards game up****, it could be quite limiting to have to include certain design concepts. These we usually gave minimal focus.*

For this game the cards we got ***didn't have many games that could be made with*** *the Dixit Card and weren't synergetic overall.*

Some ideas were better than others. The ones which were better had a ***better selection of cards****, i.e. Physiological Input is hard to use.*

The cards that we had ***forced us to create a Geocaching game*** *based on coordinates texted to the player.*

DnD because ***the cards we received pushed us towards it****. Different players = different classes and DM*

7.3.4.2.3. Effect on Collaboration

One difference between random draw and limited choice is the fact that random draw provides less structure. All participants are free to suggest their ideas at the same time, which could lead to some participants dominating others.

Some groups reported unbalanced participation and problems to agree on an idea:

Me and another group member definitely dominated coming up with ideas. The other two were very quiet and ***appeared to simply not have very many ideas****. Everyone was able to express an idea easily though.*

One or two voices dominated. For me, not easy to express ideas as ***one person takes the development one way****. Seems to "snuff" other ideas.*

Ideas were so numerous it became difficult for the group as a whole to ***settle on a final decision in such a short time****.*

Other groups were able collaborate without severe problems:

We ***all contributed equally****, was easy to express ideas as when one spoke we all listened.*

I really enjoyed the cards. They provided ***instant common ground that conversation could build on****. At times a need to express opinions could lead to more than one person talking at once but generally I felt that the cards presented a positive influence on the process.*

It was good to ***hear everyone's different ideas of each card combination****, and was easy for everyone to get involved. Some ideas conflicted but it was easy to find a good balance as a group.*

I liked the craziness and varying of ideas that people came out with, was very funny. ***Working in a group was fun*** *again just for the different connections that people made.*

It was easier to express ideas when the cards had more of a clash ***forcing us to cooperate****.*

In other groups a pattern emerged where certain participants would "shepherd" an idea and be more dominant during a specific round only:

Interacting with cards worked as a fast process for ideas. Most of the time the whole group got a say, with ***people occasionally dominating*** *conversation* ***when their ideas had more depth****.*

Everyone involved but not in every single game idea. ***One person would headline the idea*** *and others would input other smaller ideas to work with the main one. It was fairly easy to express.*

The Dixit Card sparked the setting and base, the rest of the cards just worked in. ***The idea came to me very quickly****, everyone else just helped add slight elements and possible ways the game could be played that weren't restricted by the cards.*

7.3.4.3. Opportunity Cards

In general, participants had a positive view of the Opportunity Cards and said that they found them inspiring:

The opportunity cards helped develop inspiration to further develop the game and ***give us a better understanding of what we wanted to do****.*

I thought that the cards were mostly inspiring. They gave us ***more thoughts on how to improve the game and what to add****. It made us think about other things to add to the game and how we could make all the cards fit together.*

They helped to ***inspire ideas for features*** *that could be implemented into a game and* ***suggest more ways to take them further***

With more opportunity cards to choose from and no limit to how many to use, ***the cards allowed us to think of more ideas*** *than we would have come up with on the spot.*

They didn't really limit the progress as ***they gave it a structure*** *that allowed the inspiration to work around.*

This is in line with the observations from when the students were using only the Opportunity Cards for rapid idea generation. However, this time there was no enforced card limit. Instead students were in theory able to add all of the cards to their game idea. Something which students noticed was not necessarily desirable as this caused a variety of problems.

Some students were overwhelmed by the amount of options:

It was difficult to develop the game further as ***the more cards we looked at the more possible options*** *or routes our game idea could take. We ended up with more ideas and possibilities than we needed.*

Other students realized that an idea was "saturated" after a certain amount of cards had been added thus making any additional cards irrelevant:

After the initial idea*, quite a lot of the opportunity cards were either useless to the game we were creating or* ***benefited in some way slim way*** *but I found none of them to be extremely inspiring or limiting to idea developing process.*

The opportunity cards aided in providing factors that the game could include ***but when it came to further development the cards were less useful*** *because only cards that fit the current idea were accepted and thus the game did not develop much further than the initial concept at this stage.*

We reached this point around 6 or 7 cards that ***we found that adding more just lead to irrelevant or over-complicated features****.*

The last comment mentions another problem. When students did not restrict themselves but instead kept adding cards, these were in retrospect not seen as adding anything crucial or positive to the game idea, but instead would just increase its complexity:

The opportunity cards helped to spark ideas, whilst most of the cards became irrelevant once we had an initial idea ***some helped to branch the game idea out and give it more complexity****.*

Adding cards allowed the game to develop. However, ***the temptation was to add too many cards and make the game too complex****. In general, the opportunity cards were helpful.*

The cards also enabled the participants to get a quick grasp of the complexity of their idea:

They helped us scale back the design of the game to create something more achievable, ***having too many*** *cards would lead to too many concepts to throw into one game.*

7.3.4.4. Question Cards

After developing the initial game design idea, the participants then continued with the session and used the Question Cards to investigate their existing design.

When analysing the questionnaire data several themes emerged. The Question Cards for example made the participants consider different options within their existing design which then in turn forced them to make a choice:

Again, a good amount of cards were disregarded due to irrelevance but the few that were relevant ***made us think about the depth of the game****. A lot of them were "what if" questions which made us think about the possible scenarios.*

A few of the cards ***made us refine our idea more****, such as the time the game should last and the size of the area. The target group also massively affected the theme of the game, as if it was directed at kids then we would have made the game more child friendly, opposed to a more mature themed game.*

The question cards ***helped to make alterations to account for different possibilities****. For example, the 'Nothing Digital' card, made us come up with alternative methods to play the game without using technology, replacing audio clips with actors that would say the lines.*

It is interesting to note that participants did not report that they felt "railroaded" by the cards, i.e. the cards made them consider different options without telling them which one to choose:

After the Opportunity cards we had established a fairly solid idea so only several Question Cards were relevant and help to further develop the idea. However, ***the cards didn't push the idea in any specific direction****, instead* ***it just opened up several possible options*** *the game could use/change.*

However, the cards did not only prompt the participants to think about these different scenarios, they also helped in detailing the game idea.

The question cards made us think about how the game would be implemented - the main idea didn't change, but ***became more focussed***

They allowed us to ***elaborate on the idea in greater detail*** *(for example target audience got us thinking about different age ranges).*

The question cards were very help for in ***tiding the game idea up*** *and raised questions and issues we didn't encounter during are first brain storm on the game. Most of the questions we found affected our game were technological aspects as we didn't think about that side of the game until the question cards. This resulted in us changing the game design slightly and* ***made us go in to detail*** *more on how the program would work instead of the overall idea. Also they had us look at our target audience* ***for the first time in the design process****, which was very inspiring to the final product.*

The Question Cards in this activity were helpful in the fact that the ideas that were settled upon in the opportunity stage of the activity could be ***fine-tuned*** *in order to create a better game experience.*

Overall, the interaction with the Question Cards added clarity to the game idea:

the question cards actually allowed the game to have ***more of a structure*** *to the game play.*

Sometimes the Question Cards would also go beyond refining the existing game idea. Some participants reported that they added new game elements or mechanics inspired by Question Cards:

The question cards provided more influence over the game idea than the opportunity cards did. One of the biggest influences was the Player Numbers card which ***spawned the idea*** *that players should be able to party their phones together in order to collaborate and beat the rooms quicker.*

Not all participants agreed however regarding the usefulness of the Question Cards. This seemed to especially occur when the idea was already well developed after the interaction with the Opportunity Cards.

> *We* ***already had a good idea*** *of the design and not many inspired the game further.*

> *The opportunity cards didn't help to develop the game further since* ***we had the final idea*** *of what the game should be after the first stage.*

> *They didn't really change our ideas very much they did add to the game slightly but* ***because our game was very simple*** *it didn't limit the game or make a need to change it*

Negative criticism was often focused on the majority of the cards not being useful, but then mentioning that a few of them actually were:

> *We found that* ***most of the Question cards were either not relevant*** *or didn't change anything about our game. Only* ***a few of the cards*** *actually* ***caused us to think*** *about or change an aspect of our game.*

> ***Some were irrelevant/unhelpful****, but* ***others helped develop our idea*** *further and raised good questions that we hadn't thought of.*

> *Again, a good amount of cards was disregarded due to irrelevance but* ***the few that were relevant*** *made* ***us think about the depth of the game****. A lot of them were "what if" questions which made us think about the possible scenarios.*

7.3.4.5. Challenge Cards

Following the established structure, the participants then used the Challenge Cards to identify issues and problems with their design.

Overall, the Challenge Cards seemed to fulfil this design goal:

> *The challenge cards* ***made us realise the limitations of the game****, and made us change some features to be feasible*

> *The challenge cards gave us some very potential flaws with the game which* ***helps us to discuss them and fix and improve the game further****. I thought they were very useful as they brought up big potential problems which could make the game useless*

> *The challenge cards, brought multiple issues to the surface of the development discussion, this changed our design however very slightly but I* ***made us think of the new ways***

to get round the new found issues *but still using the overall old design and components without adding no ideas.*

Participants also stated that their ideas became more realistic and grounded:

The challenge cards helped to ***fine tune the ideas and put them into a realistic and manageable area*** *for example how will a non-player gain access to all the museum at once if they choose to do so and how will crowding and noise effect the situation, whilst these were not particularly inspiring they* ***helped to limit the game into a realistic perspective*** *where the game could potentially be developed.*

Challenge cards ***create an interesting "grounding" perspective to the game****, as before that you can have effectively whatever you wanted, but those challenge cards then effectively say "That's great and all, but how do you plan to get that to work?" which is a very important ideal to remember.* ***They develop the idea to bring it closer to being a reality****, without having to actually make the game, limiting it but in a very needed way when creating games.*

They were ***the most important part of the development process*** *in my opinion. The issues of overcrowding, disruption and noise were important and raised questions about the possibility of headphones being used and the obstacle this might be to team collaboration. Certainly* ***they were useful for grounding the game in reality*** *but did not feel limiting in that respect. They simply forced us to find alternate ways to achieve the end goal without running into these issues.*

The process of actually overcoming the issues was not considered trivial by the participants. In fact, several of them encountered challenges they could not mitigate:

The challenge cards ***proved to be tricky to implement*** *as some would create noticeable changes to the game, thinking about the variable that the game would have to consider, such as area size, population of people and the chances that people would bump into each other, looking too much at their screens.*

The challenge cards made us think about what could go wrong during the game, and how to fix issues. Most were inspiring, however, ***some have no apparent solution, and were put down as limitations of the game****.*

The challenge cards were helpful in the creation of a game in the way that they addressed very real issues that could happen with a wide variety of different games therefore we would

come across one which affects our game and ***would have to either accept it as a potential risk or plan around it****.*

Several participants perceived a strong similarity between the Question Cards and the Challenge Cards. This was due to their related function (confronting the participants with elements the had not previously considered) but also due to topical overlaps:

> ***Similarly to the Q cards****, they made us think about certain elements of are game that could prove problematic, mainly regarding technical issues.*
>
> *Same as above really.* ***Again raised some questions*** *that we hadn't thought of that helped develop ideas and think about possible issues.*
>
> *The Challenge Cards were very similar to the Question Cards in terms of the influence they had. Several* ***Challenge Cards also lead to the same possible developments as some Question Cards*** *such as 'Location' and 'Relocation'. The Challenge Cards, again much like the Question Cards, also opened up several possible options the game could use/change.*
>
> *We found that, again, many of the challenges were not relevant to our game. We found ourselves* ***going over some of the same ground*** *we had covered with the question cards.*

7.3.5. Conclusion

This final validation study allowed me to investigate some aspects of the Mixed Reality Game Cards in more detail. It was interesting to find out more about the timing of the Theme Cards in the design process and their overall perception. Random draw continues to provide a challenge to many participants. However, it does seem to create rather unique ideas when it works. In addition, participants often attributed the quality of their ideas down to the *luck of draw* and felt less personal responsibility for the resulting ideas in case of a *bad combination of cards*.

7.4. Chapter Summary

The study described in this chapter serves as the final validation for the development of the Mixed Reality Game Cards. Lincoln2 is the most substantial study that was undertaken. The study itself was concerned with the role of Theme Cards and random draw vs limited choice specifically for idea generation, and the

perception of Opportunity, Question, and Challenge cards in general for idea development. The results support and deepen findings from the previous studies. The Mixed Reality Game Cards were seen as inspiring by the participants, and they were able to reflect on the different rules employed for interacting with them.

The experiences from this final study supported my decision to rely on **Dixit cards** as an external source of inspiration. Participants noted how these cards would indeed give them additional inspiration, and would often argue that the ideas that included Dixit cards were more fleshed out and included interesting themes. At the same time, some participants struggled with using the Dixit cards due to them being rather surreal. The study showed that Dixit cards can be "hit or miss". They were either perceived as rather inspirational or rather limited, and rarely neutral. Nevertheless, they play an important role in the idea generation process.

In a similar vein, **random draw** has proven its utility with this study. Participants reported that the random draw sometimes was difficult due to the cards revealed, but then also created opportunities for really unique and interesting ideas. In instances where participants could not create a satisfying game they tended to blame the cards for it and not themselves. This is an example for how a lack of perceived agency actually has a positive effect on the design process. Overall, random draw seems to be the more challenging but also a more rewarding approach to idea generation.

Like in the previous studies, participants in general appreciated the **Opportunity, Question, and Challenge Cards** as part of the idea development process. Opportunity Cards gave the initial idea and inspired several ways in which the participants could take their idea. After an idea had reached a certain level of saturation additional Opportunity Cards became less helpful. This is when the Question Cards took over that helped participants focus and refine their idea, without getting the feeling of being pushed in a certain direction. Lastly, the Challenge Cards allowed participants to further "ground their game in reality" by confronting them with specific issues. Finding solutions for these problems however was something that not all groups succeeded in. Here, the cards perhaps rely too much on the commitment of the users to push themselves until they overcome the challenge.

Part III: Results and Discussion

Play is important, because it opens the door to new possibilities. Your ideas are, by definition, strange at first. Through play we explore what they might have to offer. We flirt with the unknown.

(Robert Poynton)

8. Designerly Reflections

8.1. Overview

The final version of the Mixed Reality Game Cards consists of 93 playing cards that depict 51 Opportunities, 18 Questions, and 24 Challenges for designers of mixed reality games. They are supported by Theme Cards (repurposed from the board game Dixit), and together the cards help designers create and evolve design ideas in collaborative group sessions. The cards can be used for rapid idea generation as well as exploring a single idea in more depth as part of idea development. They not only enabled less experienced users to create their own interesting game designs, but they also make them feel valuable when working with more experienced participants. Professionals, artists and researchers with a track record of creating mixed reality games used the cards to challenge themselves and explored design ideas that at first seemed unintuitive but got turned into interesting ideas thanks to their expertise (e.g. Restickulous at Performance and Games). The cards were also used to reflect on already existing game design ideas (Magellan) or helped to expand a vague briefing into a fully-fleshed out design (Know How).

Over the course of seven studies I iteratively developed the cards and the rules on how to use them. In this chapter I will take a look at the most salient features of the Mixed Reality Game Cards and outline how these design decisions came to be by looking at how they support idea generation and idea development.

8.2. Designing for Idea Generation

Generating new, unique and/or engaging game design ideas it not an easy task. In regards to mixed reality games this endeavour perhaps becomes even more complicated. Many people that might have a good understanding of "traditional" videogames lack knowledge of the design space of mixed reality games as these have yet to reach a wider audience. At the same time, mixed reality games offer a vast design space that arguably is still widely unchartered - ample opportunity to create games that have not been done before. In the idea generation phase the Mixed Reality Game Cards try to bridge these two sides: Giving a brief but pointed look at interesting design elements (to help users understand the design space) while at the same time using limitations to force users not to copy but instead

innovate and try unusual combinations. During my design explorations, I identified two elements as crucial for the success of a session:

- Providing an external source of inspiration (namely Theme Cards)
- The method used to select cards for building the idea (random draw, limited choice, or no limitations)

8.2.1. Theme Cards

The idea to use Dixit cards as an additional inspirational element came from a research paper by Kwiatkowska et al. (2014). In the paper, they describe how they compared using Dixit cards and PLEX cards as additional inspirational triggers in a study with professional designers. Small groups of designers were given personal problems to solve and had to do so without any additional support material and with the two aforementioned card decks. In general, PLEX cards and Dixit cards led to more generated ideas, and participants saw the Dixit cards as most helpful:

> *They [the Dixit cards] allowed for free interpretation making it easier for designers to find the entry points on the given card and work further with them.*

Due to their surreal nature, they enable participants to derive several different meanings from them, and they can also focus on small aspects of the card and thus create even more diverse meaning from them.

One of the problems they identified when using Dixit cards also appeared in the studies presented in this thesis:

> *Sometimes the level of abstraction of the card was too high and it was difficult to find any association between the picture and the tackled problem.*

However, the same attribute also had positive effects on the whole process:

> *Such a level of abstraction increased the possibility that a few ideas might be innovative and provide surprising solutions.*

Based on the data presented in the previous chapters it can be said that Dixit cards did sometimes not work in helping in the design process as their "weirdness" was blocking the creativity of some participants (or in some situations). In such instances, having to include the card nonetheless into the idea was seen as limiting and overcomplicating things. At other times, however, the Dixit cards worked beautifully and enabled groups to quickly define and expand on a theme. This "hit-

or-miss" characteristic is nicely illustrated in participants' assessment of ranking the cards as limiting or inspirational. It is clear however, that the addition of the Dixit cards had positive effects on the ideas being generated. Participants overall agreed that ideas that included Dixit cards were in general of a different quality. While not necessarily "better" participants from the Lincoln2 study described them as *more fleshed-out* and *more detailed*. It seems that Dixit cards help to move away from abstract ideas and turn them into more colourful and descriptive ones based on a strong theme. Participants from the Sustrans study thought that the Dixit card *takes the idea off* and a Know How participant remarked that *the Dixit card allowed us to think outside of the box*.

An important component towards the success of a Dixit card seemed to be when it was applied in the ideation round. If a game started based off of a Dixit card, the theme would obviously be more integrated than when the Dixit was the last card to be thrown into the mix, often *shoehorning a theme onto an idea* as noted by a Lincoln2 participant. When, on the other hand, a theme is integrated from the beginning of the process the theme can evolve naturally and in unison with the remaining other (mechanical) aspects (from the Opportunity Cards).

When looking at other ideation cards decks the inclusion of Theme Cards is a unique characteristic of the Mixed Reality Game Cards. PLEX Cards, The Deck of Lenses, Exertion Cards - they all focus on the topic itself but provide no additional guidance or source of inspiration for the users. This is fine when using the cards for analysing an existing design (e.g. Deck of Lenses), however for creating an initial idea the addition of Theme Cards has proven to be a great resource, despite the described flaws.

To summarize, Theme Cards provide an additional trigger for new ideas and offer refreshing new perspective. They help create more fleshed-out ideas, but at the same time can put some people off if they cannot easily make sense of them – something that might just be a matter of experience with the cards. "Good" Theme Cards however need exactly this vagueness to function properly: Rich images that include lots of little detail so that they can be interpreted in multiple ways. It is also important to include Theme Cards already on beginning of the process - otherwise the game idea will not naturally evolve but the theme will be forced onto the idea.

While it is certainly possible to create Theme Cards from scratch, I recommend drawing from existing card decks. Games like Dixit provide a vast source of inspirational cards, but artistic tarot cards might work equally well. It should also not be too difficult to use pictures from image repositories. Figure 60 shows two such example images found on Flickr.

Figure 60. Left: "The Goddess of Lost Keys" by June Yarham (CC BY-NC-ND 2.0). Right: "Fool" by Tim Kwee (CC BY-NC 2.0).

8.2.2. Random Draw and Limited Choice

The different approaches to the rules for an idea generation session have a high impact on how the users perceive a session. The motivation for giving participants a random selection is clear in all of the methods: It should create interesting combinations of elements that participants would not have come up with necessarily without these prompts. Introducing a limited choice weakens this approach but at the same hand lets participants have more perceived agency over the design process. In random draw, participants often "complained" about bad combinations of cards that did not fit well together and that did not have much synergy. Their perception of the developed game ideas likewise showed this lack of agency. Instead of attributing the quality of the ideas to their own creativity, they typically saw the cards responsible for it. During the Performance and Games study for example a participant stated that a good idea was the result of *great cards* while ideas of lesser quality were caused by *cards that did not mesh*.

Some participants however recognized that very odd combinations of cards could indeed lead to rather unusual (and thus desirable) ideas. In a set-up with limited choice participants would instead tend to play an "easy card" that supports the already existing idea. Examples for this can be found in the Lincoln1 study where e.g. one participant wanted to play Augmented Reality into a game idea based on Dominant Audio. The other group members perceived these cards as highly contradicting and henceforth convinced him to retract his card and instead play a more "appropriate" one ("Peer-to-Peer"). From this perspective, more choice results in less of a challenge.

This increased level of challenge however also requires more skill from the participants. Sometimes they just could not think of a good way to interpret the card combination in an interesting way. This has been observed before as something the PLEX Brainstorming method can lead to (Lucero and Arrasvuori, 2010):

> *The randomness present in PLEX Brainstorming can lead to the creation of radically new ideas, but occasionally can lead to a creative dead-end which results in discarding the current hand of cards.*

While this may be seen as a negative, it is not a severe problem in general. After all the point of the exercise is not to create "one perfect idea" but instead generate a large variety of rough ideas. The next stage would then be to re-evaluate the produced ideas and chose the one/s that have the most potential. These ideas can then be developed further by (in this instance) using more time and (all of) the Mixed Reality Game Cards.

Something I introduced during the later studies was a strict time limit for the idea generation when using random draw. This ensured that groups stayed on track, and that an idea would not be discussed endlessly. While this might prevent some good ideas from manifesting, the purpose behind idea generation after all is to rapidly create a multitude of ideas.

In summary, the utilization of a random draw compared to a limited choice has the potential to create more unique ideas. However, at the same time this method is more challenging as odd combinations can come up that make users feel stumped or blocked. Not actively playing cards also causes a lack of perceived agency over the cards - the cards are seen as even more responsible for the final result. This in

turn gives participants an increased alibi as they are somewhat forced to voice crazy ideas when it is difficult to make sense of the cards and can therefore be seen also as a positive element. If all cards are revealed at the same time, it is easier for more vocal users to dominate the discussion. In groups that are aware of this imbalance or want to prevent it from the get-go a more turn-based approach as employed by PLEX and VNA might be advantageous. As a general guideline, it furthermore also seems beneficial to enforce a time limit so that a) a larger amount of ideas get generated in the first place, and b) users do not get frustrated by being unable to come up with a game design based on "unfortunate" cards.

8.3. Designing for Idea Development

8.3.1. Opportunity Cards

The Opportunity Cards are used in the beginning of the design process to gradually build a game idea. By combining the different cards designers can map out the important elements of their game and give it shape. As such, Opportunity Cards make up the building blocks of an idea. They cause **inspiration** because they do not restrict participants but instead provide interesting elements to first base an idea on and then later add to it. This way they foster **discussions** between participants because they can use the cards as an alibi while getting just enough knowledge from them to be able to participate even without much previous experience. There is however a certain danger that Opportunity Cards can create very large and complex ideas because they tempt users to add more and more cards - thus potentially needlessly extending an idea unless **restraint** is employed.

8.3.1.1. Inspiration

One of the foremost qualities of the Opportunity Cards is their ability to inspire ideas. The Taphobos group from the Performance and Games study shows how this can be achieved by just an image: The abandoned and rotting house on Unusual Locations gave one participant the initial idea of a survival horror game. The importance of rich images has also been already discussed as part of the Theme Cards.

However, it is not the images alone that made the Opportunity Cards inspiring. Instead a participant of the Know How study remarked that *the positives [the Opportunity Cards] are inspiring ideas, they are things [..] that we didn't think really think*

about before. This can be attributed to the fact that the Opportunity Cards describe the design space of mixed reality cards. As such they showcase potential elements that might be part of a game, each of them being a valid possibility for a game. In a way, the Opportunity Cards are building blocks of an idea from which the card users can pick and choose from.

Having unrestricted access to these building blocks was also mentioned by participants of the Lincoln2 study where the cards made them *think about other things to add* as well as *suggest more ways to take them [the ideas] further*.

In Know How the Opportunity Card phase was labelled as *blue sky thinking* by a participant. When interacting with Opportunity Cards the participants were not restricted by concerns of realism or feasibility. Instead they were allowed to freely brainstorm in a completely positive environment. They could add whatever cards they liked without having to think of any negative repercussions that it might have. This was also noted by a group of the Performance and Games study when they remarked that looking *at the negative and the plus [cards] together [..] would ruin part of the creativity that the plus cards are bringing up*.

8.3.1.2. Discussions

During the Performance and Games study, participants remarked how important the cards enabled them to *pull in an idea* because they got *people talking*. This is of course rather important for a collaborative design activity. The cards gave the ideation session structure by providing direct and tangible elements to discuss and use as a jumping off point for generating ideas. A participant from the Know How study described the cards as *ice breakers*. Because the team did not know each other well before the cards facilitated the discussions as they enabled them to *just reading the cards ourselves and then giving our opinions*. The cards gave them *prompts* that were *incredible and useful* thus also enabling people who *maybe not feel as confident* to participate. They mention the alibi that the cards gave them because the idea that you are proposing *it's the card you played, it is not your crap idea*. This again strengthens less confident participants as it is not them that might get criticized directly but instead the card. The cards remove *the fear of looking stupid*. One participant at the Performance and Games study who had less experience in mixed reality games remarked that the cards provide enough titbits of information *it's a process that anybody could participate in*.

8.3.1.3. Restraint

The described lack of restriction however also caused problems. Some of the groups of Lincoln2 were overwhelmed by the sheer amount of possibilities so that after a certain number of cards additional ones were rather detrimental to progress: *Adding more just lead to irrelevant or over-complicated features.* After a certain point the ideas were saturated so that "the game did not develop much further than the initial concept at this stage".

A similar notion surfaced in the Know How study where the participants ended up with 24 Opportunity Cards after the first phase. The cards just seemed too tempting not to put in as they always felt *that could be a great aspect, that could be a great aspect*. This way they ended up with a *very sprawling idea*.

During Performance and Games, a similar effect was caused not because participants necessarily seemed the cards as extending their idea but instead *people threw in cards a little bit for fun* which created a *bloated idea* that lacked focus and coherence.

The lack of limitations also caused a lack of aim for some groups. For one group in Performance and Games a very lengthy session with the Opportunity Cards did not yield any results as the groups was just *swirling around*. The Opportunity Cards allowed them to stay vague and not really work on developing the idea further - or making actual decisions of what should be part of the idea and what should not.

The aforementioned problems can be somewhat mitigated if the groups employ self-monitoring and regularly cull cards that no longer are relevant. However, this requires attention and a certain level of experience both with mixed reality games in general and with the Mixed Reality Game Cards in particular.

8.3.2. Question Cards

The Question Cards come into play to deepen the understanding of the existing idea. Where Opportunity Cards build the idea, Question Cards look at the idea as a whole and prompt users to fully define it and are a crucial element of the overall design process. They help groups to break deadlocks and to reduce the game idea to the core concept behind it. They support **detailing** and **streamlining the idea**, and foster **focusing on the task** at hand. Crucial for doing so successfully is the **timing** of when these cards are introduced into the design process.

8.3.2.1. Detailing the Idea

The Question Cards push users to provide more specific descriptions of their idea. In case of Know How, the participants for example realized the role that the locations had in the game and how this affected the riddles (the riddles should match the location). Likewise, Experience Flow helped them understand how the game will be played (i.e. not in a linear fashion but instead with drop-ins and drop-outs throughout its duration). In one Lincoln2 group the Question Cards made them think about how to implement the idea, reflecting that by doing so *the main idea didn't change but became more focused* whereas others described how the ideas *could be fine-tuned in order to create a better gaming experience* or they were able to *elaborate on the idea in greater detail*.

Participants were able to make these decisions about their idea because the Question Cards made them explore the several options they could take their idea. A participant from Lincoln2 described them as *what-if questions which made us think about the possible scenarios*. Other participants spoke of *alternate methods to play the game* or that the cards *opened up several possible options the game could use/change*. The Know How group for example discussed their reliance on smartphones in response to Target Group and Nothing Digital. Here, they realized that their tech-heavy focus might restrict their audience and as a response they decided to emphasize physical objects as part of the gameplay reducing the technological requirements drastically.

8.3.2.2. Streamlining the Idea

Somewhat similarly the Question Cards also are a good way of reducing an idea that might have grown rather big and unwieldy. The Know How group remarked that Question Cards worked to *strip things down as well* and they helped them *weed out a lot*. In this instance for example they previously planned on having two opposing teams play the game but a discussion triggered by Theme and Story made them get rid of this additional element.

A group in Performance and Games reported this effect of the Question Cards as well. They had created a rather *bloated idea* and the Question Cards helped them *eliminate things and to ask ourselves what exactly we are doing*, even if they ultimately failed to be 100% effective.

In Lincoln2 participants reported that the cards were *help for tiding the game idea up*. Discussing the questions helped participants develop a unified vision of the idea. The Question Cards force users to discuss and decide on the important (if not all) elements of the game. In case of the Know How group cards like Fun and Joy and Core Concepts led to fruitful discussions about the overall view on the game.

8.3.2.3. Focusing on the Task

The Question Cards also supplied guidance that kept participants on track. Feedback during Performance and Games included that the cards provide *some structure that pulls you back* stopping them from going *too broad and being just crazy*. Another group also attested that *they helped us focus* because they were *the right questions to think about*. The Question Cards stopped them from *swirling around* and instead the Question Cards got them *to the concrete part quickly*.

This effect of the cards was also evident when they were used to overcome deadlocks. During Performance and Games, a group *couldn't figure out how to make it [their current idea] a game* they turned to the Question Cards *to see if that could break us*. While it did not directly provide them with a solution, the cards did help them discuss the game mechanics to ultimately break through their deadlock.

8.3.2.4. Timing

This often decided whether the Question Cards were actually helpful or not. One group in Performance and Games went through them rather quickly (and therefore did not perceive them as very helpful) because they had already *talked much about the definite idea*. The group stressed the importance of having to use them right after you *have a direct idea what you want to do* and that it was important to not *develop the entire idea before you get on to them [the Question Cards]*. A different group likewise regretted not having used the Question Cards earlier - however not because their idea was already far developed but because they made them stop *swirling around* (see above). Timing was also an issue in Lincoln2 with participants later reflecting that they failed to be much helpful because they *already had a good idea of the design* or *had the final idea of what the game should be after the first stage*.

8.3.3. Challenge Cards

The Challenge Cards are the final type of card that is being used in the ideation process. They feature common design issues of mixed reality games and as such prompt the designers to examine their ideas for their occurrence. Overall, feedback indicates a strong similarity to the Question Cards with some of the positives and negatives being almost identical between the two types of cards. This is perhaps not surprising as they both fulfil the task of reflection over an idea in opposition to building an idea with the Opportunity Cards. The Challenge Cards were an important part of the overall design process. They allow **grounding of ideas** and serve as **reminders** of what problems might arise. By providing **no solutions**, Challenge Cards motivate further discussion but also run the risk of participants not pushing themselves hard enough and giving up on solving an issue at hand.

8.3.3.1. Grounding Ideas

Unsurprisingly the Challenge Cards gave participants insight into what kind of issues the game might encounter. Participants of the Lincoln2 study realized *the limitations of the game* and were able to look at *some very potential flaws with the game* because the cards *brought multiple issues to the surface of the development discussion*. For at least one participant they were *the most important part of the development process* as it made the group revaluate previous design decisions.

Mostly the Challenge Cards did not lead to broad changes of the game idea. Instead the ideas were often just fine-tuned and slightly adjusted. Participants of Lincoln2 describe how the cards made them *change some features to be feasible* allowing them to *fix and improve the game further*. Their approach typically included *using the overall old design and components without adding new ideas*. The cards forced them to *find alternate ways to achieve the end goal without running into these issues*. Similar to Question Cards the Challenge Cards narrow down the idea. They pose *specific problems that will explicitly take out other items* until *you stripped away so much that you have focus* (Know How).

As a result, the participants felt that their ideas had become more realistic. In contrast to the open brainstorming with the Opportunity Cards. Instead they helped to *fine tune the ideas and put them into realistic and manageable area* (Lincoln2). Another participant described this as creating an *interesting grounding perspective to the game* that brings it *closer to being a reality*.

8.3.3.2. Reminders

The Challenge Cards were often kept in the design as reminders informing any future development. In the Know How group for example they kept Phone Zombies, Gimmicky Tech, Confusing Interface, Unclear Instructions, Limited Resources, Relocation, and Feature Creep in the design. They did so to make sure that these flaws would not be retroactively added to the design. Instead they wanted to do their best to prevent these from happening as they would greatly and negatively affect the desired final experience, *things that we should really be mindful of*.

Some other groups actively struggled with finding an answer for the posed problems. This was especially evident with the less experienced participants in the Lincoln2 study. They called the cards *tricky to implement*. As a result, a lot of their Challenge Cards stayed unanswered and were *put down as limitations to the game* due to them having *no apparent solution*. Here it seems like the cards were too easy to disregard so that participants instead moved on to the next challenge.

8.3.3.3. No Solutions

An important element of the Challenge Cards is the fact that they are presented in the form of questions. This way, the cards speak directly to the users which makes it more difficult for them to disregard the card as irrelevant. Instead, the Challenge Cards create a discussion. As one participant of Lincoln2 put it: *They simply forced us to find alternate ways to achieve the end goal without running into these issues.*

Of course, the cards have no built-in means of making sure that users actually force themselves to work around these problems. Participants from Lincoln2 reported that some Challenges *proved to be tricky to implement*. From their perspective, this created a certain danger that others might *accept it as a potential risk* instead of *planning around it*. If they do not challenge themselves enough, they might just give up when the cards do not provide an *apparent solution*. This might then either lead to discarding a card out of frustration or accepting certain issues *as limitations of the game* without delving deeper into them.

8.4. Chapter Summary

In this chapter I have discussed the broader design principles behind the final version of the Mixed Reality Game Cards. They support idea generation where Theme Cards and random draw play an important role. Idea development is supported by the having Opportunity, Question, and Challenge Cards.

When looking at idea generation, using Dixit Cards as **Theme Cards** provides the users of the Mixed Reality Game Cards with valuable domain-agnostic sources of inspiration. Including them might be harder, especially for inexperienced designers, but participants reported that they felt that games built around these Theme Cards were **more fleshed-out and more thematic**.

Likewise, there is a clear different between random draw and limited choice in difficulty. **Random draw** is **more demanding** but at the same time also more rewarding. Participants do not get to choose the cards to include in a game, so unusual combinations are more likely to appear, which in turn lead to **more unique ideas**. On the other hand, **limited choice** gives participants **more agency** over the idea. They appreciate that they were able to influence the idea more directly and perceive their attribution as more substantial in regards to the final idea.

Overall, Mixed Reality Game Cards are **inspiring** because the separation between positive cards and negative cards (Questions and Challenges) kickstarts the design process with an open and additive activity. Designers can freely select from the broad range of elements. They can add them to the design and combine cards with each other thus often creating new meaning (compare chapter C.2). The focus on positivity helps designers come up with ideas as the overall ideation process at this stage is about growing an idea.

The Mixed Reality Game Cards initiate and facilitate **negotiations** because the different cards give everybody the opportunity to participate by providing just enough knowledge bits on each card. Designers are also encouraged to speak freely because in case they say something the other group members do not agree with, the blame is diverted at the cards. Whoever played the card can "hide behind it" as the cards provide an alibi. Playing cards also creates discussions because it allows the group to focus on the physical card (compare chapter C.1) which then is a natural topic for conversation.

The Mixed Reality Game Cards **structure** the design process, perhaps even more so than other ideation cards do. This is due to the clear separation into different phases. The Opportunity phase is all about building an initial idea which then gets expanded and detailed during the Question phase and grounded in the Challenge phase. Cards also make designers focus on the task at hand. Especially Question Cards are able to put a group back on track that might have lost their aim by asking questions crucial for the overall game design.

The Mixed Reality Game Cards **guide** along the design space by embodying the design space itself. Designers can quickly grasp and explore the existing design knowledge by reading the cards which provide limited but sufficient information, even for inexperienced users. The structure given by the cards also strengthens this aspect by starting with blue sky thinking that illustrates the rich design space and then later introducing design considerations in order to create a perhaps more realistic and detailed idea.

The Mixed Reality Game Cards allow to **focus** on specific elements and as such **fine-tune** and **strengthen** ideas. This is due to each card talking only about a very limited aspect of the design space thus enabling designers to focus their discussion just on a single element of the design idea. Question and Challenge Cards work further to streamline the idea and remove obsolete and bloating elements from an idea, reducing it to the core vision. The Question Cards also force designers to evaluate the idea from different perspectives and encourages to explore different available options which can take ideas into different directions.

9. Tangible and Playful Interactions

9.1. Overview

In the previous chapters, I talked in detail about the studies that were conducted and how they shaped the iterative design process. At the end, they resulted in a final version of Mixed Reality Game Cards with accompanying rules that support idea generation as well as idea development. Taking a step back from these design-driven study perspectives, I would like to now talk about the conducted studies from a research point of view. The design activities surfaced several salient features that affected the Mixed Reality Game Cards specifically but that can also be applied to ideation cards in general. During these studies it became apparent that tangible and playful interactions that emerge during a session are crucial phenomena in the context of ideation card sessions. These, however, lie outside the direct control of me as the designer of the Mixed Reality Game Cards. Instead we are confronted with the fact that ideation cards are – just like games – an example for a second order design problem. While content, appearance, and rules can be designed before a session, it is the dynamics during a session that likewise need consideration.

Under **tangible interactions** I understand anything that is caused due to the cards being physical objects. They are physical objects and as such have specific affordances. Cards are the target of gestures (and are gestured with), and are being arranged spatially on the table. This naturally leads to a differently unfolding design process as if the concepts of the cards were displayed in a book (due to the book being less flexible) or for example as an online resource.

Playful interactions describe the fact that ideation cards are a form of design game. Participants often referred to the experience as game-like. This is no surprise – after all ideation cards share many similarities with card games. On the one hand this allows users to instantly understand some of the underlying "game mechanics" but also creates a certain playful atmosphere.

In this chapter I will explore both phenomena in more detail. I will do so by going back to some of the studies that were described in more detail in the previous chapter, but this time highlighting tangible and playful interactions and how they affected the design process.

9.2. Tangible Interactions

The Mixed Reality Game Cards are physical artefacts that embody design knowledge of mixed reality games. They do so by splitting up the design space in atomic elements that users can pick and choose from to build their game idea. A randomized combination of cards can easily be generated just by shuffling the cards. This shuffling is but one example for one interactions afforded by having actual cards. They also afford gestures and spatial arrangement as for example mentioned by participants from the Lincoln2 study:

> *Pointing at them* ***helped to elaborate on ideas*** *attached to the topic at hand.*
>
> *Gestures towards the cards were frequently used by myself. It* ***helped describe concepts by highlighting sections of the images*** *by pointing at them.*
>
> *They were a* ***nice visual aid*** *and it was easy to* ***point to*** */* ***pick up*** *cards when talking about them. You could also* ***move them into combinations*** *that worked well.*
>
> *The physical presence of the cards helped a lot as we would interact with them and* ***moving them around allowed us to prioritize the importance*** *of each of the possible elements the cards would add to the game.*

9.2.1. Observations

In the following I will first explore these broad impressions in more detail based on the post-session interview at the Know How study and vignettes from the Lincoln1 study. In the latter case, the participants are referred to by the group they were a part of (i.e. Museum Group => M1, M2, M3, M4; Radioactive Group => R1, R2, R3, R4; Wizard Group => W1, W2, W3, W4).

9.2.1.1. Vignette 1: Getting Attention and Evaluating Ideas

In accordance with the specified rules the four students of the Radioactive group were creating basic game ideas consisting of four cards each. An important task at this stage of the process was to generate and evolve ideas together – which naturally also included rejecting proposals. The following vignette reveals how the cards supported what could be a tricky process.

One card, Dominant Audio, has already been placed on the table and made the group decide to create a game mostly based on audio output. It is R2's turn to play the next card. While R2 looks at his hand, the other group members are engaged in an off-topic discussion. Without saying anything, R2 ***plays the card*** *Large AR (promoting large-scale augmented reality objects) next to the already accepted cards. Noticing the activity, the other participants stop their discussion and instead* ***lean in to read*** *the newly played card. This is the moment when R2 starts explaining his choice.* ***With his finger, he points down on the table*** *to illustrate his thought process. The other participants, however, are not convinced. R3* ***places a finger on one of the central cards****, Dominant Audio, and argues that this card stands in stark contrast to introducing augmented reality to the mix. He is supported by R1 who makes a similar point* ***while pointing at the central cards****. R2 reconsiders his position: He* ***turns the central cards around for him to read*** *while continuing to listen to his two collaborators. Finally, R2* ***picks up his card again*** *and instead plays Peer-to-Peer. R3 and R4 inspect the new card: They* ***pull it closer to themselves****. They accept the new card that talks about direct user interactions via technologies like NFC and* ***move it right next to the original central cards*** *while coming up with new ideas. The session continues with R3's turn.*

At the start of this vignette, a participant uses the act of playing a card to get the attention of the other group members. It is not necessary for him to support this action with any verbal cues – the gesture itself is sufficient. What follows is a good example of how the cards support design negotiations. Participants have to lean in to read the card and understand what it means. They then repeatedly point at the new card and the old one while they exchange arguments. In the end, the participant retracts the originally played card (and as such retracts the idea) and instead plays a different one.

9.2.1.2. Vignette 2: Inviting Help

The three members of the Museum group are engaged in idea generation during the first session. This vignette illustrates how cards allow asking others for their input. Two cards have already been played into the centre of the table. The group is now waiting for M3 to take his turn. Up to this point M3 has been rather quiet whenever it was not his turn, but we will see how the cards help him to collaborate with the others (Figure 61).

Figure 61. Participant M3 has spread out his hand (3). M1 relates the cards to the active cards in the centre (2) while M2 is observing. Also visible: storage area for completed game ideas (1), draw pile (4) and two discard piles (5).

M3 is shuffling the cards in this hand, unsure which one to play. He also ***takes another look at the cards*** *in the centre of the table: Shared Devices (creating groups of players that access the same device) and Subverted Location (letting players do something in opposition to activities usually performed somewhere). Finally, he decides to invite the two other group members to join his thought process. He* ***spreads out the cards in his hand and lowers them****, so the others can see them: "These are not really bad cards, I just don't know which would go with them [the ones on the table]." M1 leans in towards M3 and immediately offers help. The first card he sees, Weather Input, also seems not very applicable to him as this card deals with having changes in weather affect the game. When he sees Invisible Infrastructure (using already installed technology as a game element) he suggests to play it: "Maybe that could [work]. Because you are already subverting locations at the railway station, or maybe you could in the library." During his explanations,* ***he keeps pointing from the card in M3's hand to the cards on the table****. M3 agrees: "Yeah, I was thinking that" and promptly* ***plays the card on the table****. M1 elaborates a few more ideas on how the cards could fit together and* ***keeps tapping them with his fingers****. M3 proposes to perhaps use QR codes in the game which M1 agrees with. M1 then* ***moves the three cards from the centre to the side****, signalling to start building a new game idea.*

In this vignette we can observe a participant who keeps control over the cards by keeping them in his hand. However, by spreading them out and lowering them, he invites help from the other participants. During the discussion, the other

participant keeps pointing at cards when talking about them, and continues to do so after a card has been played

Observed phenomena: looking at cards, spreading out cards in hand and lowering them, pointing at different cards to show connection, playing card, tap cards, move cards to side.

9.2.1.3. Vignette 3: Supporting Arguments

In the second card session, the Radioactive group only had three members present: R1, R2 and R4. This was by far the most confrontational session as R4 on one side and R1 and R2 on the other were rarely of the same opinion leading to several lengthy arguments. In what follows we see how the participants used the cards to support their positions. The group is just starting the session – the Question Cards are readily available on the table.

> *R4 is closest to the deck of Question Cards and* ***picks almost all of them up*** *at the first opportunity. R2 sees that he missed a few and* ***tries to take the remainder*** *– but R4 notices his mistakes and* ***grabs the other ones as well****. Without having received detailed instructions they agree on just playing one card after the other and discussing whatever comes up. Being in control of the deck of cards, R4* ***plays the first card face-up directly in front of him*** *and reads out its title: Amount of Running?, asking them how much players would need to run as part of the game. This sparks a lengthy discussion as the group had not yet decided how the content of the game should be placed in the game world. A few minutes later R4 refers directly to the card itself and seeks the support of the card authors: "They [the authors] mean running like in a game where items appear over here and then everyone starts chasing there." This prompts R1 to actually read the card – he first* ***moves it close to him and then rotates it****. He points out that R4's interpretation is "just an example". R2 follows suit, reads the card and then equally challenges R4's opinion. They continue arguing this point without reaching a conclusion. Eventually, R1* ***just picks up a card from the deck and plays it*** *– thus ending the ongoing discussion.*
>
> *At the very end of the session, Amount of Running? makes another appearance. The group is discussing the intricacies of scanning for WiFi networks, and R1 and R2 are again disagreeing with R4. This time, however, R1* ***pulls out*** *Amount of Running?* ***from the discard pile*** *to point out that the current argument of R4 runs in stark contrast to what*

he said at the beginning of the session in relation to this very card. The argument continues for a while longer before the session ends.

In this example, we can see how control over a card affects the design negotiations. One participant has control over all of the cards after having picked up the whole deck. He then also goes on to play a card directly in front of himself. This makes it harder for the other group members to see the card as they have to reach over and turn it around in order to be able to read it. The text on the cards is then also used to support the argument that is being made by directly referring to the designer(s) of the cards. During the argument, one of the participants gets so frustrated that he decides to end the ongoing design negotiation by just playing the next card. The whole incident seems to have made a lasting impression, as the same participant pulls out the same card from the discard pile much later in the session in order to win the original argument.

9.2.1.4. Vignette 4: Focused Discussions

In this vignette (showing the Museum group in their second session) we see how the cards are positioned differently depending on the focus of the discussion. The Museum group has an additional member and is going through the Question Cards one by one. They then discuss each card individually when it comes up. M1 acts as a moderator by turning over all cards and thus framing the discussions as seen in Figure 62.

M1 ***looks at the topmost card of the deck in his hand*** *and reads out the title Amount of Players?. (How many players are needed in order for the game to run smoothly?) He then* ***turns the card around and holds it up for the others to see****. The other participants all give quick answers saying that they would definitely need "one player". M1 laughingly agrees. He* ***lowers the card*** *and* ***turns it back around to himself*** *while the real discussion begins and they start discussing topics like "critical mass". Seeing that it will not be a quick decision, M1* ***puts down the card on the table*** *and* ***occasionally touches it with his fingers*** *for emphasis during the discussion. Eventually they agree and M1* ***picks up the card*** *again and* ***moves it to a discard pile****. He then proceeds with introducing the next card (Game Server?) and* ***holding it up in the same fashion****. Everybody immediately agrees that a game server is not required so M1* ***discards the card directly from his hand****.*

Figure 62. M1 is moderating the session. He has control of the draw pile (1) and holds up the current card (2). M2, M3 and M4 then react to the card before it is placed on the discard pile (4). The group had selected and laid out relevant Opportunity Cards as a reminder of their game idea (3).

Like in the previous vignette, one participant has exclusive access to the whole deck of Opportunity Cards. However, in this instance the whole process is much more balanced as the "moderator" makes sure to show each new card to everyone and gives them a chance to read it. When a card needs to be discussed in more detail, the moderator puts it on the table and thus relinquishes control over it, again levelling the playing field between the participants.

9.2.1.5. Vignette 5: Possessiveness

For our next vignette we join the Wizard group in their final session (session 3) as they try to identify issues that might affect their game design. The group is going through all Challenge Cards one by one to decide which are relevant. W4 has taken on the role of moderator and is turning over all cards. His control over the cards leads to a struggle with another participant.

> *W4* ***picks up the next card from the stack*** *of unused Challenge Cards. He reads out its title Uncontrollable Places followed by the description. The card talks about the fact that e.g. public places might not always be accessible. He* ***holds the card up above the table*** *so the others can see it. W4 is very certain that the card bears no relevance for their game and already* ***wants to discard it****. W3, however, disagrees which starts a discussion between all participants. W4 quotes the examples on the card to support its irrelevance and to strengthen his position. W2 would like to have a look at the card for*

himself and ***tries to take it*** *from W4. W4* ***does not let go of the card*** *at first. W2 however tries again a few seconds later. This time W4 lets W2 have the card who starts reading it. Afterwards he states: "No, it is relevant, we cannot control this place" - followed by him* ***handing the card back*** *to W4. W4 disagrees immediately, which prompts W2 to* ***try taking the card*** *again. This time W4* ***does not let go of the card and instead pulls it back****. W2 exclaims: "Stop snatching my card!" but W4 continues making his point while* ***holding on to the card****. Eventually he* ***puts the card down directly in front of him****. W2* ***reaches over the table, reorients the cards towards himself and moves it a little bit closer****. He is under verbal attack by the other participants. Looking for support from the card itself he* ***presents it to the others by holding it up****: "It basically says here there are elements in the environment that we cannot control." After making his point he* ***lets the card fall on the table****. Immediately W4* ***picks it up and turns it*** *towards W2 and assures him: "That does not affect us." He then* ***puts the card face down on the discard pile****, earning support from W1 and W3 for his decision. The session then continues with W4 reading out the next card from the central stack.*

This vignette showcases how the physicality of a card is again used to enact control over it. Here, two participants physically pull the same card, both wanting to have access to it. Eventually, the participant holding the card makes a strong point supporting his view and then places the card on the table. This enables the other participant to finally get a hold of it. He uses gestures like holding the card up and presenting it to the others to convince them of his opinion. When he fails, he drops the card and the other participant places it on the discard pile, thus officially ending the discussion about this particular card.

9.2.1.6. Vignette 6: Deciding Together

In the last session of the Radioactive group only two members were present: R1 and R2. This became a much more harmonic session as both participants worked well together. The vignette shows them making a joint decision, and how cards trigger each other. R1 and R2 first went through all Challenge Cards separately and divided them into three stacks: "relevant", "maybe relevant" and "not relevant". They followed this up by going through all cards one after the other from the first two stacks until they deem them as "solved" and discard them (Figure 63).

R1 finished his notes based on the discussion of the previous card, Uninteresting Locations. He then ***removes the card from the top of the stack*** *to reveal Sunshine – a reminder that display readability might suffer on bright days. R1 reads out the card's title and suggests to think about audio clues in order to be less reliant on the phone's display. While making his point he goes through the "not relevant" stack and pulls out Noise (referring to loud sounds often encountered in urban outdoor areas). He* ***places Noise next to Sunshine*** *and states their connection: "If we use sounds to get rid of Sunshine then we get Noise." Together, R1 and R2 discuss how to overcome this combined challenge and mention the use of vibration as an additional clue to the player. They then agree to* ***move both cards over*** *to the "solved" pile. R1 takes notes and they proceed with the next card.*

The participants in this vignette are using a more collaborative approach. They have divided the cards into two stacks and take turns playing them. This enables both of them to equally participate in the session. They have also chosen a different strategy for discussing the cards. At first they decide how relevant the cards are and sort those into three designated areas. Towards the end we see another example where the spatial arrangement of cards plays an important role when two cards are put into context with each other by placing them next to each other. This helps the participants to focus on the commonalities and differences of the two cards.

Figure 63. R1 has taken up Noise from the discard pile (2) and compares it to Sunshine in the active central space (4). Underneath Sunshine are the other cards deemed "relevant". Maybe-relevant cards are stored next to them (3). Cards that have been extensively discussed are placed at the side of the table (5) and results noted down (1).

9.2.1.7. Spatial Arrangements

In addition to direct gestures, the spatial arrangement of the cards was also used to create meaning during a session. This is a phenomenon that I investigated in more detail during the Know How study. In the following transcript, a participant reflects on how the cards were a helpful visual aid and how it positively affected the design process. It starts with the participant takes a look at the cards that are selected and compares – as he calls it – positive cards (Opportunities) with negative ones (Questions and Challenges):

> *K2: But isn't necessarily that big of a problem. I feel like we still have a lot of positives which I think is good. Because overall* ***you probably would want more positives than negatives in terms of moving forward****. The difficulty then is that you still have a very wide set of options to explore. I'm not sure if that would happen with all things or whether this kind of project or whether you see that a lot.*

He then describes the plans of going forward in terms of changing the spatial arrangement of the cards, namely sorting them by relevance and relatedness:

> *K2: But it still feels like there is a lot in here, and* ***I think again tagging things together and connecting these into one****... Some of these things, like the roleplaying and the actors is probably gonna be kind of one thing now. So we could probably look at this tomorrow and just sort of* ***condense things into piles****.*

The cards were seen to structure the idea in a very intuitive and visual way:

> *K2: I mean I really enjoyed having the cards. And the positives are that it* ***helped me visualize and keep track of the ideas****. Cause we can attribute those ideas to a card, and groups them, and rearrange, and so on. So it is nice to sort of have* ***a kinetic way of organizing*** *ideas that isn't just writing down notes on post-its, you know,* ***something visual****.*

The fact that the cards can be easily rearranged if need be to convey new meaning or provide context is another advantage of having physical playing cards:

> *K2: I guess one of the issues is that now, and this might be specific to this project, now we have a lot of information on the table and it is hard to pass out, you know, get down to those individual little bits. I think that will be ok, because we will just go down to each area that* ***we've laid out these cards*** *and go into what each card represents. But I*

think that other ways or ***finding new ways to strip down essentials or group things*** *is probably gonna be beneficial. But that's a minor point really.*

The participant then also remarks that their idea has become rather big and unwieldy – something that is revealed by just looking at the number of cards and the space they take up on the table:

K2: Basically, I think it is easy, we are on a big table here and ***we've laid out a lot of stuff and it is easy to see that as a big mess of stuff****. And focusing in, seeing the trees for the wood or the other way around...*

Lastly, the participant reflects on how to reduce this *big mess* into something smaller, an idea that is perhaps more focused on constrained. Again, a new spatial arrangement to focus on such issues seems to be a plausible solution for this issue:

Interviewer: Do you have an idea on how to bring more order into this chaos now? Because we did a bit with Evernote stuff, you take a picture and then you can... Like after the positive card session you did that. Circling around stuff. Do you think that was useful?

K2: Yes, I think that is useful. Because I think if we hadn't done that this would seem like an even greater pile of, you know, one big pile of stuff. But once ***we split it off into manageable chunks****... I think the next sort of stage in this process would be to have, to work out what stages of the development we need to go into and then match some of these cards to those stages a little bit. So for some areas it would be 'Oh we need to work on the initial how players get into the game and what the initial mechanic is and* ***that will take five of these cards and put them in a pile of that****.*

9.2.2. Classifying Tangible Interactions

When looking at the observations from the studies, we can classify the effects of physicality. Cards were used to **structure discussions**, to **support arguments**, to **embody ideas**, and to **control access**. There is a certain overlap between these effects, and some of them are more commonly found within gestures, while others are mainly the cause of spatial arrangement.

9.2.2.1. Structuring Discussions

Utilizing the Mixed Reality Game Cards, participants were able to structure the unfolding design discussions. The cards allowed them to open and close discussion, and often times this was done non-verbally.

The most obvious activity one can perform for **opening a discussion** with one of the cards is certainly to **place it onto the table**. This is usually followed by a verbal explanation of why this specific card was played. However, vignette 1 has shown how a silent participant can still engage the attention of the other group members just by playing the card. It is a rather iconic action and clearly communicates that the ideation process is continuing with a new topic.

Similarly, instead of placing the card on the table, participants would sometimes simply **hold it up in their hand**. An example for this can be seen in vignette 4 where one participant took on the role of moderator and sequentially revealed one question card after the other.

We have seen another powerful gesture in vignette 2. One participant did not know which card to play and decided to **reveal the hand**. This allowed the other group members to provide advice on the potential cards that could be played.

Cards were likewise also used to **close discussions**. If the group decided that a card had been discussed at depth or was not relevant, the they would simply **discard** it. If the card was accepted and deemed still relevant, it might be **moved aside** to make room to **play a new card**. Here, the second card closes the discussion about the previous one while at the same time opening its own discussion. An alternative method was seen in vignette 6 where the participants would **sort the card onto a pile** depending on how they perceived its relevance.

The physicality of the cards also supported disputes as seen in vignette 5. Here, a participant wants to close a discussion – and prohibits another participant from reading the card (which would have prolonged the discussion).

9.2.2.2. Supporting Arguments

Another way of looking at how the cards affected the design discussions is by observing how any arguments played out, and how cards were used in order to support these.

In many instances, the cards were used to **make a point**. One example for using a card in such a way can be seen in vignette 3. There, a participant directly **refers to the card text** in order to convince the other group members of his opinion. The authority of the card designer is invoked and the physical card is used as an extension for it.

Participants would also **reference other cards** when trying to support their position. Participants would say that a certain card is similar to another one or the opposite of one – both perspectives could be used to support a new card or to doubt its relevance/suitability. This would often be accompanied by physically **moving both cards close together** allowing direct comparison of the cards.

Such support was even stronger when the cards were placed next to each other allowing direct comparison.

In a similar vein, cards were also used to **add emphasis**. These were typically simple gestures that would occur naturally during an argument. Examples include participants **pointing at cards** (or elements thereof) or, perhaps somewhat stronger, **touching or tapping cards** as seen in vignette 4. Sometimes, participants would even **hold up a card** in order to make sure that their argument was heard. Finally, they could also **move a card into the centre** thus drawing more attention onto it.

9.2.2.3. Embodying Ideas

The Mixed Reality Game Cards were also used to embody the design ideas that the participants were developing.

One way of doing so temporarily was already mentioned as part of the previous sections: Participants were **grouping cards next to each other** to contextualize them and show their connection. This is not only done to support an argument, but would also often be employed during the session to show a changed and expanded state of idea.

The **sorting of cards into different stacks** as showcased in vignette 6 is another way of storing information about the idea by arranging cards in a specific way. This is also true for when participants used a **discard pile** for all the cards that had already been investigated and deemed irrelevant for the current session.

The spatial arrangements that were discussed as part of the Know How study also fall into this category – especially the way how they arranged cards at the end of a session by first sorting through and then **conserving the idea**. Participants used different ways of representing their ideas in such a way. After the session with the Opportunity Cards, they sorted the cards into **domain groups**, i.e. separating them in accordance to the element of the game that would be affected by them (Figure

64). At the end of the whole session, the final idea was visualized with the cards as well. However, this time the cards were placed mainly into **function groups**, i.e. sorting the cards by their role in the overall design (Figure 65). This shows the versatility of the cards – participants can easily structure their idea to fit different perspectives on the design.

Figure 64. The Know How participants have arranged the Opportunity Cards in thematic groups (setting, user role, other users, enabling tech, start point, mechanics).

Figure 65. Visualization of the final idea by the Know How participants. Thematic groups: core, examples, reminders, engagement, authoring for other events, future, potential elements.

9.2.2.4. Controlling Access

The way cards were placed (or not placed) during the ideation sessions had a big effect on their accessibility. As part of the vignettes, we have seen that for example the action of "playing a card" can be done in several different ways. Some participants did not actually play the card, but instead just **held it up** for others to see. Other participants played the card onto the table: Some of them directly **in front of themselves**, others **onto the centre** of the table. These variations of the placement of the card naturally had big influences on the way the design process unfolded. In vignette 5 for example two participants physically struggled for the control of card. In other examples participants first had to lean in and perhaps orientate the card towards themselves before being able to understand the card's content.

During vignettes 3 and 5 there was a clear tension between the different participants. They seem to have arisen due to the fact that the participants in question did not have equal access to the cards. During vignette 3 one participant took control over the whole deck of cards and also played cards strictly in front of himself. This made it harder for the other two participants to grasp the concept the card was talking about as it was impossible to easily inspect it. The conflict showcased in vignette 5 was even more drastic with participants physically struggling over control of a card. In both instances, we have participants unwilling (intentional or not) to give up control. Their use of the cards is not inviting and thus hinders collaboration. Playing a card in front of oneself creates friction in an otherwise potentially seamless process. Other participants need to orientate or move the cards towards themselves and lean in and reach to do so.

At the same time, holding up a card does not automatically lead to conflict as evidenced by vignette 4 on the other hand. Here, one participant took on the role of moderator while at the same time not overpowering the other participants. Likewise vignette 2 shows how offering cards to other participants can in fact invite collaboration. Before his action the other participants did not know which cards he held - by showing them he gave up some of the control he had before over the cards.

9.3. Playful Interactions

To many participants, interacting with the Mixed Reality Game Cards was often reminiscent of playing a game. This is perhaps not very surprising when considering that the Mixed Reality Game Cards consist of physical playing cards and come with a set of rules governing the interactions with them. In this section I will take a closer look at which playful interactions participants engaged with and how they perceived them, before talking about ideation cards as design games in general.

9.3.1. Observations

During the first two studies (Lincoln1 and Magellan) there were only minor hints at the role that playful interactions take on in the design process. For example, one participant from Lincoln1 compared the cards to an existing trading card game which helped in understanding the overall process:

> *Looked like* ***Pokemon cards*** *so there was a familiarity.*

In Magellan one participant remarked made a general comment about how the atmosphere was similar to playing which in turn improved the session:

> *It was inspiring* ***play like*** *made it easy to reach new points*

In the later studies, I investigated the role of playful interactions more closely. In the following sections I have grouped them into four themes: **playful artefacts**, **playful structures**, **playful empowerment**, and **playful deceit**. Together, these qualities create a game-like or playful atmosphere, but they are in turn also made possible by this playful atmosphere.

9.3.1.1. Playful Artefacts

The fact that the cards were physical objects also had a big effect on how they were perceived. This is especially evident when taking a closer look at the blank cards. These were added to the deck in order to enable users to write down their own ideas and add them to a session (and potentially keep them for further sessions). In general, they were not used quite as frequently as one might have expected.

Despite their low usage, one participant from the Performance and Games study explains why they are still a crucial element of the deck:

P6: The concept of blank cards is very important, even if people don't use them. It's like having a car. You don't need to use it, but you have it in your garage. You know you can ride it. And ***the blank cards are important because they free you from the concept of "this guy has thought out every possible idea about mixed reality games"*** *which is not possible. So the blank cards, it is very important the blank cards stay in the final concept.*

The same participant had previously reflected on a potential reason of why these cards were not used as much / at all:

P6: We did not use the blank cards at all.

P14: That's true.

Interviewer: Because you thought that's not useful or?

P6: I think it was not something conscious, it was just 'cause we were discussing... ***Because when you have the concrete cards in front of you, you start discussing what's in front of you****. You don't think: 'Oh I could write another card and put it on'. I think there should be something, encouragement for us, some mechanism which would encourage using the blank cards.*

The available Mixed Reality Game Cards took on all the attention of the participants. The substantial deck, and then having the cards physically in front of oneself demanding attention. Here, the physicality affects the focus of the participants. However, other participants had a slightly different explanation for why they did not write on the blank cards:

P15: ***I felt like I couldn't write on them. Cause they are too nice.*** *They are too nice.*

This hesitation of "destroying" the cards did not only apply to the blank cards. During the Performance and Games study, one group decided to turn their game into a poster by sticking the cards on a large sheet of paper. The same participant as above continues the reflection and refers directly to this group:

P15: And it's almost like the same with Patrick's group. I was like: ***'Ahhh, you put the cards on there, you stuck the cards on there!'***

Interviewer: Yeah, they said they had a ***very bad feeling about doing that****.*

P15: I know! But you know it's kind of so, maybe that might have stopped us. You noticed we didn't touch them, filling in our own questions or things.

Another member of the group then suggests a solution to this problem:

P16: It's almost you need that thing in the beginning that ***gives you permission****.*

P15: Permission, yeah!

P16: ***So the first rule of the game is, you take one of those cards and then without having seen any of the cards you write one.***

P15: That's actually really great.

P16: Just so that later on, it doesn't matter what you've written, cause later on it means that you will...

P15: Yeah, you got a ***license to be naughty or scribble on things****.*

P16: I was ***thinking about tearing up one****. Going 'right, this is supposed to be temporary'.*

Such an exercise might in fact lower the barrier for users and change their perception from seeing the cards as a precious artefact into more of a tool. Arguably, most owners of board and card games take great care in making sure the components are not damaged. This learned behaviour runs in strong opposition to what users might be expected of doing with the cards – but it might be rather difficult to overcome this challenge.

A participant highlights this perception of physical cards being something extraordinary that might hem users in their interactions:

P17: It would be nice, because ***the cards are kind of special****, near the end we stuck onto bits of paper. I think the other groups didn't think of doing that.* ***So they are kind of sacrosanct****. So if you could annotate them while using them...*

Interviewer: Like writing on the card?

P17: Maybe if you had loads of sets of cards. And then we could say: One set to do this.

9.3.1.2. Playful Structures

The playfulness inherent in the cards also shaped the overall interactions and how they were perceived. An example for the how an interaction with the cards was seen in a very playful way can be seen in the post-session interviews from the Performance and Games study:

> *P10: And we had that moment, definitely, hadn't we? Between us, or between somewhere or on the table somewhere. Somebody played Social Contract, and somebody else said "Oh and I think User-Created Content really fits nicely to that". **That was a game-y moment**, like putting the right card on the table.*

The situation the participant describes is reminiscent of many card games. Playing the perfect card in a given moment allowing one to perhaps even win the game and seeing how everything comes together just right.

At the same time, this playful approach to the interaction allowed the same participant to undo a less than ideal move:

> *P10: And also vice-versa, we had the moment of "I think I played the wrong card, **I should take it back** and I think that's a better idea for the moment." So it did help facilitate the process somehow.*

While such behaviour is not necessarily that common in games (that usually do not allow you to take a move back), it is still different to how such a situation would perhaps play out in another type of brainstorming session: By being in the mode of a game, the act of reversing a move is something that everybody intuitively understands and in turn is willing to undertake.

Framing the whole experience as a game however can also have detrimental effects to a session as outlined here by another participant:

> *P6: In the third round, we had the combination between the game from the second and third round. And then we had drawn additional even more additional cards to find rules for our own game. But we had way too many ideas. In the third round we already threw in cards although we actually had said 'oh, enough'. **People threw in cards a little bit for fun** saying: 'Oh, I'll add this as well. Although it doesn't work. But I put it in regardless.*

Playing any card to extend the idea creates a challenge for oneself and the other members of the group. In turn, some participants did so in order to see if the others

were able to deal with the new situation. They make it intentionally harder to make the design process more enjoyable from a certain perspective.

Overall, these interactions are of course affected by the underlying rules of the session. While these rules should guide the session, the participants agreed that they should not be interpreted too strict. The example or nullifying a turn from above is one such example where the difference between the activity being playful and it being a fully-fledged game becomes apparent. Participants appreciated that the rules could be bent so that they were not overshadowing the session:

> *P16: Yes, I think in general that's that flexibility, isn't it, where it's in the rules saying* ***'don't be constrained by the rules'****. So that kind of cards we weren't exactly sure what to do with. But then, you know, sort of using them as the ide was developing and you know* ***messing about with the structure a little bit was kind of a positive****. It wasn't like... It's good that it's not a proper board game. You know, with points and loads of mechanics and stuff.* ***I think that flexibility and looseness is positive****.*

At the same time, there are still more possibilities for the rules to frame the session. One participant speculates on other elements of improving the structure of a session:

> *P6: What the cards cannot do is to really control the group dynamics. If somebody is overbearing in the group. For this,* ***you would need some meta cards****. That do not just talk about the themes of the game, but also about the process. This process, maybe it is there, and we have just not found it, the process of the development itself. Something like "does the group take a vote on a topic if there are two different ideas, or is the decision made by one person? Are there different roles within the team? Something like that for example, that would be kind of interesting to think about.*

9.3.1.3. Playful Empowerment

The playfulness of the whole experience also led to a certain empowerment of the participants. Playing a card is a very simple act that, as we have seen in the section on physicality, can attract attention. This is likewise also relevant when looking at it from a perspective of playful interactions. For example, two participants from the Performance and Games study reflect on how turn-taking was beneficial to how a session played out:

P13: Everybody put one card in, chose one card, so you did have some control, and some influence anyway, ***even if you are not necessarily very vocal.***

P8: The turn-order as well seemed good because there is that stage were, I think you started to put a card in and we had to kind of follow your lead and say why we would complement that. But ***that meant that you actually influenced the game.***

The playfulness of the session however even goes beyond this – which is something that was especially evident in the post-session interview with the participants of the Know How study:

K2: I think it is like important as a function as an ***ice breaker*** *as well. Because at QUAD me and K3 and K1, we are not in the same department. We all don't work together all the time. And I obviously just met you, just met K4. So getting those cards out and having us all do something were we are not expected to come up with the ideas ourselves, we're just reading the cards ourselves and then giving our opinions on them was a really really important tool I think for just* ***keeping the thing flowing and stopping people from being shy****, stopping people, you know...*

The fact that the session was set-up like a game enabled the participants to easily transition into the ideation activity. The cards were a tool that helped them overcome any barriers or inhibitions they might have:

K2: It overcomes a load of problems I think we are not even considering, you know. We jump straight into them being useful. And I think when you are working with other people, like a lot of people who maybe not feel as confident about talking through with a group... Or people who maybe don't normally work in those kind of processes. I think ***giving them these prompts is incredible and useful****.*

K4: ***The fear of looking stupid****.*

K2: Yes exactly, yeah, you are reading a card, it's the card you played, ***it is not your crap idea, it's the card told me to do it****.*

The latter was something that also had a big effect how participants perceived game ideas generated with the random draw method or limited choice. Looking at it from the perspective of playfulness, the alibi that the cards provide is perhaps even more evident.

The same participant continues his thoughts and describes how the fact that they were seemingly playing a game affected this perception:

K2: And I think once you throw it down, everyone considers the same topic for a second or two, so anything really obvious and pressing that is from that card will get discussed by everyone in the group and you make sure you get everyone's viewpoint on it from their varying backgrounds and then you move on. Cause everyone's got another card they wanna play. ***Cause you are almost playing a game.*** *You feel like you wanna get rid of all your cards, you know, you want to hurry up and play them. And once they are down on the table you can come back to them later. You got a note there that says what you are gonna do, so. I think it's perfect, the kind of development.*

The fact that the Mixed Reality Game Cards turn a session into a playful experience also allowed participants to learn and understand the process rather quickly – even going so far to being confident that they could now introduce the method to new users themselves:

K2: But I love the fact that ***it feels like you are playing a game****. And it feels like you are playing a game to the point where I now feel like I could go and explain it to other people and use this technique with other things. And that's, from my experience of playing games, that's how that works. One person plays it with a group of people and then they can take it away and can show their friends and explain the rules. I think it will be really interesting to see if other people take this set and adapt and get their house rules.* ***How they are gonna play it, how they are gonna make it adapt to their workflows or their products or whatever it is they are trying to get as an outcome.***

9.3.1.4. Playful Deceit

The playfulness proved to "trick" the participants into forgetting that they were participating in an ideation session. This is best illustrated with a discussion from the post-session interviews at the Brisbane Writers Festival study. Participants were reflecting on how they would go through the stack of discarded cards looking for something that would help them in their design process:

Interviewer: At some point I noticed that you were looking at all the cards that were still available and then picking them from it. Which could be another mechanic of getting the cards as compared to drawing them randomly.

B7: I had that card before and I put it back in, because I was realizing that all my cards were decent. and when I picked it up later I thought it was a relevant point so I searched through to find it.

This is when another participant chimes in and brings up the idea that they were playing something akin to a game:

B8: Yeah, its ***potluck*** *in the beginning, and it's* ***almost like a game*** *and then you just build on your own power: Ok, I am going through this deck of cards, which one will actually let you feed into the game.*

Interviewer: Because you already knew the cards.

B8: Yes, yes, exactly.

Here, arguably the fact that participants would get access to the cards in a random order created a game-like atmosphere. However, in addition the participants felt that (again, like in a game) they now had a goal to achieve in order to "win". This is further evidenced in the next part of the interview:

B7: I think I found myself confused about what I was doing at some point, because ***I initially started out at looking at this as a game*** *and drawing random cards and constructing this thing as we went along, which was just* ***kind of a fun exercise*** *but then after a while it felt like, oh god,* ***we are actually trying to develop something****.*

B8: The responsibility!

B7: And digging through the cards, ***we have to make sense of this now****!*

What was first perceived as a *fun exercise* turned into a more serious endeavour all of a sudden when the participants realized that – despite the session being playful – there was actually a meaningful outcome expected of them beyond the actual duration of the session.

9.3.2. Classifying Playful Interactions

The Mixed Reality Game Cards are **playful artefacts**. The physical cards are creators of a playful atmosphere due to their resemblance to card games. When the cards are placed in front of them, they create the playing field upon which the design process unfolds. This also caused the Mixed Reality Game Cards to be

perceived as *sacrosanct*. Participants were hesitant to destroy the cards by writing on them or sticking them onto a sheet of paper as a poster.

Users know how to hold the cards, how to play the cards, how to discard the cards. They use their knowledge of card games to easily follow **playful structures**. Due to the familiarity with games, the sessions with the Mixed Reality Game Cards became very natural. Users decided to increase the challenge of the ideation process by intentionally playing cards that would be difficult to integrate. Likewise, when the "perfect" card got played, participants felt like they had "won" the session.

Being in this state of play led to a certain **playful empowerment** when using the Mixed Reality Game Cards. The cards allowed them to propose an idea without *the fear of looking stupid*. In this way, the cards acted like a shield which lowered the barrier for participation. The cards also gave participants agency over the idea. In a way, the act of playing a card was almost as important as suggesting the change to the idea resulting from the card.

Lastly, some participants forgot that they were not actually playing a game. This **playful deceit** made them operate as if they were playing a game, with all the aforementioned effects. Eventually however, participants would realize that the activity was in fact more than a game and an actual output was expected from them.

9.3.3. Ideation Cards as Design Games

Another way to look at the elements of these playful interactions is via the lens of design games for which ideation cards are an example. You use physical cards and then collaboratively explore whatever it is that you are designing. The cards will come with more or less complex instructions on how to use them, even if it is just "Go through all of the cards one by one and discuss how each card relates to your design project." Other ideation decks might tell you exactly how many cards to draw, how to play them, and maybe even want you to follow turn order. These are all interactions we all know from card games we played when growing up and might still be playing these days. These instructions are the rules of the ideation game that we are going to play. Unlike most card games we are doing this collaboratively, trying to "win" the game together by creating an interesting design. We are also constantly reminded of partaking in a game because we are **playing** the cards. This is the language that the participants of such a session use, and they then also often adopt typical game behaviours (see below). Ideation cards have the same

affordances that playing cards have, and as such playing, drawing, discarding, shuffling, moving, stacking, etc. comes naturally to whoever participates in the design process.

Let us take a step back and look at a session with ideation cards from the perspective of a game. In the case of ideation cards we can observe several elements that are typical for games:

1. Players - the designers that participate in the session
2. Game pieces - the ideation cards themselves
3. Rules - the instructions on how to use the cards
4. Goal - the development of an idea

To further investigate the role of playful interactions within ideation cards as design games, I want to come back to the distinction between paida and ludus made by Caillois (1961):

> Such a primary power of improvisation and joy, which I call paida, is allied to the taste for gratuitous difficulty that I propose to call ludus, in order to encompass the various games to which, without exaggeration, a civilizing quality can be attributed.

Depending on the level of rules that a specific deck of ideation cards employs, we might say that it is an example of paida if it is rules light and focuses on creating a playful atmosphere and discussion and of ludus if the rules are detailed and follow a more well-defined structure. This difference is especially prominent when comparing idea generation and idea development with the mixed reality game cards. Whereas the first is highly structured and so serves as an example for ludus, the latter allows participants to follow a more free form of play (paida).

An additional concept to help with understanding the effects of ideation cards as design games is Huizinga's magic circle (1970) or rather the interpretation by Salen and Zimmerman (2004):

> *In a very basic sense, the magic circle of a game is where the game takes place. To play a game means entering into a magic circle, or perhaps creating one as a game begins.*

How does this magic circle affect a design session? Before the session starts, everybody is themselves with the goal of designing a game. Generating and developing an idea is not an easy task but instead a serious one. When we use the

ideation cards however we begin a game where we play designers creating a game. The magic circle then protects and guides us along this journey. The game rules give us constraints but also make us free (e.g. we are not taking the blame for the ideas). Throughout the process the players may step in and out of the magic circle and for example reassess the progress they have made based on real world concerns. Then, at some point, the game finishes by arriving at a joint design idea. The players leave the magic circle and become themselves again. However, the outcome of the game leaves the magic circle with them: the developed idea. This process is summarized in Figure 66.

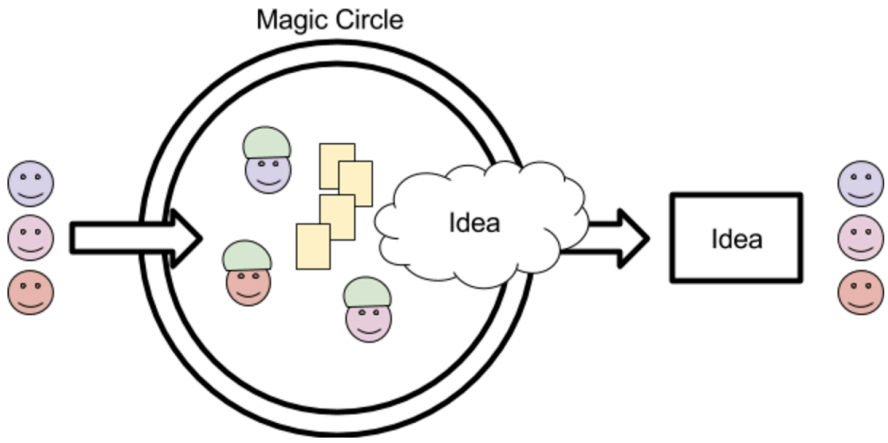


Figure 66. Alex, Brook, and Clay enter the magic circle. They play the role of game designers using ideation cards. They return to the real world with a concrete idea.

In the illustrated example, Alex, Brook, and Clay want to generate and develop an idea for a mixed reality game. They gather around a table and start preparing the Mixed Reality Game Cards. Alex explains the rules while Brook separates the cards and shuffles the different stacks. During this process the three gradually enter the magic circle. Once the cards are handed out the game-to-make-a-game begins. The three are now playing game designers. The cards and the rules guide them, and the magic circle protects them from the outside world. The three of them play cards, discard others, discuss their actions, and how best to overcome the obstacle of creating this specific game. After two hours, the game is coming to an end when the idea they have been building becomes more and more solid. They end the session, cease playing game designers, and leave the magic circle behind. From their

journey however they have brought along the idea which has now become real and substantial.

Taking the experiences with the Mixed Reality Game Design Cards and situating them into the context of play and the magic circle, three themes seem to be important to discuss: rules, safety, and purpose.

Games have rules. Brandt and Messeter (2004) see strong similarities between the structure that rules give to games and the design process in multidisciplinary teams:

> *When playing a game the rules set the boundaries for what is possible and structure the play of the game. In design the designers have various roles and responsibilities. [..] The design assignment, the resources, the participant's roles and responsibilities and the ways of working establish, like game rules, the boundaries for the work.*

The importance of such a structure has already been explored in the previous chapters. The rules set up a framework within which the players are allowed to play with the cards. The rules prescribe whether there is turn-taking. How players should go through the deck. When to play cards and when to discard them. In some ideation card systems, these rules might be written down in much detail (e.g. VNA, PLEX) others promote a more free-form approach (e.g. Tangible Interactions Framework Cards, Deck of Lenses), but perhaps prescribe turn-taking. This structure is an example for ludus.

Because they feel like they are playing a game, it also does not take a lot of convincing to make players follow the rules due to an emerging *lusory attitude* (Suits, 2005). This provides an important layer of structure to the design session as it makes participants hesitant to break the rules as they do not want to be seen as a spoil-sport (Huizinga, 1970).

> *Inside the play-ground an absolute and peculiar order reigns. Here we come across another, very positive feature of play: it creates order, is order. Into an imperfect world and into the confusion of life it brings a temporary, a limited perfection. Play demands order absolute and supreme. The least deviation from it 'spoils the game', robs it of its character, and makes it worthless.*
>
> *[..]*
>
> *The player who trespasses against the rules or ignores them is a 'spoil-sport'. The spoil-sport is not the same as the false player, the cheat; for the latter pretends to be playing the*

game and, on the face of it, still acknowledges the magic circle. It is curious to note how much more lenient society is to the cheat than to the spoil-sport. This is because the spoil-sport shatters the play-world itself. By withdrawing from the game he reveals the relativity and fragility of the play-world in which he had temporarily shut himself with others. He robs play of its illusion - a pregnant word which means literally 'in-play' (from inclusio, illudere, or inludere). Therefore he must be cast out, for he threatens the existence of the play-community.

Similarly, more on the side of paida, players will immediately adopt typical behaviour from card games: They will know how to hold the cards and more often than not hide their hand of cards from the other players as if playing a game of poker. They will likewise respect their fellow players and not "steal" cards from their hand without being invited to do so.

With clear rules, ideation games also control the flow of the discussions. Kultima et al. (2008a) conclude the following:

[Rules] make the game progress in an orderly fashion and provide a fair chance and equality for all the players. The game, the playing session and the rules provide a solid facilitator for the idea generation session.

Experienced players will also not hesitate to create so-called house rules for the particular ideation game to shape the play according to their preferences, e.g. deciding between turn-taking and free play of cards. Again, Brandt and Messeter liken this to design as an activity:

In both playing games and designing the rules can be subject to negotiation and change.

Games are safe. According to De Koven (2013) two important elements of playing a game are safety and trust:

We need to feel safe within the game we want to play well together. [..] The safer we feel in the game we're playing, the more willing we are to play it. But, for this experience of safety, we can't solely rely on the game. We must also be able to believe that we are safe with each other.

While De Koven compares this to the danger when e.g. mountain climbing, the social contract that games create make the players feel safe within the magic circle. They trust that they are playing just a game and the unfolding activity loses its perhaps threatening seriousness. These observations are supported by Castronova

(2008) who considered the magic circle a shield of sorts, protecting the players from the outside world. Apter (1991) speaks of the way how *the real world [..] can do no harm*. Reflecting on this, Stenros (2014) calls it a *psychological bubble*, that makes one feel *secure and unthreatened*.

While asking someone with little experience to help design a game might be a frightening for them, it might appear less so if you invite them to play a game. Framing the activity in such playful way lowers the entry barrier and makes players feel more relaxed – something that was very evident during the session with the charity members from Sustrans. They know it is a game, and after all it is acceptable to be bad at a game and maybe even lose. Because players are playing a game they are allowed to make mistakes. A common occurrence in the studies was for players to blame the cards afterwards: *Sometimes the cards weren't very good which could limit your ideas* (Lincoln2). This shows how a lot of pressure is alleviated from the players and shifted towards the cards. The cards provide an alibi if something does not work out. For the same reason it is also easier for players to *say daft things (Sustrans)*. They feel encouraged to come up and propose unrealistic and whacky ideas (read: creative), sometimes even required to produce such ideas. Because the cards allow them to hide behind them. Or because they were forced to say these things due to the (bad) luck of the draw. The serious activity of brainstorming is turned into a game that brings with it a playful attitude positively affecting creativity and is an example for how paida positively shapes the atmosphere of a design session. The players know that they are playing a game and that the special social contract for games intuitively also apply when playing an ideation game. They are inside the magic circle, protected from the harsh and serious outside world. This is similar to how the red hat protects participants that voice negatives when applying the Six Thinking Hats method (De Bono, 1999). Critique that is e.g. voiced when a Challenge Card is played becomes impersonal and loses its potential for harming other participants.

Games have goals. Huizinga sees tension as an important element of play.

> *Tension means uncertainty, chanciness; a striving to decide the issue and so end it. The player wants something to 'go', to 'come off'; he wants to 'succeed' by his own exertions. Baby reaching for a toy, pussy patting a bobbin, a little girl playing ball - all want to achieve something difficult, to succeed, to end a tension.*

These tensions, the striving to achieve the goal of "winning" the ideation game aligns itself nicely with the desired outcome of creating an idea. Players will not only try to develop the idea because this is the ultimate target of the activity, but also because it is now a (joint) competition. This creates another layer of motivation, of driving force, to the ideation activities. Practically it means that holding cards also encourages players to play these cards. This is done in order to progress in the game and as such gives a feeling of accomplishment, a feeling of having contributed. Players will want to go through all of the cards, especially cards that pose them with a question or challenge (paida). Then, when they have completed the stack, they have finished this particular level of the game. This eagerness also brings some peculiar effects with it. Players might continue adding cards to an idea not willing to stop the powerful act of playing. Other players might play a card just because they can, for example to see how the others (or they themselves) will deal with this additional obstacle as seen in the Performance and Games study. Here, participants clearly enjoyed the freedom that allowed them to play cards without restrictions. In a more ludus-driven session this might be non-acceptable behaviour and shows how paida can stimulate a session.

On the other hand, the strive to "complete" the game can also tempt them to "cheat". If they cannot find a quick or obvious answer to a card that is trying to provoke reflection or a discussion, they might just quickly continue with the next one and shrug this one off. This was for example observed during the Sustrans study when a particularly "difficult" card was going to be ignored. However, one of the study participants stepped up and insisted to include it after all in order not to make things too easy. As they are all playing together, the game is the antagonist but cannot do anything directly to stop them to properly deal with the issue at hand. Here, the rules of the game might need to intervene and discourage such behaviour from happening. On the other hand, a very strict enforcing of this rule might reduce the freedom of the session, so it is important to find the right balance between ludus and paida.

9.4. Chapter Summary

This chapter looked at some of the previously described studies from a more research-driven perspective instead of the design-focused ones from preceding chapters. The Mixed Reality Game Cards are physical objects that resemble ordinary playing cards. As such, they share the same affordances as them: users can shuffle, play, discard, point at, and arrange them in their hand or on a table. They afford gestures and spatial arrangement in the form of tangible interactions. Additionally, the Mixed Reality Game Cards also promoted playful interactions – for many participants interacting with the cards was reminiscent of playing a game. These *action-possibilities* (Gibson, 2013) have a profound effect on how a design session unfolds that is conducted with the Mixed Realty Game Cards. Tangible interactions include how cards structure discussions, how they support arguments, and how they embody the ideas that are being developed (Table 26).

Structuring Discussions	Opening Discussions	Placing card on table Holding card up in hand Revealing own hand of cards
	Closing Discussions	Discarding card Playing a new card Sorting card into pile
Supporting Arguments	Making a point	Referring to card text Referencing other card(s) Moving cards close together
	Adding emphasis	Pointing at card Touching / tapping card Holding card up Moving cart into centre
Embodying Idea	Ad hoc	Grouping cards Sorting cards into stacks Discarding card
	Post session	Arranging cards into domain groups Arranging cards into function groups
Controlling Access	Giving up control	Cards in centre of table Orientate cards towards others Revealing own hand of cards
	Keeping control	Cards in front of oneself Orientate cards towards oneself Holding on to cards

Table 26. How tangible interactions influenced the design process.

In addition, the Mixed Reality Game Cards also afford playful interactions (Figure 67). The nature of using playing cards in addition to a varying amount of guidance set-out by the rules lets participants take on a lusory attitude. And overall playful atmosphere is achieved and the design session takes on many attributes typically associated with games. Rules structure the session, participating designers attempt to achieve the goal of creating an idea (or several). At the same time, the magic circle protects them and makes them feel safe, so that there is no longer a fear of looking stupid.

The playfulness of the session is a mixture of paida and ludus. Where idea generation is often highly structured and thus falls closer to ludus, idea development thrives in open sessions that resemble paida.

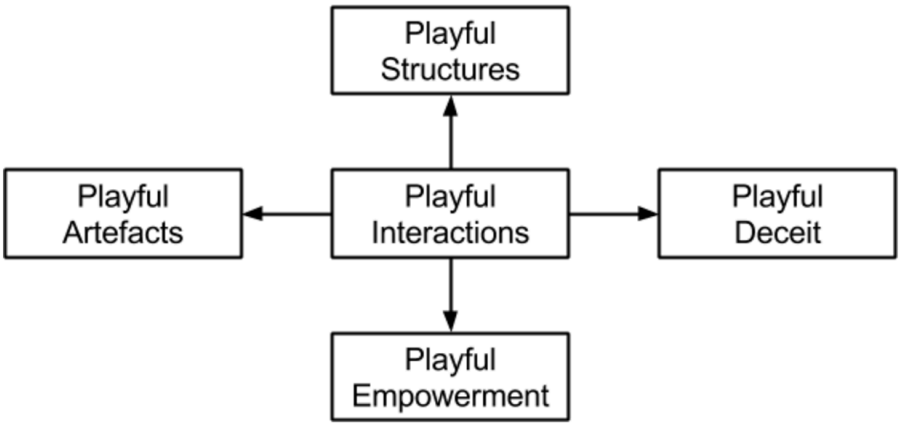


Figure 67. Overview of playful interactions during an ideation card session.

10. Unpacking Ideation Cards

10.1. Overview

In the previous chapters I have looked in detail at how the design of the Mixed Reality Game Cards unfolded by describing seven studies. The resulting deck of cards supports **idea generation** and **idea development**, the two ways that ideation cards are being used in ideation sessions. As a designer of ideation cards, I was able to influence the **content** and **appearance** as well as **rules** of the Mixed Reality Game Cards in order to promote these two similar but ultimately different purposes. In addition, I also discussed two phenomena that lie outside the direct influence of the ideation card designer but naturally emerge during such a session: **tangible** and **playful interactions**. Together, they form the core qualities that enable ideation cards to be successful facilitators of design sessions, and can be briefly summarized as follows:

Content. Cards contain text and images. These can be domain-specific or domain-agnostic. The content of a card can take many forms as evidenced by looking at the various different ideation card decks that have been developed. Depending on the type of content some ideation cards might be more useful for idea generation while others shine at idea development.

Appearance. This is how a card is physically designed. How is the text laid-out? Are visual cues used to make the cards easier to distinguish, and how appealing are they. While some cards might be oversized and printed in landscape format, others have typical playing card dimensions and make use of portrait format.

Rules. Ideation cards do not exist in a vacuum but can come with quite detailed prescriptions of how to use them. Typical rule variations specify turn-taking, random drawing of cards, card limits, or when and how to introduce the cards to a session. Some rules also mention how much users are encouraged to deviate from the proposed rules.

Tangible Interactions. Ideation cards are physical objects. Cards are being picked up, played, discarded, grouped, held up, stacked, and shuffled. From a high-level perspective cards afford gestures and placement that have been identified as core contributors to the intricacies of ideation card sessions in section 9.2.

Playful Interactions. Ideation cards are design games as seen in section 9.3. Users of ideation cards often perceive themselves as players of an ideation game. Embracing such a playful atmosphere lets users feel safe while at the same time allowing them to focus on the goal of the game – creating an idea.

These five qualities affect the design process in a multitude of ways. I will describe how they affect what I have identified as the crucial elements of the design process: **knowledge**, **inspiration**, **focus**, **negotiation**, and the **idea**.

Idea. The idea is the conceptual outcome of an ideation session. A session might generate ideas from the ground-up or thoroughly evolve an existing idea. While the idea itself is abstract it is typically visualized and documented for later use and to summarize intermediate stages of the idea.

Negotiation. In collaborative design sessions, the participants need to agree on the overall idea. As such arguments and suggestions are made and designers are trying to find common ground by discussing their standpoints. With the introduction of ideation cards this is often done also non-verbally.

Inspiration. Creativity plays an important role in ideation sessions. Participants need to come up with innovative ideas that ideally are new and unique. Inspiration may come from a variety of different sources. These can be domain-specific but inspiration is likewise also often triggered by domain-external sources.

Focus. To develop an idea, designers need to be able to focus on the specific elements of it. The idea is put under scrutiny and viewed from different angles that help turn it from a hypothetical vision to a more well-rounded and realistic idea. Such idea development often follows a previous phase of idea generation.

Knowledge. In order to contribute to an idea it is necessary to be aware of the intricacies of the design space in question. Being aware of related ideas helps to evaluate new ones and to put them into context. This awareness of the design space not only helps with the development of ideas but also with their generation.

In this chapter I will explore these concepts more closely and put the experiences with the Mixed Reality Game Cards into the wider context of ideation cards in general. In order to do so I will unpack how a typical design session unfolds and discuss the features of ideation cards in general and unpack **how they ultimately influence the design process**.

10.2. Understanding the Design Process

In order to understand how the design process unfolds when ideation cards are being used, it is helpful to first visualize the lifecycle of a card. The lifecycle describes how a card enters a session, what happens next, and how the card remains (or leaves) the design process.

At first, we might want to look how the lifecycle of an Opportunity Card looks like during idea generation utilizing random draw. A card is revealed together with others), they are discussed, and afterwards the resulting idea is archived.

With limited choice, the card is first drawn into the hand of a participant who then contemplates whether to play or discard it. When a card is displayed, it is then discussed by the group. A card is then usually kept as part of the current idea.

The latter is very similar to how cards are used during the idea development process: The enter the session by being drawn, considered by a single participant in their hand, played, discussed, and then discarded or kept.

These three seemingly different lifecycles can in fact be simplified to only contain three elements that are important for the collaborative design process. Each card is first played (by randomly revealing it or by deliberately doing so by a participant), then discussed, and then a decision is made by the group (to keep, discard or archive the card). The process then continues by playing the next card. Figure 68 illustrates this simplified lifecycle that is performed several times during an ideation session.

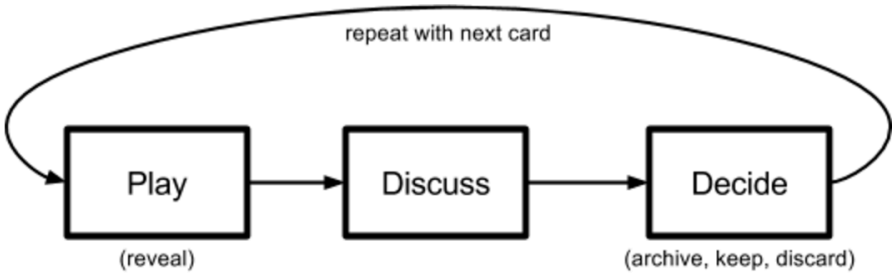


Figure 68. Simplified lifecycle of a card during the design process.

The most interesting part of the design process with ideation cards arguably happens during the design **negotiations** which are bookended between playing a card and the final decision. After a card has been played, suggestions are being

made and argued for and against. In section 9.2 we have seen an account of how gestures with (or at) cards are being used to facilitate these discussions.

These design discussions end with a decision, which ultimately affects the overarching **idea** that has been the goal of the whole session. We can say that each idea development session consists of one all-encompassing idea that will be the end result of the session. In idea generation, multiple of them are created (which are smaller in scope). We might however also say that the overall design process includes a constant creation of (small) ideas that influence the state of the overarching one.

Ideas are the outcome of design discussion. However, how are these discussions facilitated exactly with ideation cards? We can find accounts of the effect of ideation cards in work by Hornecker (2010). She talks about the role of structure and rules in regards to the Tangible Interaction Framework Cards. According to her, the cards act as *orienting devices*. She notes that cards led to *productive discussion* due to a *willingness to interpret the questions loosely*. The cards also *successfully structure discussion* and are *fostering shifts of focus*. In general, they also *initiate discussion* and can be used to *short-cut unproductive discussions*. The creators of the Exertion Cards report similar findings (Mueller et al., 2014). Overall the *cards helped fine-tune ideas*, making them more concrete. The *cards offered guidance* on *how to proceed with the design task* and they *expanded horizons*, meaning they forced participants to consider areas they normally would not. They also had the effect of *shifting processes*, making participants think less about what elements to add to a game design and focus more on how to emphasize a desired quality. Another element was the *factorizing of tasks* or enabling participants to look separately at different aspects of an idea. Another quality, *weighing up options* describes how participants could visualize the strong points of their design and easily identify (and fix) flaws. Lastly, the cards kept the participants on track to design an engaging game by *focusing the aim*.

Summarizing these observations, we may say that ideation cards provide **inspiration** as well as **focus**. We can find these two qualities in the Mixed Reality Game Cards as well where interacting with the Opportunity Cards has been likened during the Know How study to *blue sky thinking* and Question and Challenge Cards were seen by the same participants as *grounding an idea* and scrutinizing it. The difference between these two elements become more pronounced when we

compare their role as part of idea generation and idea development. Ideation card sessions can just revolve around one of these goals, or they can combine them (just as the Mixed Reality Game Cards do). The main difference between these two goals is that idea generation arguably requires more inspiration while idea development profits from a strong focus on specific elements. Inspiration is about extending (creating) the idea whereas focus attempts to analyse and refine the existing idea (visualized in Figure 69).

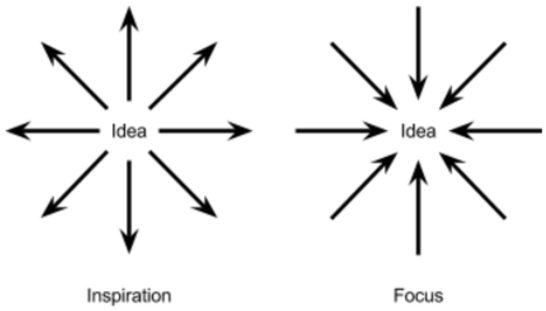


Figure 69. Emphasis on inspiration during idea generation, and focus during idea development.

It is of course too simple to say that idea generation only consists of inspiration - likewise idea development does not solely rely on focus. Both modes are used side by side during all stages of ideation, with inspiration dominating focus during idea generation and vice versa during idea development.

However, there is a third important element that is provided by ideation cards in addition to inspiration and focus. The Mixed Reality Game Cards (like many other ideation cards) also provide participants with access to **knowledge** of the design space of mixed reality games. This is a further element which is typical for domain-specific ideation cards and for example cannot be found in ideation cards like VNA that do not make use of the underlying design space in a direct way. In many ways, knowledge (or pre-existing experience) is a core requirement for successful design. Designers draw from their (domain-specific) knowledge both for inspiration as well as focus. Mumford and Gustafson (1988) go so far to define knowledge (and comprehension) as crucial during ideation:

> *One implication of this statement is that knowledge and comprehension of a given problem area are likely to represent prerequisites for creative activity and idea generation.*

In their article they refer back to several theories (Bradshaw et al., 1983; Langley, 1987; Simonton, 1984; Snow, 1986) that all stress the essential role of knowledge in idea generation. It is certainly not a stretch to extend this importance also to the act of idea development. After all, it is an undeniably advantage for exploring an idea in more depth when one is aware of its potential shortcomings that might not reveal themselves without previous experience of the domain.

Bringing all of these elements together, a typical ideation activity can be represented as in Figure 70. The design discussion stands in the centre of the overall process. It is influenced by the other elements, and likewise affects inspiration and focus (through influencing the other designers present in the session) before ultimately resulting in the final idea.

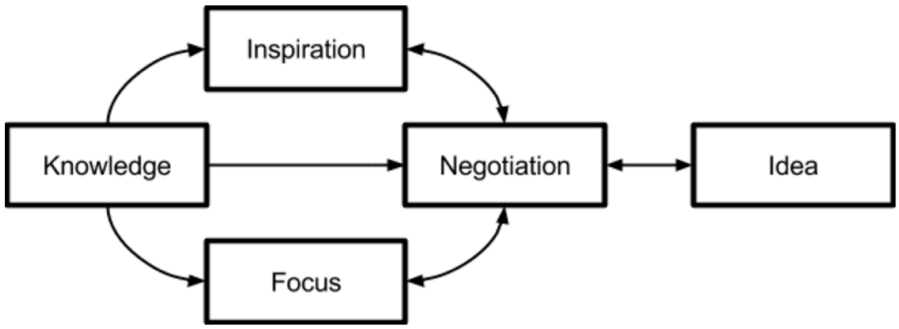


Figure 70. The design process during a session with ideation cards.

10.3. The Role of Ideation Cards

The model from the previous section has uncovered the salient elements of a design process facilitated with ideation cards. But how do ideation cards actually influence the different elements of the design process?

When designing the Mixed Reality Game Cards, I was able to directly influence three qualities of them: the **content** of the cards and their **appearance**, and the **rules** for interacting with the cards.

The content on an ideation card can take on a variety of shapes, be it images, short phrases, questions, or elaborate descriptions of certain aspects of the design space. This content is then put on a physical card of certain dimensions and presented in a specific way. Additionally, ideation cards usually prescribe how they are supposed to be used. These rules then clearly affect the enfolding ideation session. As part of the design chapters, we have also seen how different content and different rules are

necessary to support both idea development and idea generation, and how the appearance can help or hinder a fluent session.

In addition to this, in chapter 9 I have identified two phenomena that play an additional and important role in the design process: **tangible interactions** (gestures with and placement of cards) and **playful interactions** (paida and ludus).

Unlike content, appearance and rules, a designer of ideation cards can only indirectly influence the unfolding tangible and playful interactions. Content and appearance of the cards influence each other. The physical dimensions limit the amount of content that can be put on a card while the design has to make sure to e.g. include images and needs to make different categories of cards visually distinct. The rules then prescribe how the content in the form of the cards should be interacted with. However, these are naturally only suggestions than can encourage and promote specific tangible and playful interactions. Figure 71 gives an overview of the interdependencies of these elements of ideation cards.

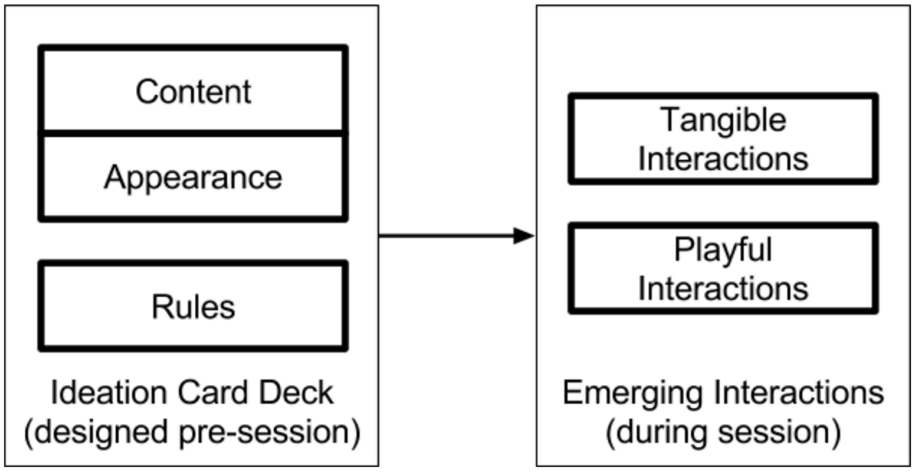


Figure 71. The five qualities of ideation cards. Content and Appearance constitute the cards and create an ideation deck together with the rules. These are created before the start of a session and cause tangible and playful interactions to emerge during the design process.

Having defined the elements of the design process in the previous section, we can now set the qualities of ideation cards in relation with these. In the following sections I will investigate the role that each of the five qualities (content, appearance, rules, tangible interactions, playful interactions) plays in relation to the five elements of the design process (idea, negotiation, focus, inspiration, knowledge).

10.3.1. The Role of Content

Ideation cards enable designers to use them as building blocks for their **idea**. As each card talks about a separate aspect of the design space, it enables designers to choose the cards that are appropriate for the idea. During an ideation session, they slowly assemble the idea from these distinct pieces. At the end of a session, the idea is represented by the cards. Depending on the type of the content the cards either directly embody the idea like Opportunity Cards or elements of the idea are derived from them as is the case for Question and Challenge Cards. Content that is not specific to the design space adds external flavour and colour to an idea (e.g. Theme Cards). Some ideation cards add to an idea whereas others refine it and perhaps even reduce it.

Likewise, the type of content has broad implications on the ongoing **negotiations**. Opportunity Cards are direct positive elements that are proposed as new features into the negotiation. Question and Challenge Cards however trigger reflective negotiations about the current state of the idea. This is the difference between expanding an idea and grounding it in reality. The negotiation is furthermore heavily influenced by the phrasing on the cards. If a card is text-heavy or difficult to understand it brings the negotiations to a halt while participants have to carefully study the card. Instead, the content of a card should be succinct and easy to understand (depending on whether the cards also target inexperienced users). The exact phrasing of a card also has a direct influence. Open questions that require elaborate answers provoke discussions while simple yes/no questions lend themselves to being quickly answered and then disregarded. Cards also change the dynamics of the negotiations as they are being used as an alibi. Criticism of an idea is directed at the card but not at the person who played it.

The latter is an important consideration when talking about **focus**. In order to promote in-depth reflections, the card should not provide an easy answer like the aforementioned yes/no questions. Instead it is important that a card introduces a specific aspect of the design space to force the designers to think about their idea from this (new) perspective. The cards can talk about high-level as well as low-level elements of the design space as both are crucial to fully develop and flesh-out the idea. Likewise, the Mixed Reality Game Cards have shown that highlighting potential design issues is considered helpful by designers, perhaps especially by less

experienced ones. This allows them to "proof" their designs against real issues way before actually implementing them. The cards ground an idea and make it more realistic by providing practical cues.

The content of ideation cards is also a powerful source of **inspiration**. They provide designers with a base for their creativity by showcasing the overall design space they operate in. Design elements are depicted on the cards and are available to be combined with others. Here, cards need to strike a balance between being neither too vague nor too concrete. The former will be too broad to inspire new ideas while the latter arguably limits the diversity of the design space. Examples might be useful to illustrate how a design element has been used in the past but at the same time it runs the danger of being taken literally with the designers not pushing themselves hard enough to come up with something truly creative. A very important source of inspiration are also non-domain-specific cards. These provide valuable external elements that are then put into context with the design space at hand. The Mixed Reality Game Cards use surreal images from the board game Dixit for this task.

The content of a card is the main way to increase the **knowledge** of the participants. This is especially important in multidisciplinary teams as everybody brings their own understanding of the design space to the session. Here, the cards act as a mediator that synchronizes the knowledge of the different participants. This also empowers non-expert users to participate in design sessions with designers more experienced than they are, but it also enables groups of inexperienced users to slowly develop an understanding of the design space. For these purposes it is important that the content is easy to understand but at the same time rich enough to provide enough background information. The cards also act as a conductor to create a joint language between the participants. As they are all referencing the same cards, they are able to refer to the depicted concepts by using the card titles as short hands.

10.3.2. The Role of Appearance

At any stage during the design process, the cards are embodying the **idea**. They are the visual reminder of what has been said and what the current state of the idea is. As such, the appearance of the cards is important to be considered. Visual distinct cards can make it easier to spot patterns. The size of the card influences how much

space is needed and how the cards can be arranged. If the cards can convey the important information very succinctly and in an easily perceivable way such as large titles, it makes it easier for designers to change and adapt the idea by replacing cards or by moving them around. Depending on the material of the cards, participants might be hesitant to annotate them directly with their thoughts, so additional means to capture these might be needed.

During design **negotiations** the layout of the cards play a very important role. How is the text laid-out and is the information easily readable from across the table? Otherwise it makes it difficult for everybody to engage in the discussion until they have had the time to pick-up the card and read it themselves. The necessity to do so however slows down the session and causes a break in its natural flow. This can be prevented by restricting the amount of content that goes on a card. If there is only a small amount of text on it, then the same text can also be written in e.g. larger font. The title of a card could also be put twice on the card with different orientation to make it easier to read the card when it is played upside down from oneself. Lastly, using heavier card stock than normal printing paper makes it easier for participants to move cards around as they e.g. will not be accidentally blown away.

One of the main sources for **inspiration** from the cards is an evocative image. Choosing these images is not a trivial task as the authors of PLEX Cards have described (Lucero and Arrasvuori, 2010). It is important that the chosen images are not too specific as this will limit the designers in their thinking. For the same reason, the images should for example avoid featuring celebrities. For the Mixed Reality Game Cards non-stock photos were carefully selected as these were often rich and inventive in what they are depicting. However, one also needs to take into consideration the final size of the cards and how the chosen image will look like in that size. Here, considerations between content and appearance have to be especially considered.

The graphic design of a card can greatly enhance the **focus** during an ideation card session. Clear text and good contrasts allow participants to quickly and efficiently read a card. Colour-coding also plays an important role as it makes it possible for participants to understand the underlying concept. In the case of the Mixed Reality Game Cards for example designers can easily focus on all elements that have to do

with locations as the green colour makes it quick and efficient to identify all cards of this type

The **knowledge** instilled by the cards is naturally very dependent on the content. Similar to the considerations regarding inspiration, the physical dimensions of a card will limit how much text can be put on it (assuming one will avoid using very small font-sizes). This requires a card designer to carefully consider the phrasing. It needs to be succinct (to fit on the card) but likewise needs to transport enough information that it stays understandable for potential non-expert users. This can especially turn into a problem when acronyms have to be used for space conversation which might be less well-known as expected.

10.3.3. The Role of Rules

Rules give designers a structure along which they will create and explore the **idea**. The rules will tell them how to first start with idea generation and then how to transition into the idea development stage. It seems essential for the rules to make a clear distinction between the two in order for the designers to be able to switch from blue-sky thinking to a more critical mindset for analysing and (re)evaluating their idea. Rules should be used to assure that the designers challenge themselves and make sure that the card content is utilized in an efficient but at the same time thorough way.

The way the participants interact with the cards has a big influence on the ongoing design **negotiation**. The rules might restrict who is allowed to play a card at any given moment by enforcing turn-taking. A very strict turn-taking ensures that all designers play an important role in the design process, but it can be perceived as limiting if someone is not allowed to play a card that would "make perfect sense to play now." Turn-taking can therefore be relaxed or forgone completely. In general, the rules provide the underlying structure of the design session. Another example is the appointment of a moderator who observes the flow of the discussion and intervenes when it goes into a wrong direction (just like they would in a session without cards). The design negotiation will also be heavily influenced depending on whether participants always have their own hand of cards and can decide when to play it, or if the group goes through them one-by-one without designers being given a personal choice. Lastly, rules can prescribe if cards are held "hidden" from the

other group members before they are played or if they are put openly on the table so that everybody can see the choices a user has before playing a specific card.

There are several ways in which the rules can improve **inspiration** for a group. The most impactful might be whether the participants employ a limited choice approach where every participant chooses a card from their hand to play for each idea being generated. This method is perceived as easier and is well suited for beginning or inexperienced designers. Alternatively, the rules could prescribe a random draw where the users lose the agency of deciding which cards should build the design idea. This method is more challenging but for the same reason creates more daring and unique ideas. It is the role of the rules to specify how strict the method should be implemented (e.g. whether participants are forced to include all randomly revealed cards or can skip or exchange a certain number of cards). Likewise, in the inspirational phase, the rules should limit the number of cards than can be used to generate an idea. These should be built on a low number of cards so that the core design elements are clear and feature prominently in the brief(!) description that designers should create for their ideas.

The rules of a session are crucial in achieving **focus** during a session. This is foremost a matter of the right timing. It is important to establish when a group should switch from the idea generation phase to idea development, or more precisely when to stop extending an idea in order to start grounding it. There is a certain danger that designers might create an idea that becomes so vast that it loses (or never develops) focus. This can be prevented by enforcing a card limit for extending the idea, or by regularly taking the time to check the progress that has been made. It is then likewise important to recognize the right moment to start evaluating the idea with e.g. Question and Challenge Cards. The rules then also structure how to go through the cards, whether a moderator introduces all cards one after the other or if all participants draw and play cards. Rules can also encourage the participants to first go quickly through all of the cards to decide which ones should then be looked at it more depth as compared to discussing each card in detail when it comes up the first time.

Rules do not directly influence the **knowledge** of the users. The rules however are important to enable designers with enough time to study a card and think about its content. This can for example be assured in set-ups when each participant draws a

certain number of cards into their hand. This allows them to read and understand a card as compared to cards that are revealed and then instantly discussed. By making designers play a card from their hand it furthermore puts them into the role of "champion" for this card. They need to introduce the card to the other participants and explain how it affects the current design and idea. This makes them arguably more familiar with its concept than cards played by other participants as they are the ones that need to put them into context in the first place.

10.3.4. The Role of Tangible Interactions

Ideation cards allow a very physical and intuitive way of displaying the **idea** that is being created. Each card embodies a different facet of it and allows it to be changed and adjusted quickly and without much effort. If one aspect of the idea is no longer desired, the corresponding card will be discarded. Cards allow the details of an idea to be arranged thematically, so that the different aspects of it can be understood with a quick glance. It also allows designers to distinguish e.g. between core elements of the idea, open questions, and important challenges. The cards serve as a constant reminder of what has been discussed and depict the current state of the idea. At the end of a session the idea can be captured easily in the form of a picture of the selected cards that are best representing the idea.

Cards have very direct influence on **negotiation** based on their physicality. This includes gestures with the cards as well as their spatial placement. Cards are moved to the centre when they are being discussed - either because a card has just been played or because a previously played card has become the focus of the discussion again. Holding cards up puts an even stronger emphasis on them and the content they contain. Cards are furthermore also used to frame a discussion. The simple act of playing a card signals the start of a design negotiation while discarding it likewise indicates the end of it. The placement of a card also shapes the negotiation. Cards under direct control of a designer (e.g. by holding it or by playing it directly in front of oneself) take on a different meaning than cards played into the communal centre of the table. Where the latter includes and invites the whole design group, the former enacts a certain amount of dominance over the card - and as such over what the card depicts.

As playing cards they are very easy to randomize which in turn fosters **inspiration**. Designers can shuffle the cards which allows them to create new combinations of

the different design space elements. It also enables designers to sort cards in a way that helps them be creative. This might be done by arranging the order of cards in their hand or by forming conceptual groups with the cards by placing them near to each other on the table. By placing cards in vicinity to each other they create a new joint card that can then be interpreted creatively. These spatial arrangements create new relations between the different cards. These new contexts stimulate an inspiring search for previously unexplored meaning that might otherwise not have been uncovered.

There are several ways in which tangible interactions are used to foster **focus**. The different elements of the idea as well as the sources for critical reflection are embodied on the cards itself. This allows participants to easily sort cards according to their relevance. Unimportant cards can be discarded or moved to the side. If a certain aspect should be explored more the specific cards can be moved into the centre of the table to highlight their significance. Cards can be placed into thematic groups to show their connection to each other or perhaps their contradiction. The cards also give an overview of how sprawling an idea might have become. A large quantity of cards signals a lack of focus and might entice a group to "clean the table".

Tangible interactions are also being used to indirectly influence **knowledge** during an ideation session. The cards allow the designers to inspect them at their own leisure. They can pick up cards that they do not yet fully understand to read them (again) for example. They are also constant visual reminders of the current state of the idea. This makes it easier for designers to put the different elements on the cards into a wider context and form thematic groups by spatially arranging them. This increases their awareness of the design idea. The design space becomes tangible as cards serve as embodiments of the concepts which makes the depicted knowledge easily retrievable.

10.3.5. The Role of Playful Interactions

When using ideation cards, designers enter a state of playfulness and conduct playful interactions. This lets them forget that the **idea** they want to develop is an outcome that should live on past the session. Creating the idea is becoming a game and ceases to be a mundane task. Users achieve enjoyment when they make progress with their idea which generates additional motivation. During idea

generation, each finished game idea is akin to succeeding in a mission of a game. Similarly, contributing the *perfect card* (Performance and Games study) increases the power of the idea through a *game-y moment (ibd.)*. Interestingly enough, unlike in games, the outcome of a design game lives on after the end of the session. The idea leaves the magic circle of play and is an actual and quantifiable result of the ideation activity.

Playful interactions break the seriousness of unfolding design **negotiations**. Designers are working together for a common goal (the idea) against a common enemy (the draw of the cards). This facilitates the collaborative aspect of the design session just like it would in a game where the players are not competing with each other. The negotiations also take on the form of moves of a game. Playing a card or discarding a card become substitutes for proposing an idea and disregarding an idea. However, this act is arguably less "aggressive" than in an ideation session conducted without cards. Because the idea is ultimately attributed to the card and not the person who played the card, the design process runs less of a danger to cause personal conflicts. After all, it is the card that is being criticised and not the person who proposed the idea. This also allows a group to gracefully remove unwanted elements from an idea – the game move is just rolled back and with it the idea is restored to its former state.

The very same quality likewise has an effect on the **inspiration** during a session. Users are able to overcome the *fear of looking stupid* (Sustrans study that can plague a brainstorming session. The playfulness of the cards creates an alibi for participating designers. As it is less personal when an idea (card) is rejected, they are more open to *say something daft* (ibd.). Odd card combinations need to be "solved" and weird ideas are fully acceptable as on the one hand they are inherent to the cards while at the same time it is just a valid attempt at overcoming the current challenge.

The playful interactions with the cards also impacts the **focus** of the session. As in a game, rules are a natural part of the session, and the playfulness ensures that the spirit of the rules are followed (if not by-the-book). Users are aware that games include rules that need to be followed. This allows them to demand and ultimately get the attention of other users who might not be paying attention to session. After

all, it is considered rude when playing a game to not focus on it but instead perform another activity.

The **knowledge** of the users is perhaps least obviously affected by playful interactions. However, the playful framing of the session again reduces inhibitions of users that might have less experience than others. They are empowered to play a card without the necessity to fully understand its meaning or repercussions. The card can then be explained and consequently integrated by more experienced users. Nevertheless, the person who originally played the card will have substantially contributed to the session. In that sense, the playfulness levels the playing field (just like the content) between participants of varying backgrounds and levels of experience.

10.4. Implications for Designing Ideation Cards

In the previous section I have discussed how rules, appearance, content, and tangible as well as playful interactions shape and influence the design session. The Mixed Reality Game Cards were the basis for these insights - but what can we learn from their design that helps future designers of ideation cards to create their own decks? In this section I will highlight the design implications derived from the studies and reflections.

10.4.1. Content

10.4.1.1. The Importance of Simplicity

The physicality of ideation cards brings with it a hard limit of the amount of content that can reasonably fit on a card. Here, it is important to strike the right balance between reminding designers of the concept in question while at the same time providing just enough information that the concept also becomes clear when someone is not an expert in it. This can be achieved by choosing an evocative and memorable title and an additional explanation. The title will become the shorthand for the card in future discussions, but the description is especially crucial the first time a card is played. This ensures that all participants have the same understanding of the card. While it might be tempting to go into much detail on the card itself, this will slow down the overall ideation session as it grinds to a halt until everybody has read all of the written information. This is detrimental to the natural flow of a session and should therefore be avoided. Examples for this can be found in both

the Lincoln1 study as well as the Brisbane Writer's Festival one. These were conducted with the first version of the cards that provided too much text for a dynamic session.

Creating succinct content that is easy to understand is not an easy task, and one always has to consider whether for to use technical terms of the domain or not. An example for the latter is the card Seamful Design. This is a rather well-known concept for designers of mixed reality experiences, however lacking such a background makes it hard to grasp the concept on the card. Such trade-offs can never be fully avoided as it is likewise important to also introduce less experienced users to the specific terms and phrases used in the field.

10.4.1.2. The Importance of Openness

Another important aspect is the way the (written) content is phrased. In early versions of the Mixed Reality Game Cards the descriptions of the Challenge Cards described the design issue in a factual statement. This enabled participants to easily ignore the card as it did not force them to actually discuss it in more detail. The card seemingly only wanted to know from them whether the issue might appear in the game. In later iterations, the Challenge Cards were rephrased to feature more open questions instead of statements. The cards should be a prompt for discussion, and this works better with questions that ask "how" compared to ones that can be answered with yes or no. Instead of *a list of issues that can be ticked off* (Hornecker, 2010) the openness of the cards invites the participants to discuss the topic more deeply. Such an *open-ended stimulus* (Mumford and Gustafson, 1988) promotes divergent-thinking, a construct seen as crucial for idea generation (Guildford, 1950).

This openness is not only important for focusing and discussion an idea in detail, but also during the inspiratory phase of ideation. The authors of the PLEX cards for example describe how they removed pictures of famous people from their cards as these created rather direct associations (Lucero and Arrasvuori, 2010). In contrast, the utilized Dixit cards are rich sources of inspiration as they allow multiple interpretations of what they are depicting. In general, such an external source of inspiration also opens up the ideation session beyond the investigated design space, bringing with it valuable and unusual angles. Interestingly enough, other ideation card decks do not seem to be concerned with a lack of external

influences - none of them provide additional ways for inspiration outside of the actual cards that describe the design space. Halskov and Dalsgaard (2006) on the other hand strongly advocate to include such external sources:

> *We recommend including sources of inspiration that vary in their conceptual distance from the use domain, in order to foster design concepts that may both fit into, and expand the domain.*

Similar observations were made by Kwiatkowska et al. (2014) specifically about Dixit cards were perceived in a similar setting:

> *Personal thoughts and feelings became projected onto the cards, where pictures supported the metaphor building. The participants could express their individual experiences indirectly, which made them feel secure and comfortable in the confrontation with others.*

Overall the surreal Dixit cards were well received. The cards help create a richer game idea that instantly contains a theme. Before Dixit cards were introduced the resulting ideas were often kept in generics. For some participants the Dixit cards proved an additional hurdle as reported in the description of the Lincoln2 study. Here the already challenging task of rapid idea generation was seen to be complicated by also having to include a Dixit card. Despite this, participants likewise reported that they found the ideas including these cards to be more daring and more creative – as such it is strongly recommended to include surreal non-domain specific cards into ideation sessions.

While not many groups made use of the blank cards, making them available is helpful in creating more perceived openness in an ideation session. Participants understand that they can always extend the canon of cards in case they have new ideas that are not explicitly conveyed on a card. They feel less restricted by the naturally limited selection of cards.

10.4.1.3. The Importance of Specialization

When looking at the different ideation cards that have been published it becomes clear that they have not only been created for different domains, but also for different occasions. Some cards are more suitable for idea generation while others shine during idea development. It is important to be aware of this design goal when creating ideation cards. While PLEX cards can also be used for developing an idea, and the Tangible Interaction Framework Cards certainly cause inspiration, both

decks of cards would have been designed differently when aiming for the respective other purpose. Should the cards help participants focusing on the details of an idea, or should the cards inspire new ideas? It is important to use the right cards for the right purpose, which is the reason why the Mixed Reality Game Cards consists of four different types of cards. Opportunity Cards showcase the design space and together with Theme Cards strongly inspire participants. The strict positivity of the cards is important for the creative idea generation phase of ideation. Here, Opportunity Cards provide an overview and inspiration from the design space at question whereas Theme Cards specifically have no direct relation to it. This creates a powerful synergy between design space internal and external inspiration.

The Opportunity Cards also allow designers to directly build and assemble their idea. They can be used as building blocks of the idea and encapsulate the current state of the idea in a very direct way. Question and Challenge Cards switch from the purely positive Opportunity Cards towards the reflective stage of the ideation process. The idea is now under scrutiny and designers are challenged to investigate their idea more deeply, evaluate it, and ultimately adjust and refine it. The different qualities of these different types were especially noted by the participants of the Know How study who reported that they enabled them to go from *blue sky thinking* over to *grounding the idea in reality*.

The different cards perform different duties during an ideation session which are all of importance to the success of a session. When looking at other ways to facilitate group ideation, the Six Thinking Hats method (De Bono, 1999) bears some similarities to the division in Opportunities, Questions, and Challenges. De Bono also advocates the advantages of different modes during brainstorming, e.g. suggesting new ideas (Opportunity Cards) or criticising existing ones (Challenge Cards).

10.4.2. Appearance

10.4.2.1. The Importance of Graphic Design

Perhaps the most obvious criteria for the appearance of ideation cards is how they present the content. The size of the card is a first restriction on the amount as is the chosen font-size. With the latter one should be careful and ensure that any text is easily readable so that a design session is not interrupted for too long when participants try to read it from across the table – this is especially important for the

title of the card that should be memorable and convey the concept of the card. If possible, it is also a good idea to display the title of the card a second time rotated by 180 degrees. This makes it even easier for participants around the table to identify the different cards.

Similar considerations should influence the choice of image. This is of course also a matter of content (see previous section) – however again the size of the card has a big influence on how much detail can and should be presented.

If at all possible, the cards should be made visually distinct in order to make it easier for participants to identify them in e.g. a pile. This is easily done by colour-coding different categories. In the case of the Mixed Reality Game Cards this allows designers to quickly see which Opportunities, Questions, and Challenges deal with e.g. sensors or locations. While utilizing a mix of colours also makes the cards more vibrant it should not just be used for this purpose. The Sound Design in Games Deck is a good example for professionally looking cards where the colour has not added additional meaning to the cards.

Something that is often neglected by ideation cards created in academia is a professionally looking graphic design (e.g. Exertion Cards, Tangible Interaction Framework Cards). That this does not need to be the case is evidenced by e.g. VNA Cards, PLEX Cards, Sound Design in Games Deck. Well-designed cards will be more appealing for the participants and increase their perceived value. While version 1 of the Mixed Reality Game Cards was regularly criticised for their graphic design (as happened during all three studies from phase 1), the improved design of version 2 and 3 were appreciated by all participants.

10.4.2.2. The Importance of Material

Ideation cards developed as part of academic research are often available as print-to-play. This encourages the use of the cards as they do not need to be (potentially expensively) purchased. However, this also means that they more likely than not will be printed on standard (thin) paper. This on the other hand means that the cards will be rather flimsy which has a negative impact on the majority of possible tangible interactions. It makes moving cards and placing them on a table less reliable (as they might get moved accidentally by brushing over them). Likewise holding several of the cards in one's hand will feel less satisfying. Instead of evoking playing a game, it comes across as playing a prototype. This was one of the criticism

that the first version of cards was exposed to – especially professionals from the Magellan study commented on it. In such a case, cards should at least be put into card sleeves to give them more weight and make them more durable.

A negative side effect of using high quality card stock was observed during later studies. The professional print of the cards made participants hesitant to fully engage with them. One participant on the Performance and Games study pointed out that the cards felt *sacrosanct*. People are used to highly regard their game materials, and this was not different for the Mixed Reality Game Cards. Cards on normal printing paper made participants more willing to use the blank cards for example and also scribble on other cards. Annotations of this form were de facto non-existent while using versions 2 and 3 of the cards – post-it notes were used instead. Blank cards were only used when I personally urged participants to use them as they felt they would ruin these. One strategy that seemed to work well was to rip a card apart in front of the participants at the start of the session. This is a strong signal that the cards should be seen as a disposable tool and made participants more willing to "destroy" them.

Depending on the circumstances and intended use of the cards it is therefore important to think about how the cards will be printed. Do you want to encourage participants to modify the cards, or do you want to foster tangible and playful interactions?

10.4.2.3. The Importance of Documentation

The physical presence of the cards lends itself very naturally to be used for documentation purposes. The cards that are currently in use automatically create a visual representation of the current state of the idea with (generally) only cards on the table that have some relevance to the idea. Hornecker (2010) calls this *a form of embodied facilitation*. Participants also use the table space to arrange cards in a meaningful way to help them make sense of the current state of an idea.

This makes it possible to take snapshots of the idea as it is being worked on. Such a way of documenting the idea also works really well at the end of a session, for example by arranging the cards as a poster as seen in Figure 72. A poster adds further physical restrictions on the designers who now have to collaborative agree on their final idea. This stage often surfaces unclear elements of the idea, or previous misunderstandings and as such is immensely valuable. This also allows for

additional annotations of the idea to label for example different thematic groups or to sketch out the anticipated trajectory through the game.

The cards also lend themselves well to annotations already during the design process. Post-it notes are quickly produced and discarded when no longer needed. Making use of dedicated blank cards is also a possibility. Their design should match the actual ideation cards in use, so that new ideas and thoughts are seen with a similar authority as the originals. Often times participants are hesitant to do so because they do not want to "destroy" the cards. In that case using post-its attached to the cards or card sleeves can lower the barrier for creating new content.

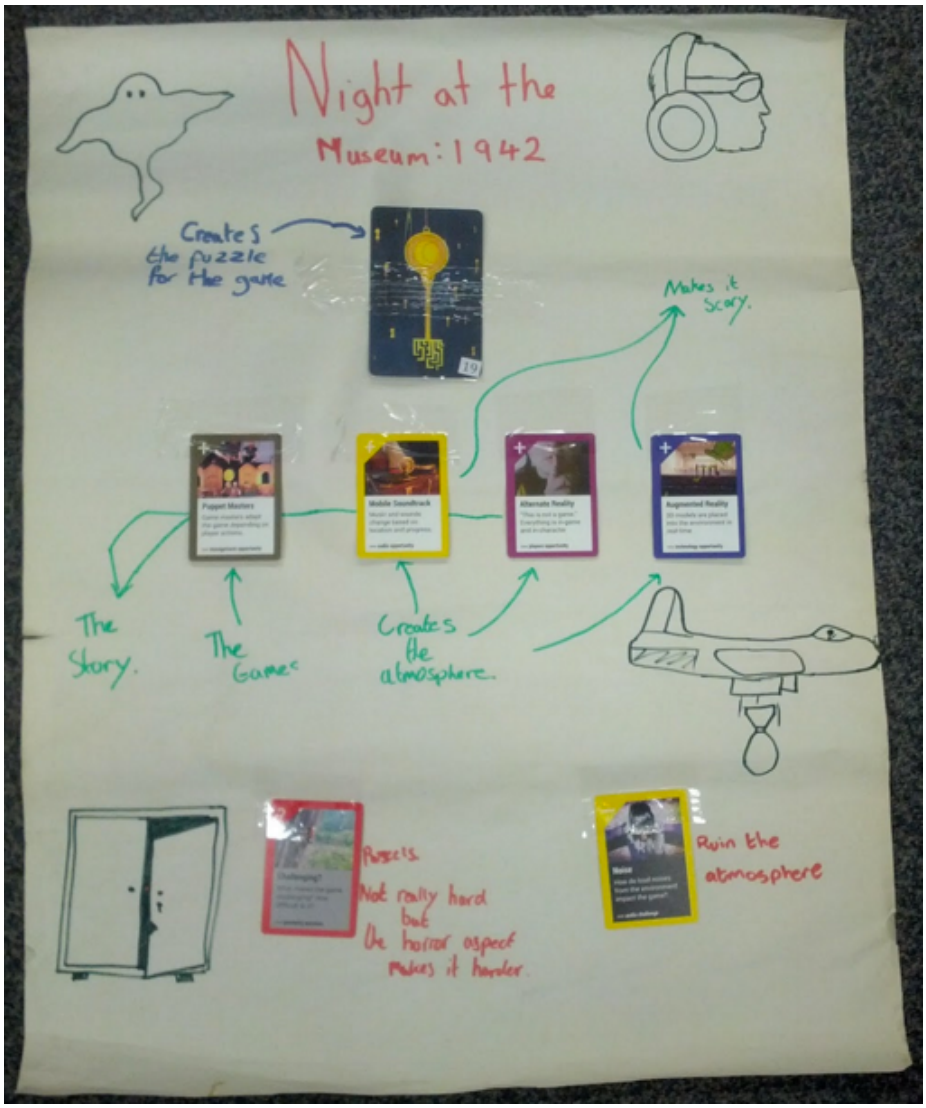


Figure 72. Annotations and illustrations by a group from the Lincoln2 study.

10.4.3. Rules

10.4.3.1. The Importance of Challenge

The rules for ideation card sessions are the main way to assure the participants challenge each other. A prominent example during idea generation is the difference between random draw and limited choice methods of selecting cards. The rules have the power to create a session that is more inviting to less experienced or confident users, or a session where the designers need to work around and with seemingly obscure combinations of cards. The latter method only works if the rule "all cards must be used" is (relatively) strictly enforced as otherwise unusual combination would be quickly discarded. The randomness and restrictions of the cards play an important role in this case. Surprise has been noted as a fundamental concept in this context (Schön, 1983), and Dorst and Cross (2001) build upon the notion:

> *Surprise is what keeps a designer from routine behavior. The 'surprising' parts of a problem or solution drive the originality streak in a design project.*

Comparing the two methods applied by the Mixed Reality Game Cards, limited choice creates a *constrained situation* while random draw can be seen as a *highly constrained situation* as described by Moreau and Dahl (2005):

> *In this highly constrained situation the likelihood of a known solution matching the inputs designated for the solution is extremely low. Thus, consumers will be forced [..] to mentally combine the inputs in different ways, to search for a satisfactory interpretation, and to cycle back and forth until they have reached an acceptable solution.*

Supporting this interpretation Finke et al. (1992) report that heavy restrictions can improve the outcome of idea generation activities.

Challenge likewise needs to be taken into consideration during the idea development phase. It is very tempting for participants to looks at a Question or Challenge Card and decide that the card does not apply to their idea. Or they find an obvious answer and immediately proceed to the next card. Sometimes, design issues might be relevant for an idea, and the designers acknowledge this. But instead of working on overcoming this problem and discussing how to solve it, they discard the card as something they cannot remedy. It is crucial for these phases to be successful to stress how the cards should be used, and that the cards a play the role

of a devil's advocate that cannot be disregarded easily. Designers should be urged to try their best to reinterpret a seemingly pointless card into being relevant for the current idea. The initial card then transforms into a source of inspiration for a new Question or Challenge. Hornecker (2010) makes an interesting observation in this regard stating that it is difficult to predict which card(s) will be the most helpful in any given situation:

> *Yet it is not always evident which themes will be most fruitful. Often 'irrelevant' and partially relevant cards could result in the most intense and fruitful debate, while a clearly relevant question was too obvious.*

Perhaps less intuitive, similar considerations also apply during the idea generation phase. Often, less experienced participants would introduce a card like Mini Games or Riddles without the group going beyond the surface of the card and not actually specifying what Mini Games and what Riddles exactly. Requiring concrete examples from participants in such situations is rather beneficial for visualizing the idea and improving the understanding of the game within the group of designers.

10.4.3.2. The Importance of Structure

Rules give an ideation session structure. This starts with simple decisions on whether to enforce turn-taking or a free-for-all when playing cards. Both approaches have their advantages. While turn-taking assures everybody gets a say in developing the idea, some participants might feel put on the spot, and others might feel restricted because they had *the perfect card* at a time when it was not their turn (as for example remarked by a participant during the Performance and Games study). The amount of structure needed is strongly dependent on the individual group dynamics and the experience of the different participants. Turn-taking seems to be more appropriate when some or all users lack experience. A free-for-all works well when participants know each other well and they form a balanced group. The creators of the PLEX Cards also report a mixed reception when they investigated their versions of random draw and limited choice (Lucero and Arrasvuori, 2010):

> *Some participants considered that the structured approach provided concrete results, while others felt turn taking, selecting three cards, and building the idea from a seed card blocked their creativity.*

Another element structuring a session is timing. It is crucial for the group to regularly take a step back and look at the big picture. Does the idea feel relatively rounded? Are new cards only watering down the idea without adding substantial elements to it? The group needs to decide when to transition into the next phase and introduce the Question Cards, and then when to talk about the Challenge Cards. In her studies, Hornecker (2010) has likewise come across this problem of hitting "the sweet spot", i.e. when to introduce the Tangible Interaction Framework Cards into the design process:

> *The brainstorming exercise seems the most fruitful at such a midpoint, when a good understanding of the problem is reached, use situation and core goals are decided upon, but there is still space to flesh out details.*

As the Mixed Reality Game Cards on multiple roles due to their versatility, the matter of timing becomes relevant for each of the card types. This was an issue I could observe for example in one group during the Performance and Games study. The participants spent a long time discussing their idea just with the Opportunity Cards that by the time they switched over to the Question Cards (and later Challenge Cards) these felt rather superfluous as the main issues had already been discussed. Something that has worked well in the Know How study was to use an egg timer that forced the group to regularly reflect on the state of the idea thus making them aware of their (lack of) progress. In order for this to work the group needs to be aware of the goal for each of the phases, so that they then can make an informed decision to move forward in the design process. One way of framing the different parts of the design process during idea development when using the Mixed Reality Game Cards is illustrated in Figure 73.

Figure 73. The different phases of the idea development process.

10.4.3.3. The Importance of Reduction

Having access to a large deck of cards entices designers to make use of all of these cards. While this shows that they are engaged with the content, it can also lead to less targeted but instead sprawling ideas. Designers keep adding Opportunity Cards to an idea, without actually meaningfully changing or extending it. This is the reason

why the idea generation phase should have very clear and strict limits on how many cards are allowed to be used by the group.

For the initial fleshing-out of the idea during idea development, it is usually necessary to add more Opportunity Cards to really get a feel for the different elements of the idea. However, it is crucial that the designers are aware of the cards that really describe the core elements of the game. They then should not hesitate to remove any cards that are only tangentially relevant for the idea. This reduction can be performed as a clean-up step at the end of each stage of interacting with the cards as it is part of reflecting and summarizing the current state of the idea. The effects of such a lack of reduction was clearly observable during the Brisbane Writer's Festival study. Unguided, participants kept adding Opportunity Cards to their idea which created a rather unspecific but sprawling game idea.

Likewise, cards can also already be removed while the different stages are happening. This does not mean however to discard all Questions and Challenges that have been satisfyingly been dealt with. Instead, those cards that resulted in useful and rich discussions should be kept as a representation of these negotiations. These reflections developed the idea in a meaningful way which means they have now become part of the actual design as reminders, warnings, and a documentation of the decisions they caused.

10.4.4. Tangible Interactions

10.4.4.1. The Importance of Gestures

Naturally, participants of an ideation card session will refer to the cards constantly. They will do this verbally by saying the title of the card, or by reading out the description on the card. However, one powerful additional way to create meaning is caused by the fact that physical playing cards are being used. These afford gestures that designers can utilize in a variety of ways. Gestures are known to be an important non-verbal part of human communication (McNeill, 1992). Uses for gestures in group design sessions have previously been categorized (Tang and Leifer, 1988): storing information, conveying ideas, representing ideas, and engaging attention. Streeck and Hartge (1992) provide more detail on the latter use in what they call projections, e.g. signalling one's desire to speak. These applications for gestures are in line with what previous work observed in regards to ideation cards (Buur and Soendergaard, 2000; Halskov and Dalsgaard, 2006). Hornecker

(2010) talks about cards being used as orienting devices by utilizing such gestures. Users of ideation cards will point at them, hold them up, move them about, and wave them around. They do this to strengthen their arguments and to put emphasis on specific concepts that are depicted on the cards.

10.4.4.2. The Importance of Access

In an ideation card session, the spatial arrangement of the space will clearly affect the overall session. The places where the participants are situated and how they relate to each other play a crucial role in creating a balanced and fair environment. This is a common concern in table-top settings. Sharlin et al. (2004) for example stress the importance that spatiality has for tangible user interfaces (TUIs). As the physical space is limited in shared workspaces, separation (Tse et al., 2004) and orientation (Kruger et al., 2003) play important roles as well. Kendon (1990) introduced the notion of F-formations and distinguished between o-spaces (in the centre between all participants) and p-spaces (between two specific participants). The latter provides us with some guidance on how to set-up the space for an ideation session. In addition, Scott et al. (2004) distinguish between personal territories, group territories and storage territories, and highlight the differences in how they are used and perceived by users.

Based on observations of how the Mixed Reality Game Cards were used, it becomes obvious that the different territories on the table all need to be as equally accessible as possible for every participant. The most prominent territory is the main area of where the cards are being played. This central space holds the current state of the idea and therefore everybody should be able to reach and manipulate it with ease. It is important to prevent ideation from happening in personal territories and instead promote the usage of group territories. Similarly, the locations of the storage territories such as draw and discard pile should be considered when setting up the ideation session. Participants that cannot reach the discard pile will be more hesitant to e.g. lean over the table to resurface a card from there. Likewise, the draw pile has to be accessible as it enables users to refill their hand at will and perhaps look for specific cards or just browse the available ones.

Participant should keep this in mind also when they are playing cards. It creates a more collaborative atmosphere if they do indeed play the card into the centre of the table instead of in front of them or just holding it up. In the latter two cases it

makes it harder for the other participants to inspect the card and creates unnecessary friction. Especially during the Lincoln1 study I could observe several instances where a lack of access caused friction in the design process. Here, the habit of several participants to play a card directly in front of them instead of into the communal workspace made it hard (or impossible) for other group members to inspect the newly played card.

Figure 74 shows a sample layout where the reach of participants has been taken into account.

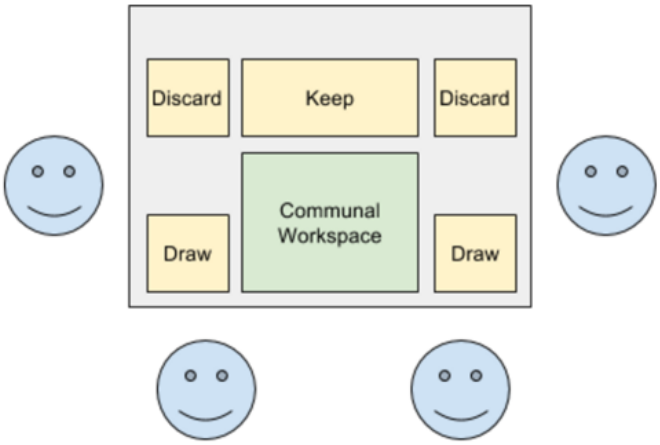


Figure 74. Proposed setup for four participants. By implementing two draw and two discard piles all participants are in good reach of all areas. The only exception is the discard pile on the opposite side of the table. However, this means that they will still have easy access to half of the discards. Green denotes a group territory whereas storage territories are yellow.

10.4.4.3. The Importance of Placement

Hornecker (2010) describes the fact that cards *invite and support spatial interactions*. One of the most powerful interactions that physical cards like the Mixed Reality Game Cards afford is the arrangement in clusters. Participants should be encouraged to move cards around and form new thematic groups when they see synergies or contradictions.

Cards change their meaning when put into relation with other cards, and arranging them in that way provides a quick and intuitive cue. This way cards can signal what currently is being discussed (*these two cards that we just moved into the middle*), and also what is saved for later (*we will move these cards over here, so we remember to talk about them*). This allows the whole group to focus on specific topics or cards and encode the

current state of the idea by placing cards in different locations. Both Kirsh (1995) and Zhang (1997) have described this phenomenon of how people use spatial arrangements of objects to aid in their thinking processes. According to Kirsh and Maglio (1994) this is an example for an *epistemic action* that indirectly helps in solving a problem compared to *pragmatic* ones.

Figure 75. Participants of the Know How study have arranged their chosen Opportunity cards thematically.

Groups have flexibility in how they want to utilize these placement options. They might have a workspace where cards are placed when they are being played and subsequently discussed. Or new cards are placed next to others to show how they directly relate to established themes and concepts. This way cards can be moved and placed in order to create connections or to emphasize their concept (for an example see Figure 75). Some groups might even wish to create clearly marked zones on the table for these different purposes, e.g. to designate different levels of importance.

10.4.5. Playful Interactions

10.4.5.1. The Importance of Flexibility

While maintaining structure in a session is advisable, the session should not be overregulated. It is important that the rules allow enough flexibility to enable playfulness. While ideation cards can be seen as design games it might be more appropriate to call them design play. Here, the distinction between paidia and ludus points us in the right direction (Caillois, 1961). If an ideation session is governed by too many and too detailed rules, the natural flow of creativity will be obstructed as participants are more concerned about not making a mistake than they are in actually thinking about and discussing the ideas. A good source of comparison might be pen and paper roleplaying games where one common rule is the ability to adapt or ignore all other rules in case they hinder the flow of the game. In an ideation session we have the same conflict. The rules should be a guideline but not an immutable law. Allowing the odd player to play a card out of turn, or to let the group once in a while discard a card they are unable to deal with (be it during idea generation or development) does not destroy the integrity of the session - as long as it is done in moderation. In any case, each group will always be free to adjust the rules according to their preferred ideation style.

10.4.5.2. The Importance of Lightness

The playfulness of ideation cards brings with it a certain light-heartedness. Whereas *typical brainstorming sessions seem formally more like serious business meetings* (Kultima et al., 2008a), the introduction of playing cards instantly reframes the activity into something more casual and lively. This is the atmosphere that all participants should attempt to create. One important step to achieve this is to emphasize that no proposed ideas will be devalued as "stupid". Instead the goal, especially during idea generation, should be to not hesitate to propose something that might seem a bit (or more than a bit) "out there" as especially such ideas might initially seem inappropriate but then later turn out to have brought an interesting perspective to the session.

The ideation cards themselves also help achieve this atmosphere. Although participants might play cards and introduce ideas this way, they will always be able to deflect the criticism back to the card. The cards provide a strong alibi for the

designers, and they are encouraged to make use of this opportunity. Not just as a defence when under scrutiny themselves, but also when commenting someone else's card play. Instead of commenting on the quality of the proposed idea ("I don't think that is a good idea."), any negativity should directly refer to the card ("That card really does not make much sense."). This was something especially appreciated by the participants of the Sustrans study who not normally engage in ideation sessions. At their normal work, they are therefore afraid to *say daft things* while the cards and the overall playfulness of their interactions provided them with a strong alibi that lowered their reluctance.

10.4.5.3. The Importance of Action

During an ideation session, all participants should be enabled to play an important role in the design process. This does not mean that they all have to be as vocal as one another, and that everybody is expected to propose the same amount of ideas. Instead, the cards provide another type of activity: To play a card. Due to the nature of the cards as embodiment of the different concepts of the design space, playing a card can be classified as productively participating. The person that plays a new card presents this concept to the group and can perhaps be seen as its "champion". The actual negotiation can then be performed by other members of the group, which, by extension, the player of the card has instantiated. While the cards provide the ability to distance oneself from what they are saying, at the same time it also provides a certain amount of agency to the designer by offering it for discussion to the group. As such it is advisable to make sure all participants get access to their own cards that they can then play in the different stages of the design process. By letting the participants draw up a hand of cards and then play whichever one they seem appropriate is a very simple way of ensuring that everybody actively partakes in the session. Playing cards is by itself a joyous activity and increases the playfulness for each designer doing so.

This is something that should especially be taken into consideration when engaging with the Question and Challenge Cards during the idea development process. As part of the Lincoln1 study we have seen different examples how groups dealt with a moderator. In one of them, the moderator presented the cards and then opened the floor for the other participants to discuss it. In another case, the moderator did introduce the cards with their own strong opinion, and also did not let another

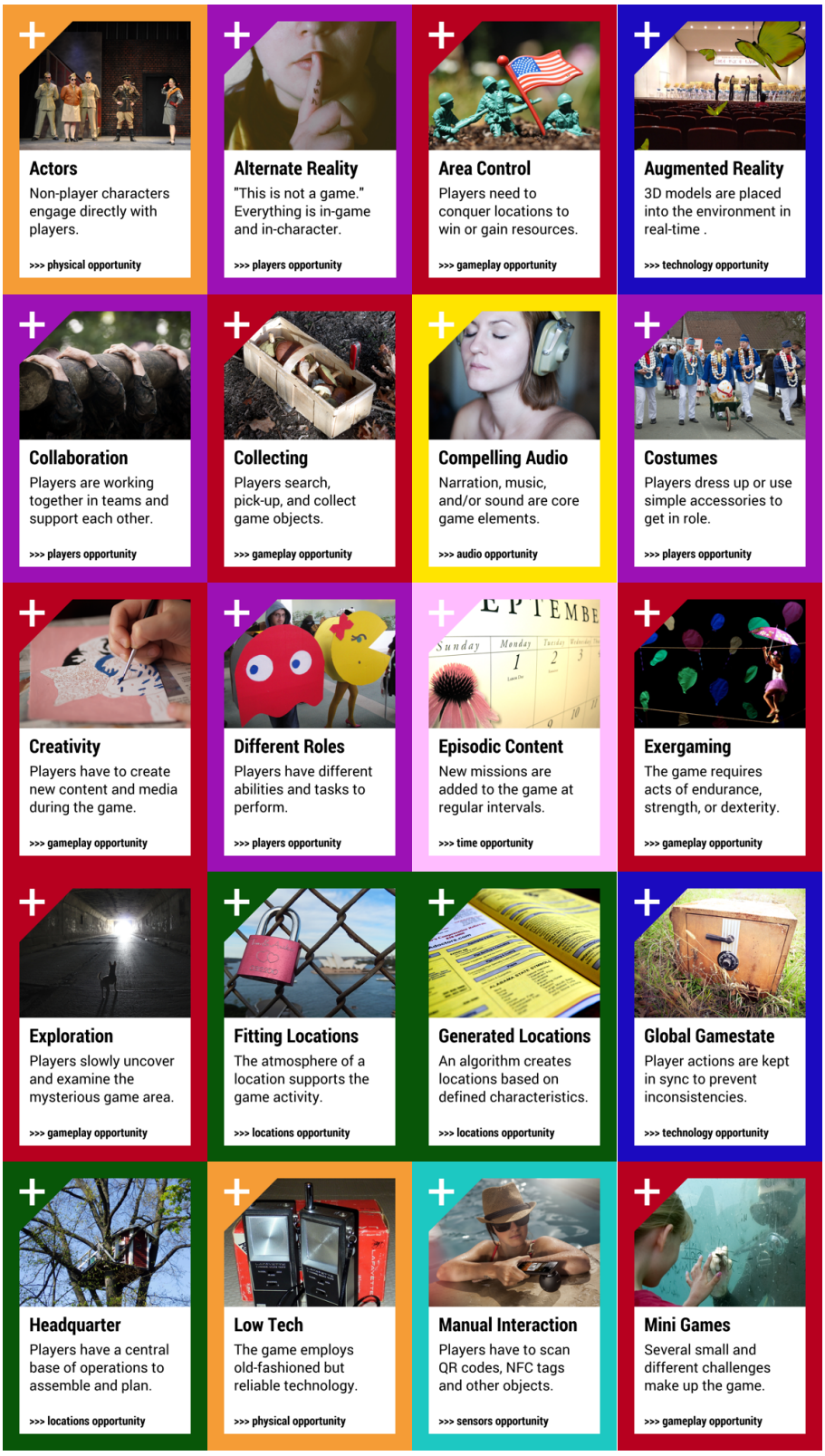
participant inspect the card in question. An ideal set-up was finally observed in a third group where both participants took turns in playing a new Challenge Card. This way they both were actively engaged in the process of play.

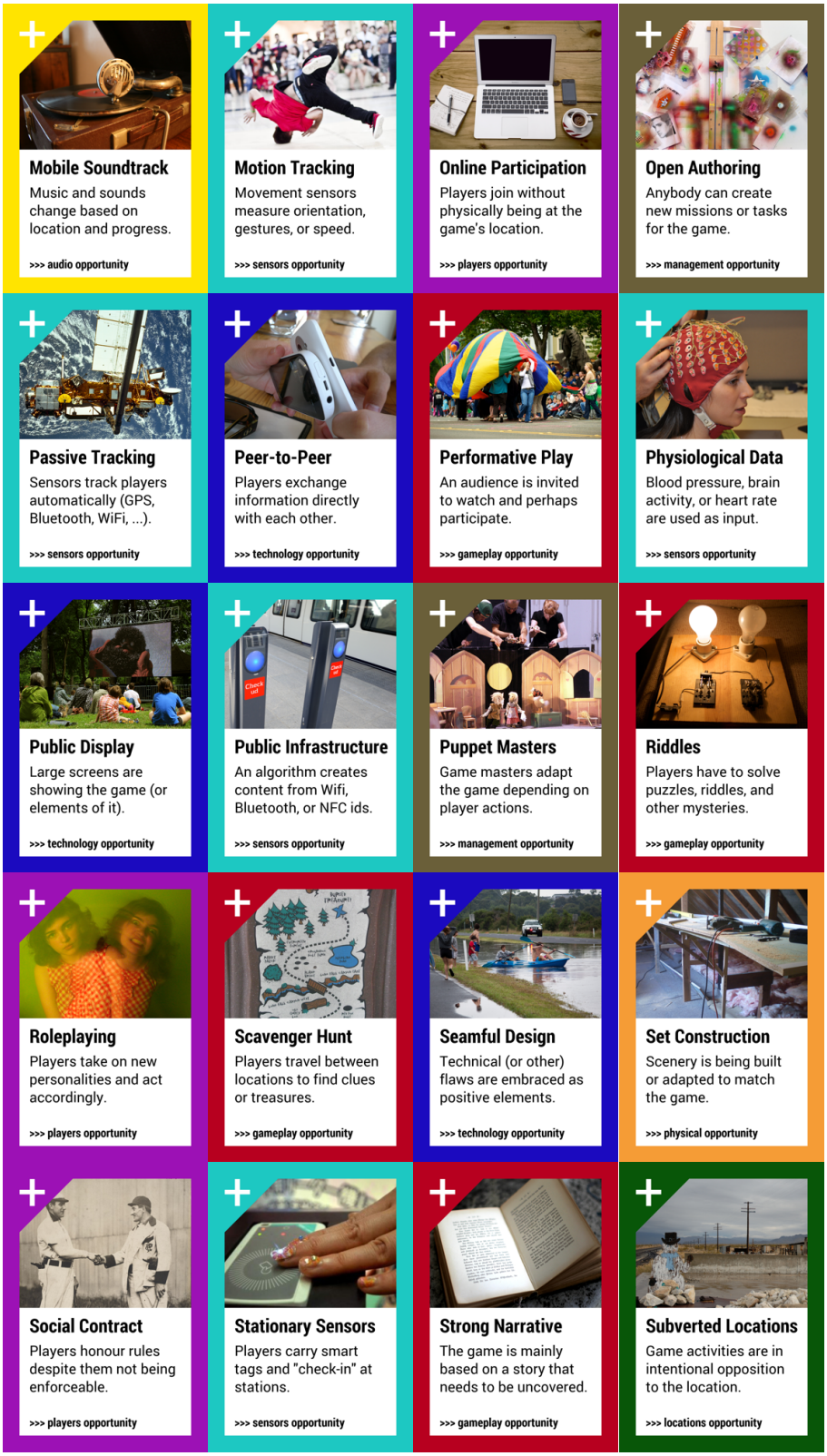
10.5. Final Version of the Mixed Reality Game Cards

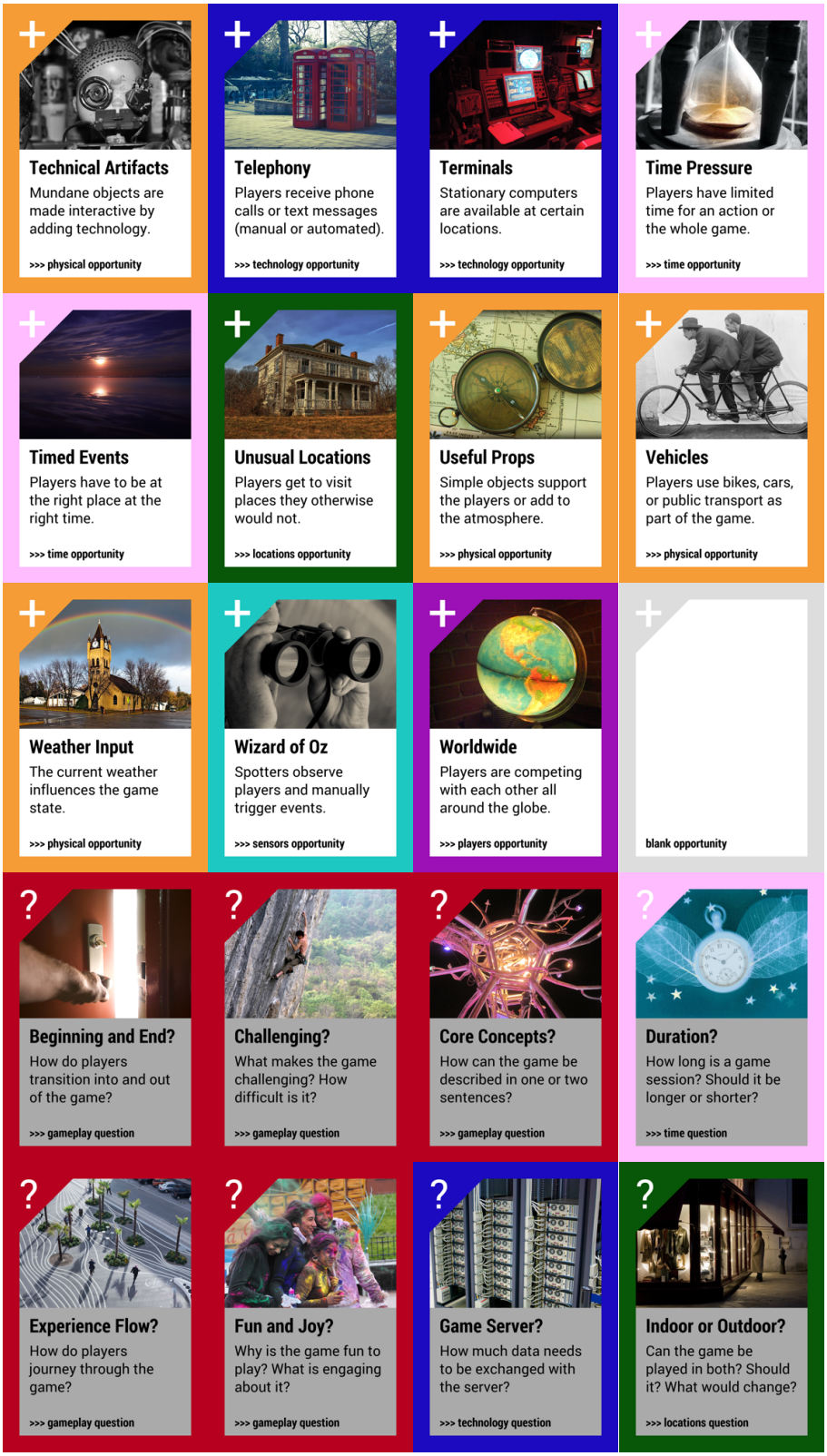
The development of the Mixed Reality Game Cards has ultimately led to the findings and reflections presented in the previous sections. In turn, those findings have influenced the content and the rules of the Mixed Reality Game Cards. In the following two sections I present the final outcome of this thesis as a snapshot of the design. The first section showcases all of the cards, namely Opportunities, Questions, Challenges, (and their blank variants) as well as example Theme Cards. This is followed by the leaflet that describes the rules and which is packaged together with the cards. Together, these embody my interpretation of the design implications from the previous section. The Mixed Reality Game Cards are the artefact that this thesis set out to develop in order to investigate the intricacies of ideation cards.

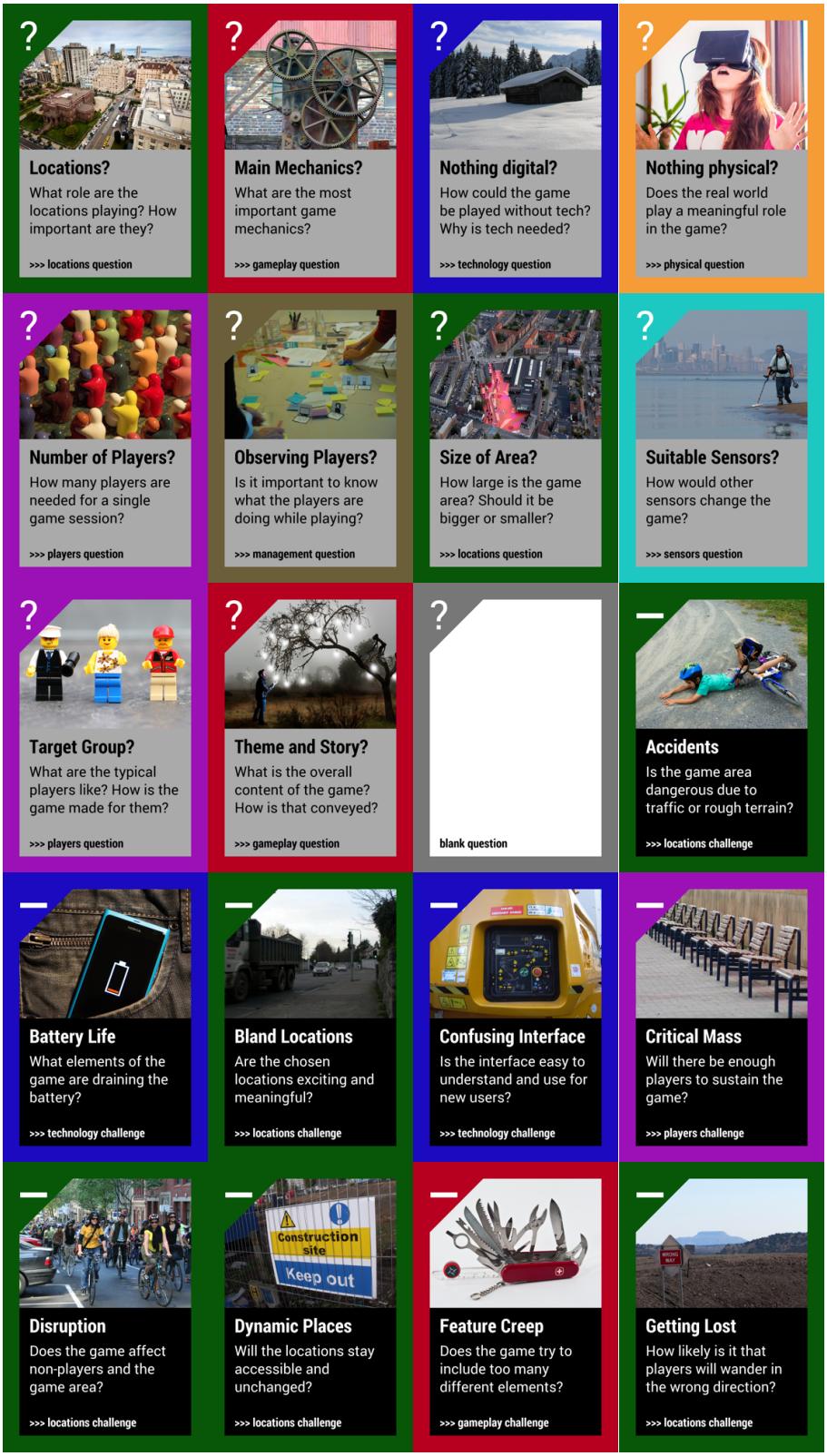
Once the final deck of cards was developed, I also created a brief guide that went into more detail on all of the concepts from the cards and also provided a little more framing around the specific game genre. This guide can be found in the appendix.

10.5.1. Content and Appearance




Mobile Soundtrack
Music and sounds change based on location and progress.
>>> audio opportunity
Motion Tracking
Movement sensors measure orientation, gestures, or speed.
>>> sensors opportunity
Online Participation
Players join without physically being at the game's location.
>>> players opportunity
Open Authoring
Anybody can create new missions or tasks for the game.
>>> management opportunity
Passive Tracking
Sensors track players automatically (GPS, Bluetooth, WiFi, ...).
>>> sensors opportunity
Peer-to-Peer
Players exchange information directly with each other.
>>> technology opportunity
Performative Play
An audience is invited to watch and perhaps participate.
>>> gameplay opportunity
Physiological Data
Blood pressure, brain activity, or heart rate are used as input.
>>> sensors opportunity
Public Display
Large screens are showing the game (or elements of it).
>>> technology opportunity
Public Infrastructure
An algorithm creates content from Wifi, Bluetooth, or NFC ids.
>>> sensors opportunity
Puppet Masters
Game masters adapt the game depending on player actions.
>>> management opportunity
Riddles
Players have to solve puzzles, riddles, and other mysteries.
>>> gameplay opportunity
Roleplaying
Players take on new personalities and act accordingly.
>>> players opportunity
Scavenger Hunt
Players travel between locations to find clues or treasures.
>>> gameplay opportunity
Seamful Design
Technical (or other) flaws are embraced as positive elements.
>>> technology opportunity
Set Construction
Scenery is being built or adapted to match the game.
>>> physical opportunity
Social Contract
Players honour rules despite them not being enforceable.
>>> players opportunity
Stationary Sensors
Players carry smart tags and "check-in" at stations.
>>> sensors opportunity
Strong Narrative
The game is mainly based on a story that needs to be uncovered.
>>> gameplay opportunity
Subverted Locations
Game activities are in intentional opposition to the location.
>>> locations opportunity


+
Technical Artifacts
Mundane objects are made interactive by adding technology.
>>> physical opportunity
+
Telephony
Players receive phone calls or text messages (manual or automated).
>>> technology opportunity
+
Terminals
Stationary computers are available at certain locations.
>>> technology opportunity
+
Time Pressure
Players have limited time for an action or the whole game.
>>> time opportunity
+
Timed Events
Players have to be at the right place at the right time.
>>> time opportunity
+
Unusual Locations
Players get to visit places they otherwise would not.
>>> locations opportunity
+
Useful Props
Simple objects support the players or add to the atmosphere.
>>> physical opportunity
+
Vehicles
Players use bikes, cars, or public transport as part of the game.
>>> physical opportunity
+
Weather Input
The current weather influences the game state.
>>> physical opportunity
+
Wizard of Oz
Spotters observe players and manually trigger events.
>>> sensors opportunity
+
Worldwide
Players are competing with each other all around the globe.
>>> players opportunity
+
blank opportunity
?
Beginning and End?
How do players transition into and out of the game?
>>> gameplay question
?
Challenging?
What makes the game challenging? How difficult is it?
>>> gameplay question
?
Core Concepts?
How can the game be described in one or two sentences?
>>> gameplay question
?
Duration?
How long is a game session? Should it be longer or shorter?
>>> time question
?
Experience Flow?
How do players journey through the game?
>>> gameplay question
?
Fun and Joy?
Why is the game fun to play? What is engaging about it?
>>> gameplay question
?
Game Server?
How much data needs to be exchanged with the server?
>>> technology question
?
Indoor or Outdoor?
Can the game be played in both? Should it? What would change?
>>> locations question


Locations?
What role are the locations playing? How important are they?
>>> locations question
Main Mechanics?
What are the most important game mechanics?
>>> gameplay question
Nothing digital?
How could the game be played without tech? Why is tech needed?
>>> technology question
Nothing physical?
Does the real world play a meaningful role in the game?
>>> physical question
Number of Players?
How many players are needed for a single game session?
>>> players question
Observing Players?
Is it important to know what the players are doing while playing?
>>> management question
Size of Area?
How large is the game area? Should it be bigger or smaller?
>>> locations question
Suitable Sensors?
How would other sensors change the game?
>>> sensors question
Target Group?
What are the typical players like? How is the game made for them?
>>> players question
Theme and Story?
What is the overall content of the game? How is that conveyed?
>>> gameplay question
blank question
Accidents
Is the game area dangerous due to traffic or rough terrain?
>>> locations challenge
Battery Life
What elements of the game are draining the battery?
>>> technology challenge
Bland Locations
Are the chosen locations exciting and meaningful?
>>> locations challenge
Confusing Interface
Is the interface easy to understand and use for new users?
>>> technology challenge
Critical Mass
Will there be enough players to sustain the game?
>>> players challenge
Disruption
Does the game affect non-players and the game area?
>>> locations challenge
Construction site
Keep out
Dynamic Places
Will the locations stay accessible and unchanged?
>>> locations challenge
Feature Creep
Does the game try to include too many different elements?
>>> gameplay challenge
Getting Lost
How likely is it that players will wander in the wrong direction?
>>> locations challenge

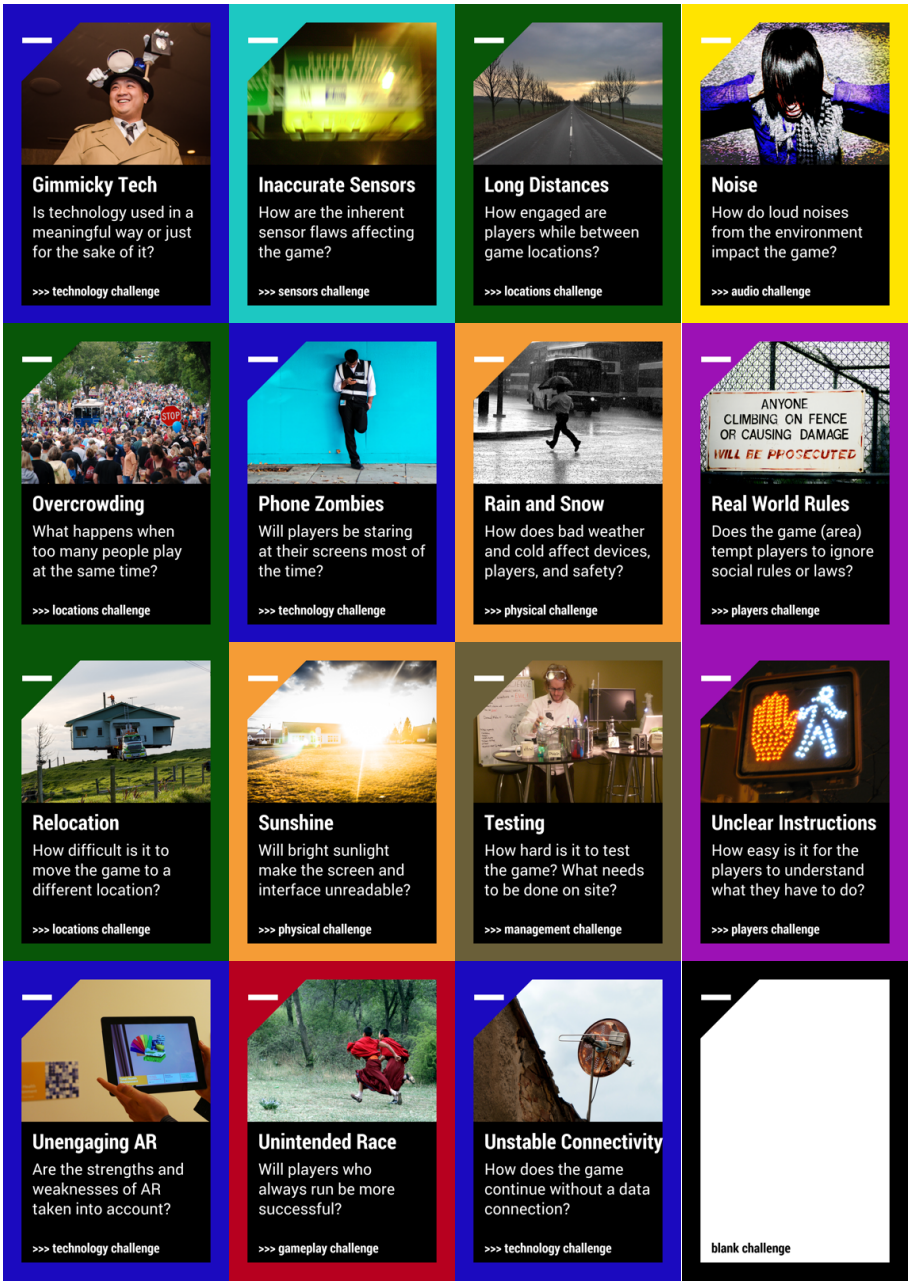


Figure 76. All cards of final version of Mixed Reality Game Cards.

Figure 77. Selection of Theme Cards taken from board game Dixit Odyssey.

Mixed Reality Game Cards

Overview

The cards are made for ideation sessions to support the design of mixed reality games, pervasive games, augmented reality games, and location-based games. The cards talk about different design opportunities and challenges that are typical for this type of game. They are typically used in small groups of 2 to 5 people. It is not necessary to have any previous expertise in mixed reality or game design as the cards should provide you with enough information to come up with some great designs. Multidisciplinary teams also work really well due to the different perspectives that everybody brings along. There are two main purposes for using the cards: generating many ideas in a short amount of time, and in-depth development of an idea from concept to fully-fleshed design.

Ideation Cards

Physical playing cards are a great tool for collaborative design. You can move the cards around to show connections and contradictions – they give you a nice visual representation of your idea. Ideation cards are also a form of *design game*. Playing a game to create a game is a great way of getting everybody into a relaxed and playful mood which is great for feeling inspired and creative. Cards also allow you to focus on the specifics of an idea, as each cards highlights a different element of it. Ideation cards are a great way to explore a specific design space such as mixed reality games, as they give you a quick but intensive overview of existing design knowledge.

Card Types

The cards consist of three main types: *Opportunity Cards*, *Question Cards*, and *Challenge Cards*. Each of these cards also belongs to a category that is illustrated by the border color. Categories are: *audio*, *gameplay*, *locations*, *management*, *physical*, *players*, *sensors*, *technology*, *time*.

Opportunity Cards talk about typical (and untypical) design elements of mixed reality games. They are the building blocks of any game idea.

Question Cards provide prompts about the crucial elements of a mixed reality games which will make the game more defined.

Challenge Cards describes typical issues and problems that your games might encounter in order to ground them in reality.

Blank Cards are not their own type. Instead each card type comes with a couple of empty cards. You should use these to create your own cards whenever you think a concept has not been covered on one of the other cards but is relevant for the game you are developing.

Using the Cards

It is important to remember that you can interpret the cards however you like! Just because something is written on them, does not mean you need to take it as face value. The cards are meant to inspire you – and if they inspire you beyond their original intent? That is great! Feel free to focus on single words or details of an image. The same goes for the proposed rules. Adapt them to whatever works best for your group!

While you can run a session just with the Mixed Reality Game Cards, I recommend you also have the following at hand: post-its, pens, paper for taking notes, a camera, a timer, and of course a nice table. Some people also like to create a poster of their final idea by stick the cards onto a large sheet of paper or use a whiteboard with magnets.

Especially for idea generation it is also useful to have additional inspirational cards (*Theme Cards*). The cards that come with the board game *Dixit* (or any of its expansions) work really well as they are rather surreal and detailed. You can also find some inspirational images in these Flickr groups: *shadesoftinspiration*, *ass795*, *artshow*.

Acknowledgements

I developed the cards as part of my PhD at the Mixed Reality Lab (University of Nottingham). The content of these cards is based on publications by other researchers, my personal experiences, and an analysis of existing mixed reality games. I would like to thank the members of the lab for supporting me, and especially the many participants of my studies. Thank you!

Contact

If you have any questions, comments, ideas for new cards, feedback, or criticism, please do not hesitate to contact me! I am also always looking for session reports and photos of the cards being used.

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Figure 78. Final rules for the Mixed Reality Game Cards (page 1).

Activity 1: Idea generation

You can use the cards for rapidly generating a bunch of ideas. Some of these ideas will be amazing, others weird, and some others not really that exciting. The point of this activity is to create many ideas in the hope that some (or maybe just one) will be useful for later. Therefore, you should not be afraid of proposing something that sounds stupid at first! At this stage, anything goes! There are no "wrong" ideas.

Easy Mode

Shuffle the *Opportunity Cards* and hand out three to everyone. One person goes first by playing a card from their hand and explaining how this creates a rudimentary game. Don't worry too much about implementation or cost at this point, but limit yourself to only a few sentences! Then, someone else plays card and explains how it expands on the previous idea. Continue doing so until everyone has played exactly one card. This is your idea! Note down your game design and which cards you used. Remember, at this point the game description should be really short!

If you have *Theme Cards*, use one of them as an initial seed before playing any *Opportunity Cards*.

Hard Mode

Again, start by shuffling the *Opportunity Cards*. Instead of handing everyone a card, just randomly reveal three of them in the middle of the table! If you have any *Theme Cards*, add one as well. The group now has three minutes to come up with an idea that incorporates all three (four) cards.

This mode can create quite unique ideas as some of the card combinations will be rather unusual.

Activity 2: Idea development

In this activity we will use all the cards to really explore one idea in more detail. This could be the idea you like best from the previous phase, or maybe you already have something more or less concrete in mind. If that is the case, use post-its to quickly note down all the different elements of your idea. In general, the whole session will probably last two hours, but that really depends on the group.

Phase 1: Exploring

In this phase you want to expand your idea. Everybody should draw three *Opportunity Cards* and hold them in their hands. Anybody who has a card that they think could enhance the current design can play it onto the table and explain how it changes the game idea. You should also discard cards that you do not like, and in general everybody should always draw back up to three.

Feel free to also remove cards from the center of the table if they do not fit anymore.

Variant: Instead of a free-for-all play cards by going around the table to give everyone a chance to participate. You might want to start in this mode and then switch to the other one eventually.

Troubleshooting: It is a good idea to use a timer and have a quick check every seven minutes if ideas are still flowing. If that is not the case, try to play some random *Opportunity Cards* or throw in another *Theme Card.*

Sometimes you will notice a lack of concreteness and maybe too many cards are "active". Trim regularly and remove cards that are not essential to the game idea!

Phase 2: Refining

Put the Opportunity Cards aside and hand everyone three *Question Cards*. If you think a card you are holding is relevant for the game and should be discussed, play it on the table. The same should be done for cards that seem irrelevant. Some people might disagree! Use the cards to further define your idea and talk about the important aspects. The goal is to go through all of the cards eventually. It works best if you keep the "important" cards on the table as a reminder, and to use post-its to quickly note down interesting answers to them.

Variant: Instead of going through all *Question Cards* one by one, take all and sort them in order of importance for your game design.

Troubleshooting: If you feel that your idea is still a bit vague after phase 1, start with the red *Question Cards.*

Phase 3: Grounding

This phase is identical to the previous one, but this time you should use the *Challenge Cards*. They will help you identify potential problems in your design.

Variant: As above.

Troubleshooting: Sometimes it is tempting to instantly disregard a card. Instead try to find other interpretations that might be affecting your game.

Phase 4: Finalizing

In this phase you should try to summarize the whole game idea. This usually works best by arranging the cards according to themes or by importance for the overall design. Sticking the cards onto a poster enables you to draw lines and add annotations, as does using a whiteboard.

Figure 79. Final rules for the Mixed Reality Game Cards (page two).

10.6.Mixed Reality for Ideation Cards

One common question when showcasing the Mixed Reality Game Cards was whether technology could (or should!) support the ideation session. After all, the users of the cards were designing mixed reality games, so it is perhaps only natural to wonder whether the cards themselves could be turned into a mixed reality experience. During the course of my PhD studies I refrained from exploring how to introduce technology into a session as I was more interested in exploring the intricacies of how ideation cards work. With this in-depth knowledge it is now perhaps time to reflect on the potential for adding mixed reality technologies into the design process. In this section I will therefore critically assess what types of technologies might be suitable in order to inform any future developments regarding mixed reality ideation cards. In general I believe that a mindful integration of technology is advisable while at the same time making sure that the technology adds meaningful value to the ideation process. Incidentally, this is also a common design issue for designing mixed reality games as illustrated by the Challenge Card Gimmicky Tech (Figure 80).

Figure 80. A Challenge Card highlighting the importance of only using technology when it is truly meaningful.

10.6.1. Background

Ideation cards are a type of design game and as such they have a lot in common with traditional board or rather card games. Especially recent years saw a rise in board games that utilize technology as part of the gameplay or in order to support it. Recent examples include XCom: The Board Game (Lang, 2015) where a smartphone app controls the environment and enemies and a such can be seen as taking on the role of game master. Another example is how Golem Arcana (Johnson et al., 2014) uses an app and digital pen to calculate difficulty levels for skill checks and also offers the option to make dice rolls.

Research into these games speaks of hybrid gaming environments (Magerkurth, 2011), computer-augmented games (Bergström and Björk, 2014; Lundgren and Bjork, 2003), electronic augmentation (Boer and Lamers, 2004), augmented board games (Peitz et al., 2005), real and virtual objects for tabletop games (Leitner et al., 2009), smart device tabletop games (Kankainen and Tyni, 2014), digital tools supporting board games (Hartelius et al., 2012), augmented reality board games (Ip and Cooperstock, 2011), digitised board games (Rogerson et al., 2015), and digital tabletop board games (Wallace et al., 2012; Xu et al., 2011).

The combined work has identified several of the roles that technology plays (or could play) in such hybrid games. Wallace et al. (2012)for example take a look at how automation could positively affect a gaming experience:

- *Performing complex or routine in-game activities*
- *Acting as an impartial referee*
- *Automating game progression*
- *Digital media can provide a more dynamic sensory experience.*

Kankainen et al. (2014) describe the design space from a device-centric point of view and state the way in which they can be useful:

- *Smart device as the game board*
- *Smart device as a game pawn*
- *Smart device as a gameplay accessory for a tabletop game*
- *Smart device as a tabletop game helper*
- *Smart device overseeing play*

Tangible interactions (gestures, placement) plays an important role in ideation card sessions. For this reason I want to advocate against fully digitizing ideation cards. There exists some work that combine personal devices with a communal ones to copy the typical setup of card games (Kerne et al., 2012; Lobunets and Prinz, 2011; Scott et al., 2014). Here the authors are often mainly working on recreating the feel of physical playing cards and are especially concerned with finding a suitable way to bridge the gap between the different devices.

Cheung et al. (2013) follow a more promising way. The aim of their research is to support socially negotiated play via flexible design. For achieving such a system the authors set themselves the following design goals:

- Dispensability (not being forced to use all subsystems)
- Live tweakability (being able to make spontaneous changes mid-game)
- Physicality (keeping physical playing cards)
- Mobility (being able to play anywhere)
- Value (meaningful additions to a play session)

Their system is called Coardial and consists of a deck of playing cards that have been equipped with NFC tags and a number of mobile devices. Each mobile device is able to scan the cards and provides three main functions working either as a personal display or a communal one:

- A card viewer displays contextualized rules, explanations, hints, strategies
- A turn keeper tracks the gamestate and based on it guides players with visual and audio effects
- A scoreboard records the points and all cards played

This way the system maintains the act of physically playing and holding cards while providing additional benefit. One of the main drawbacks of Coardial is the fact that cards need to be scanned. While this is by itself a rather minor task it creates a certain amount of friction that study participants reported as tedious when no clear value is derived from it. However as the mobile devices are de facto used as second screens (with the playing cards being the first "screen") the system keeps the main attention on the cards as the first "screen". Players were however able to ignore Coardial at any point in time and for example forfeit a match or play cards without registering them. This dispensability is named as another strong point of the design.

Other systems try to include digital technology in the form of a smart table. A good example for such a system is Tisch (Hartelius et al., 2012). It is an application that runs on a Microsoft Surface multi-touch table and was designed to support board and pen & paper roleplaying games. The authors have defined the following design goals for Tisch:

- *Allow House Rules regarding interpretation of, and compliance to, rules.*
- *Allow both improvisation and preparation without requiring the latter.*
- *Reduce or remove excise already inherent in the games.*
- *Enhance the gaming activity through immersive features but*
- *do so while being Calm Technology.*
- *Have Social Adaptability and keep Social Weight as low as possible to avoid the system's interface disrupting the social interaction.*

Calm Technology (Weiser and Brown, 1997) refers to technology that supports rather than direct activities. For Eriksson et al. (2005) Social Adaptability means that a technological game can cope with different levels of attention from the players. Toney et al. (2002) describe the concept of Social Weight:

> *The measure of the degradation of social interaction that occurs between the user and other people caused by the use of that item of technology.*

The finished system had a strong focus on sketching and providing a visual layer e.g. in the form of maps for pen & paper roleplaying games. It also allowed for tangible user interfaces by preparing game pawns with tagged tokens so that Tisch for example could create a fog of war around a player character. For some of the studied games Tisch was programmed with some additional rules. In one interesting case of the game Frag the players decided against using the line-of-sight calculations Tisch could have provided. In this instance the reduction of excise by Tisch was not desired. This is likely related to an observation that is discussed in more depth by Xu et al. (2011). Here the authors propose that chores (i.e. excise) are in fact fun and are often *critical for supporting players' engagement with each other*.

Coardial and Tisch are two examples that strive for mindful integration of technology. Both of these systems place the game and the physical interaction at the forefront, and also strive for high flexibility by staying modular and not strictly enforcing any rules. They both potentially enhance a play session by providing

additional value, for example in the form of contextual information or high-fidelity visualizations. I believe that such an approach would likewise be most suitable for mixed reality ideation cards as it ensures that the strengths of ideation cards are not undermined but instead potential weaknesses are mitigated.

10.6.2. Areas for Technological Support

I will now reflect on the different components of ideation cards (content, appearance, rules, tangible interactions, playful interactions) to explore how technology could potentially enhance the overall ideation process.

10.6.2.1. Content

One of the most difficult tasks when designing the content of the cards was providing just enough information so that the concept was clearly conveyed while at the same time not bogging down the design process by overloading the card. This delicate balance however is hard to achieve as some concepts are surely easier to explain than others (e.g. Riddles and Seamful Design). This is especially a concern when targeting less experienced users that lack previous knowledge of the design space. Here, technology could provide additional information for a designer to request when not fully understanding a card, e.g. by providing more detailed descriptions and examples, or by offering explanations for technical terms.

The Mixed Reality Game Cards also utilize images on the cards for illustrative and inspirational purposes. However, these images are of course always the same for each card. Ideally there would be a certain amount of variety where each card is connected to several appropriate images that are regularly substituted. Another step further would be to enable multimedia cards that also show video or play audio. Together this would give each card the ability to show the wide possibility space covered.

Technology could also play a role in enhancing the Theme Cards. While the Dixit cards proved to be rather well-suited, groups might want to use more targeted cards for specific ideation sessions. A filter would enable them to request Theme Cards that are more closely associated with their imagined theme of the game, e.g. drawing from scary images for mixed reality survival horror game.

10.6.2.2. Appearance

Appearance plays a slightly different role in the process of creating technology enhanced ideation cards. One obvious way to go about it would be fully digitized cards that no longer possess any materiality. As this would have a huge impact on tangible interactions, the repercussions are described in the corresponding section.

Another way would be to design cards in a way that they could be tracked and processed by a computer system. One simple way to achieve this would be QR codes that we can already find on the cards from the Sound Design in Games Deck. However, manual scanning of QR codes by the participants is arguably tedious, and perhaps more importantly, it takes up crucial space on the card. A more sophisticated computer vision system could instead recognize the card itself (e.g. based on the inspirational image). Here, the system would need to deal with overlapping cards and occlusion in general.

Another simple solution would be to equip all cards with NFC tags. They could then be read by a smart table or scanned manually by the participants after the session or throughout if desired / necessary.

One advantage of tracking the state of the cards would come into play in documenting a session. If the system is always aware of the state of the idea (as represented by the cards) snapshots could be created easily. Likewise, technology could enable participants to create rich annotations on the fly and thus personalize and modify the cards that are in play. Together this would enable participants to easily continue work on the idea after the end of an ideation session, e.g. to write a more structured and in-depth description of the idea.

10.6.2.3. Rules

A technological system could be well suited to act as moderator that watches out over the rules. In the idea generation phase the system could for example require confirmation that all drawn cards have been used for the idea. During the idea development phase, technology could act as a tracker and keep a tally of which cards have been played and discarded. This would enable the system to make suggestions on how to proceed. It could for example propose to introduce Question Cards when the idea continuously grows bigger and becomes unwieldy. Alternatively, it could suggest to remove a certain number of cards in order to

streamline the idea and force participants to evaluate the current state of the idea. A system with such capabilities would also be able to pre-select cards that might be especially relevant for the group considering the cards that are currently part of the idea. For a game that does not include any cards of the type location it could recommend the Question Card that talks about the role of locations. Similar possibilities exist for recommending Challenge Cards based on the selection of Opportunity Cards.

Apart from the number of cards as an implication for introducing other cards, the system could also employ a simple timer that triggers an evaluation of the group. A low-tech version of this was successfully employed during the Know How study where I acted as a moderator and made the group reflect on their progress every seven minutes. As moderator, I also had the ability of interfering in the session not just based on the elapsed overall time but also depending on the depth of the discussion about certain cards. If the group discarded a card very quickly I would sometimes step in and ask them to spend some more time on it. A technological system that is aware of the time between playing a card and discarding it could take on such a role.

10.6.2.4. Tangible Interactions

The physicality of the cards affords several interactions that have proven to be beneficial to the ideation process. This for example includes how gestures are being used during negotiations. Pointing at cards, picking them up, moving them closer to other cards. For a technological solution, it is crucial to keep these physical qualities.

However, there are some ways in which the physicality also arguably hinders a smooth design process. For example, each card exists only once. While this is positive to assure everybody is focusing on the same card, it also has certain drawbacks. If somebody wants to take the card to read and fully understand it, they are removing access from the other participants. Having to rotate a card in order to be able to read it is another example where the physicality of a card causes friction. A digital representation of the card would not have these problems as each designer could have their own copy of each card. This would mitigate many of the problems of providing equal access to all resources to the participants. With fully digital cards there also exists no difficulty in reaching the draw or discard piles as

duplicates can be created easily. The virtual version of the cards would still need to be able to be placed into contextual groups on the fly. The ability to do so was observed both as a very natural type of interaction as well as a very powerful one. It enables the group to encode meaning into cards by placing them into spatial vicinity, be it congruence or conflict.

If done carefully, technology could also be used to motivate designers to actually play cards into the centre of the table instead of keeping control over a card by just holding it up or playing it into one's personal territory. If participants perceive additional value when they place a card into the communal space, they might be more likely to do so. An example benefit could be provided by tracking cards as outlined in the above section about technology and rules. If this tracking only works in the central area of the table, it might make users more likely to place cards there.

10.6.2.5. Playful Interactions

Playful interactions, like tangible ones, might seem somewhat at odds with technology when initially thinking about it. Here, we can again derive design constraints from any envisioned system. Playfulness needs to be maintained, and this for example requires that the technology likewise does not reduce the flexibility of a session. Like in other games, participants will likely develop house rules or maybe want to bend or break the rules sometimes a little bit. If the technological system is set-up in a very strict manner it will only be perceived as an additional burden an artificial restriction on the session. Therefore, the system needs to be implemented very carefully in what it actually enforces.

Digital versions of board games also usually reduce the amount of excise (or chores) that are required by the players. Calculating and updating the score automatically is a common example. Taking away too many of such interactions however also often reduces the appeal of the game as it limits the activities that the players undertake. This in turn leads to a lower understanding of the game, its mechanics, and the overall state of the game (Xu et al., 2011). A technologically enhanced ideation session might make similar mistakes. Participants no longer need to manually move cards to the side or into the centre, and they also do not need to draw and reveal cards themselves. The effects of such an automation need to be weighed carefully in order to assure that it does not remove too much of the agency and the engagement of the participants.

10.6.3. Mindful Mixed Reality

Looking at the above examples for technological intervention in ideation card sessions it is clear that there is great potential for introducing mixed reality into the design process.

The following broad categories seem to be the most salient for technological support:

- **Dynamic and rich additional content**. Participants should be able to delve deeper into the concepts of the cards including detailed descriptions, illustrative examples, and explanations of technical terms.
- **Structural guidance and contextual recommendations**. The system should be aware of the idea state and advise participants on next steps and when for example to reduce the scope of an idea.
- **Facilitation of annotations and documentation**. At the end of the session a digital representation of the idea should be created with support from the system to enable further work on the idea.

At the same time, it is important for the system to be mindful of the following:

- **Flexibility**. Participants need to be able to freely play cards and break and bend rules throughout the session. The system should not prevent any type of interactions.
- **Materiality**. Gestures and placement play an important role when interacting with ideation cards. Therefore, the system should not completely virtualize the cards.
- **Individual interactions**. The automation of the system should not remove any of the card interactions as these are a valuable part of the ideation process.
- **Seamless integration**. The system should not require continuous attention from the participants and should also not remove focus from the actual card interactions.

In order to provide more design guidance on these systems it is necessary to reflect on how they would integrate into the design process while keeping the aforementioned constraints in mind.

The additional content would be mostly requested on demand by participants in case they wish to engage more with a specific card. For such an activity, it would be acceptable for example to require participants to trigger the technology, e.g. by scanning a card or otherwise actively informing the system of their intent.

The guidance and recommendations on the other hand would be running in the background during the session. This would for example only require from rather simple methods like checking a timer to counting the number of cards in the "active space" of the table. The system would then notify the participants when it detects the need for an intervention.

The system for documentation would likewise run in the background during the session and not require interaction while the group is still engaged in the ideation process. Then, at the end of the session, the system would then require feedback and user input in order to process and refine its understanding of the idea. Figure 81 illustrates the different modalities of the three systems.

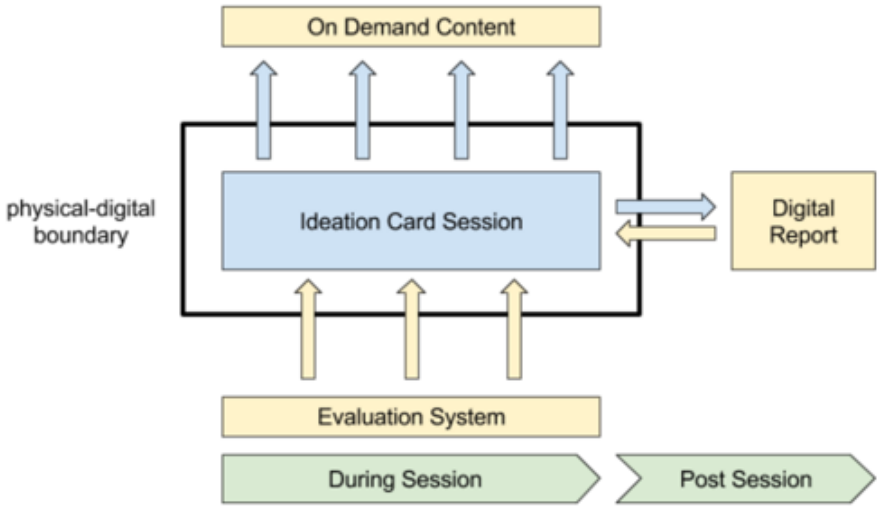

Figure 81. During the course of the ideation session, the evaluation system occasionally actively breaks through the physical-digital boundary. The participants can always demand additional content by likewise crossing the boundary. After the actual session is over a digital report is created based on what happened during the session and additional input.

The described system distinguishes itself by keeping a physical-digital boundary mostly intact. Only at certain moments during a session will the focus of the participants shift towards the digital system. This can either happen when a participant actively decides to extend the ideation space into the digital realm by

requesting additional content. Perhaps similarly, the evaluation system occasionally prompts the participants of the ideation card session with suggestions. When the actual ideation part of the session is over the system can then demand more attention from the designers in order to jointly create a digital report of the session.

This approach is in line with the way Cheung et al. (2013) describe their system:

> *Our system is primarily designed as a tool rather than as a game director. We convey a vision wherein these components are, first and foremost, not meant to be intelligent. They are more like the casino personnel who deals out cards in blackjack and nudges players; sometimes counselling on actions available. Intelligence and decision-making control rest in the players' hand.*

I believe that the system should be as least invasive as possible and be delegated to working in the background as much as possible. The system should be a valued assistant that has a low impact on the flow of a session in order not to destroy the qualities of an ideation card session.

This is reminiscent of how Weiser and Brown (1997) define Calm Technology:

> *Calm technology engages both the center and the periphery of our attention, and in fact moves back and forth between the two. [..] Technologies encalm as they empower our periphery. This happens in two ways. First, as already mentioned, a calming technology may be one that easily moves from center to periphery and back. Second, a technology may enhance our peripheral reach by bringing more details into the periphery.*

For the envisioned system to support ideation card sessions I would like to put a slightly different emphasis on the qualities of the technology. It is important that the technology does not overwhelm the activity that is happening at the centre of attention (the card play), but at the same time the system needs to be able to gracefully attain focus when appropriate without being overbearing or too demanding. The technology truly needs to be supportive of the activity without restricting or leading it, even unintentionally. As in the case of ideation card sessions we are talking about an activity that is deeply rooted in the physical space I want to call the proposed system an example for "mindful mixed reality". Mindful mixed reality is carefully designed to not adversely affect the rich physical interactions and the freedom of the underlying activity but instead is considerate and assistive of it.

This is achieved by assuring it:

- waits until users explicitly call upon it
- only occasionally advises users when appropriate in a gentle manner
- interacts with the users more directly in the aftermath of the session

10.7. Chapter Summary

In this chapter I have discussed and identified the attributes that make ideation cards such successful mediators for idea generation and idea development.

These five elements are:

- **Content**. Each card conveys a concept with a combination of text and images. The Mixed Reality Game Cards describe design opportunities, ask reflective questions, surface design challenges, and they are supported with inspiring cards from the board game Dixit.
- **Appearance**. This includes both the graphic design as well as the materiality of the cards. The physical dimensions of the cards shape the content that is put on them and afford several interactions.
- **Rules**. Instructions prescribe how designers can use the cards to foster idea generation as well as idea development. They frame the session and provide a flexible structure.
- **Tangible Interactions**. Physical playing cards bring with them a set of affordances that create rich opportunities to influence the design process, e.g. by allowing gestures and placement for efficient non-verbal communication.
- **Playful Interactions**. Ideation cards are a form of design game and as such the magic circle of games and play create a casual atmosphere that the ideation process benefits from.

The qualities of ideation cards interact and shape the components of ideation sessions. I have identified the latter as the following:

- **Knowledge**. In order to develop an idea experience of the design space under investigation is beneficial and is used to draw from during a session.
- **Inspiration**. Ideation sessions are conducted to tap into the creativity of the participating designers. For idea generation inspiration is perhaps most desired.
- **Focus**. During an ideation session ideas come under scrutiny. This focus is especially relevant during the development of an idea that refines and evolves an idea.
- **Negotiation**. In collaborative ideation sessions, the participating designers need to discuss their ideas and agree on a path to pursue.
- **Idea**. The idea is the outcome of a successful ideation session. During the session itself, the designers will develop one main idea that consists of several smaller ideas to form a coherent whole.

By putting content, rules, physicality, and playfulness in relation to knowledge, inspiration, focus, negotiation, and idea I have described the intricacies of ideation card sessions in detail. This enabled me to provide guidelines for future designers of ideation cards or for conducting sessions with ideation cards. These guidelines are presented under the lenses of the different aspects of ideation cards as summarized in Table 27.

Lastly I have reflected on how future ideation cards and sessions could be meaningfully supported by technology, i.e. mixed reality ideation cards. For such an endeavour, I propose a hypothetical system that keeps in the background for most of the session apart from:

- Explicit invitations by the users (to display additional content)
- Occasionally gentle nudges (to encourage discarding of cards or reflections of the idea state)
- The end of the session (to support the designers in creating a digital report)

I believe it is important to not disturb the natural flow of an ideation card session with technology. I believe this can be achieved by something that I call mindful mixed reality that puts the physical experience above the digital enhancement.

Content	**Simplicity**. Cards have to balance the right amount of information in order to not slow down a session with too much of it or hinder the understanding of a card by providing too little.
	Openness. Cards need to leave room for interpretation, so that participants have various options of what a card means exactly in context of their idea.
	Specialization. It is difficult to design cards that are well suited for idea generation as well as idea development, therefore a range of card types for the different tasks is recommended.
Appearance	**Graphic Design.** The look and feel of the cards can promote a playful atmosphere. It also has a big impact on readability, especially once the card has been played on the table. Colour-coding should be used to make cards distinct and form conceptual groups.
	Material. The thickness of the card stock has an impact on how easy and pleasurable the tangible interactions with the cards will be. At the same time, such high quality makes users hesitant to scribble on and otherwise "destroy" cards.
	Documentation. The cards lend themselves well for documenting the idea at the end of a session, e.g. by creating a poster. This activity also helps in ensuring a joint understanding of the idea.
Rules	**Challenge**. Participants need to be encouraged to not always make the obvious choice, be it when building the idea or when reflecting upon it. They need to challenge themselves and play devil's advocate.
	Structure. Turn-taking and free play of the cards affect the flow of a session. The participants need to be empowered to reflect on the status of the idea and progress to other phases in the process at the right moment.
	Reduction. Participants should be encouraged to expand an idea but then also to reduce it again by discarding cards that are not crucial for the overall idea.
Tangible Interactions	**Gestures.** Participants will employ gestures referring to cards in order to communicate their design intent, call for attention, and they will move the cards around.
	Access. The spatial layout of the table, card stacks, and participants is crucial to give everyone equal access to the different territories as otherwise their engagement might suffer.
	Placement. Participants should be encouraged to make use of the communal space in the centre of the table where they can arrange cards in different types of contextual clusters to convey additional meaning.
Playful Interactions	**Flexibility**. Participants need to be allowed to bend and break the rules during a session while still following the overall structure.
	Lightness. Participants will be required to come up with several ideas over the course of a sessions. The cards can work as an alibi for them which encourages them to also propose weird and unusual ideas.
	Action. Participants have fun when they play cards themselves. Therefore everybody should be put in charge of a range of cards to also give them greater agency over the developed idea.

Table 27. Overview of guidelines for designing ideation cards and running sessions.

11. Conclusions

11.1. Summary

In this PhD, I have taken an in-depth look at the underlying principles and phenomena of ideation cards and investigated how the shape the design process. I did this by employing a **Research through Design** methodology and developing the **Mixed Reality Game Cards**. These are a deck of cards to facilitate the collaborative design of mixed reality games. They support rapid **idea generation** as well as in-depth **idea development**. The Mixed Reality Game Cards have been developed iteratively over the course of seven studies, separated into three phases.

Phase 1 describes the initial exploration. The approach of separating the Mixed Reality Game Cards into three distinct types of cards was successfully tested. **Opportunity Cards** are the building blocks for the ideas and contain typical design elements of mixed reality games. **Question Cards** are using once an initial idea has been established in order to explore the design in more detail. Lastly, **Challenge Cards** are used to ground the idea in reality by confronting the designers with issues and problems that arise when staging mixed reality games. The cards were evaluated with three different user groups: students of Games Computing from the University of Lincoln, researchers and professionals of the Magellan project, and writers and publishers at the Brisbane Writers Festival.

The results from the three initial studies fed into the second iteration of the Mixed Reality Game Cards that were further refined during **Phase 2**. In addition to the three aforementioned types of cards, a fourth one was introduced. **Theme Cards** enrich the idea generation session by providing additional, domain-external sources of inspiration. For this, the colourful and surreal cards from the board game Dixit are being used. Furthermore, I explored different methods for idea generation in more detail. **Random draw** requires participants to randomly reveal a certain number of cards and create an idea out of them and **limited choice** lets them chose one card from their hand each. A total of three studies were conducted during this phase with participants ranging from highly experienced academics, artists, and developers to completely inexperienced members of the UK-based charity Sustrans.

The findings resulted in the final version of cards for **Phase 3** of the development process. I conducted a final study, again at the University of Lincoln, to validate the third iteration of the cards.

Overall, the studies then also allowed me to investigate how and why ideation cards affect the design process. I have identified **content**, **appearance**, and **rules** as well as **tangible** and **playful interactions** as the core qualities of ideation cards. I have then discussed how they influence the **idea**, **negotiations**, **inspiration**, **focus**, and **knowledge**. Based on this I formulated design implications that aim to help future designers of ideation cards in their endeavour which are summarized in Table 27. The final contribution of the PhD consists of a reflection on how ideation cards themselves could be turned into a mixed reality experience, namely by utilizing mindful technology that supports but not overwhelms the interactions with the ideation cards themselves.

11.2. Research through Design

Developing the Mixed Reality Game Cards is an example for research through design. The cards (including the rules) are an artefact reflecting the outcome of my research, and the artefact is the basis for the theoretical results derived from the studies. The cards informed the research and the research informed the cards.

Zimmerman and Forlizzi (2008) summarize, how this methodology can be applied in HCI. Research through design allows to:

- *address wicked problems*
- *consider relationships between multiple phenomena in the design space*
- *create research outcomes that serve as design exemplars that aid in the translation of findings to the practice community*
- *explore how new technology can advance current and future products and services*
- *investigate how future products and services might affect people*

The Mixed Reality Game Cards are an example for mostly the second and third of these application areas, perhaps also covering the first one depending on whether the design of ideation cards is considered to be a *wicked problem* or not. Designing the Mixed Reality Game Cards has clearly surfaced several of the phenomena that make ideation cards such a powerful tool for supporting collaborative design processes. This includes my observations on content, appearance, rules, and

tangible and playful interactions as the enablers for idea, negotiation, focus, inspiration, and knowledge. By having the clear design goals of supporting idea generation as well as idea development my research was perhaps more focused as it would have been if I had just set out to explore ideation cards in general. The development of a product on the one hand fosters a slightly different mind-set, while at the same time the act of creation creates substantial tacit design knowledge (in this case about the design of ideation cards).

Friedman (2003) highlights the difficulty that designers often face (or ignore) when transferring such tacit design knowledge into design theory:

> *One of the deep problems in design research is the failure to develop grounded theory out of practice. Instead, designers often confuse practice with research. Instead of developing theory from practice through articulation and inductive inquiry, some designers simply argue that practice is research and practice-based research is, in itself, a form of theory construction. Design theory is not identical with the tacit knowledge of design practice. While tacit knowledge is important to all fields of practice, confusing tacit knowledge with general design knowledge involves a category confusion.*

In research through design, this is most often mitigated by producing an artefact as the outcome of the research in the form of a design exemplar. While the Mixed Reality Game Cards as such are certainly such a design exemplar that other creators of ideation cards can use for inspiration, this is not necessarily enough. The Mixed Reality Game Cards as an artefact mostly communicate design knowledge about ideation cards through their content and rules. This thesis however has shown that tangible and playful interactions are two additional underlying phenomena that have a substantial impact on the success and suitability of ideation cards. However, the implications from both are less clear when just observing the artefact itself as they are created implicitly. To circumvent this issue, it is necessary to combine the designerly reflections with more research-driven findings in order to arrive at a holistic theory of ideation cards. I have presented such a theory in the previous chapter with direct connections between it and the practical artefact. This way I hope to have provided an equally accessible as insightful account of the high and low level workings and peculiarities of ideation cards.

11.3. Impact

The Mixed Reality Game Cards have been used by over 150 participants in the studies described in this thesis. In addition, I have used them twice as part of teaching Master students at the University of Nottingham with 50-70 students each time. The cards were also used successfully at two events at QUAD Derby with children aged 10 to 14 and young adults aged 14 to 16 respectively. The cards were showcased in three 1h sessions at the Now Play This event as part of the London Games Festival in 2016 and were selected as one of the example of ideation cards for game design at the Pervasive Play workshop at CHI2016. Recently, I also demonstrated the cards at the Artful Spark event at the Barbican Centre and at the GameCity Festival. While the Mixed Reality Game Cards were originally developed as part of the ORCHID project, they have now also been integrated into the EU-research project Magellan. Furthermore, the cards have also been used independently from me for teaching at the De Montfort University in Leicester, at Leeds Trinity University, and at the TU Graz, Austria.

This resulted in large number of brief game ideas and several ones that were developed in more depth. Grand Push Auto (Marshall et al., 2015) and Taphobos (Brown et al., 2015) were the subject of academic publications with the latter going on to become a fully developed game exhibited at international festivals. The study participants from QUAD published the game as originally planned as part of the Format15 photography festival.

In September 2016, I started selling the Mixed Reality Game Cards on my website (https://www.pervasiveplayground.com). So far, without targeted advertising and mostly word-of-mouth I have sold 64 decks in a little over two months. People are now using the cards in the UK, Germany, Austria, France, Malaysia, and Singapore, and are hopefully designing exciting new mixed reality games.

In order to further support the ideation cards I have also developed a guide to accompany them that invites further reading outside of ideation sessions or as a general reference should a concept on a card be unclear. This guide is reproduced in the appendix.

11.4. Future Work

A natural next step for work on ideation cards has been laid out in the discussion chapter: The investigation of mixed reality ideation cards. These would be ideation cards that are supported with technology. However, it needs to be assured that the strengths of ideation cards as described in the previous section are not undermined by "gimmicky" introduction of technology. Instead I have proposed an approach I call mindful mixed reality. Within it I outline the importance of flexibility and seamless integration of any developed system and retaining the tangible and playful interactions. For the role of technology, I suggest the following areas that might benefit the most:

- Dynamic and rich additional content
- Structural guidance and contextual recommendations
- Facilitation of annotations and documentation

The exact means of implementing these functionalities and what type of technology will be most suitable is an open question at this point. Using only a deck of cards for example has the advantage of not having to rely on complex or expensive set ups - a deck of cards literally just works out-of-the-box. Developers of mixed reality ideation cards would need to evaluate whether technology does not only provide meaningful added value but also investigate the practicality of any solution developed.

11.5. Closing Thoughts

In this thesis, I have described how I developed the Mixed Reality Game Cards to support the design of mixed reality games. Opportunity Cards, Question Cards, Challenge Cards, and Theme Cards bring in different perspectives and enable the rapid generation of game design ideas as well as exploring specific ideas in more detail. The process results in a fully-fleshed out idea that started within blue sky thinking and later got grounded in reality.

I reported on seven studies that I undertook with a wide range of participants including professional developers, artists, academics, students, and domain experts ranging from rich experiences with mixed reality games to none. The results of these studies not only demonstrated the usefulness of the Mixed Reality Game

Cards, but also perhaps more importantly allowed me to study ideation cards and their peculiarities in much detail. Content, appearance, rules, and tangible and playful interatctions take on an important role in ideation card sessions.

The findings and design implications presented in this thesis provide a holistic understanding of ideation cards. They go substantially beyond previous work by not only reporting on the existence of important phenomena of ideation cards but also deconstructing and analysing them. Therefore, I am confident this thesis will prove to be useful for future researchers, designers and users of ideation cards alike.

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Appendix

A. Image Rights

The Mixed Reality Game Cards use images that have been made available under Creative Commons. The following is an overview of the cards with the appropriate credit for the creator of the image. The credits are first sorted by license and then alphabetically by card. I would like to thank all creators for their inspiring images!

CC BY-SA 2.0: Accidents (Mario Antonio Pena Zapatería: "bike accident"), Battery Life (Martin Abegglen: "low battery"), Challenging? (Maria Ly: "rock climbing @ lei pi shan, yangshuo china"), Collecting (onnola: "Pilzkorb"), Core Concepts? (Fabrice Florin: "IMG_9329"), Costumes (phoTTo.de: "DSC_2534"), Creativity (Wolfgang Lonien: "7dd_2246024-painting-by-numbers-1-2"), Disruption (Takver: "Cyclists riding in Melbourne for 350 Climate Protest"), Fitting Locations (Michael Coghlan: "Harbour Love"), Game Server? (Torkild Retvedt: "Server room"), Headquarter (Udo Schröter: "Svensk koja"), Inaccurate Sensors (Douglas Muth: "Blurry sign"), Long Distances (Harald Hoyer: "Road to nowhere..."), Low Tech (Joe Haupt: "Vintage Lafayette 10-Transistor Citizens Band Walkie Talkies, Two Channel, Model HE-210, Made in Japan"), Mini Games (Marion Doss: "Kids play games and get wet with Navy Divers"), Nothing physical? (Sergey Galyonkin: "Anna Bashmakova and Oculus Rift"), Number of Players? (Meg Cheng: "group hug"), Observing Players? (Kennisland: "Storytelling"), Open Authoring (See-ming Lee: "Artist Toolbox: Dean Russo / Dumbo Arts Center: Art Under the Bridge Festival 2009 / 20090926.10D.54862.P1.L1 / SML"), Performative Play (Daniel Stockman: "Fremont Solstice Parade 2010 - 173"), Phone Zombies (Garry Knight: "National Security"), Real World Rules (Kurt Bauschardt: "Insignificant Protest"), Roleplaying (maria_lc: "Dr. Jekyll & Mr. Hyde"), Seamful Design (David Dashwood: "Narre Warren Floods"), Stationary Sensors (Abd allah Foteih: "Hkg9722273"), Sunshine (Ricky Cain: "Sunset HDR (11 of 11)"), Target Group? (Dan Goodwin: "lego-city-folk"), Theme and Story? (Andrés Nieto Porras: "19/365²: El árbol de las ideas"), Time Pressure (openDemocracy: "egg_timer"), Unengaging AR (Ted Eytan: "Kaiser Permanente Center for Total Health Content Refresh 19661"), Unstable Connectivity (Jerzy

Kociatkiewicz: "The future was here"), Wizard of Oz (Edith Soto: "binoculars"), Worldwide (Alexis O'Toole: "globe").

CC BY 2.0: Actors (Monomoy Theatre Photo GalPal: "KISS ME KATE - 2014 Monomoy Theatre"), Alternate Reality (anna gutermuth: "109/365"), Area Control (John Morgan: "Iwo Jima"), Augmented Reality (Bert Kimura: "Butterflies are free"), Beginning and End? (Chris Costes: "Day 32 - What Lies Beyond"), Collaboration (DVIDSHUB: "OCS honors Montford Point Marines during challenge [Image 4 of 20]"), Compelling Audio (Nickolai Kashirin: "Headphones"), Confusing Interface (Nicolas Nova: "Complex interface"), Critical Mass (John Haslam: "Waiting for summer; Empty benches, the promenade - Birzebugga, Malta"), Different Roles (The Conmunity - Pop Culture Geek: "Anime Expo 2010 - LA - Ms Pac-Man and ghost"), Duration? (Robert Couse-Baker: "time flies"), Dynamic Places (Elliott Brown: "Construction site Masshouse Lane / Albert Street - Construction site Keep out - sign"), Episodic Content (Andreanna Moya: "Calendar"), Exergaming (Abhisek Sarda: "Walking the Rope"), Experience Flow? (Forgemind ArchiMedia: "BIG - Bjarke Ingels Group - SUK - Superkilen Park - Photo 0025.jpg"), Exploration (David Fulmer: "Austin looking the light from abandoned tunnel"), Feature Creep (Jim Pennucci: "Swiss Army"), Fun and Joy? (FaceMePLS: "Holi Feest 2008"), Generated Locations (Jamie: "Obsolete Book - 5/365"), Getting Lost (Peer Lawther: "Tucamcari Mountain and a wrong way sign"), Gimmicky Tech (Paul Callan: "Nerd-O-Ween 2013 - 59"), Global Gamestate (Will Folsom: "Safe"), Indoor or Outdoor? (Mike Melrose: "looking through window"), Locations? (Angelo DeSantis: "Taken from the top of the Mark Hopkins Intercontinental San Francisco"), Main Mechanics? (Kevin Walsh: "cogs"), Manual Interaction (Vernon Chan: "Sony Xperia V"), Mobile Soundtrack (Jeremy Baucom: "Vintage Record Player"), Motion Tracking (Leland Francisco: "Break Dancing"), Noise (Jason Rogers: "Day 642 / 365 - Myself is against me"), Nothing digital? (Allie_Caulfield: "2007-11-17 11-18 Partenkirchen (Klais, Kranzbach, Schloss Elmau, Elmauer Alm) 128"), Online Participation (Alejandro Pinto: "MacBook Air: Estación de Trabajo"), Overcrowding (Amy West: "Crowd"), Passive Tracking (NASA Goddard Space Flight Center: "NASA's Upper Atmosphere Research Satellite, or UARS, is expected to re-enter Earth's atmosphere late September"), Peer-to-Peer (Al Pavangkanan: "2012-06-29-699"), Physiological Data (Simon Fraser University - University Communications: "Brain

study"), Pokémon Go (iphonedigital: “Pokémon Go da más dinero a Apple y Pokemon Company que a Nintendo”), Public Display (Canadian Film Centre: "WSFF 2012: Shorts for Shorties at Dufferin Grove"), Public Infrastructure (Tim Adams: "Check out posts for Rejsekort IC card"), Puppet Masters (Jackie: "Marionette Show"), Rain and Snow (Beshef: ""), Relocation (Dave Young: "mobile home"), Riddles (Todd Huffman: "EFF Riddle"), Scavenger Hunt (Eden, Janine and Jim: "Playground Map"), Set Construction (Les Chatfield: "Working on the railway"), Size of Area? (Forgemind ArchiMedia: "BIG - Bjarke Ingels Group - SUK - Superkilen Park - Photo 0002.jpg"), Social Contract (Boston Public Library: "Napoleon Lajoie and Honus Wagner shake hands"), Strong Narrative (Christian Schnettelker: "Once a time / Es war einmal"), Subverted Locations (Thure Johnson: "Ivanpah snowman"), Suitable Sensors? (Ingrid Taylar: "Metal Detector on Crown Beach"), Technical Artifacts (Doug Bowman: "Whatever Happened to Baby Jane?"), Telephony (Douglas Neiner: "Phone Booths in London (Stylized)"), Testing (JD Hancock: "Doctor Science"), Timed Events (maxime raynal: "Ambiance lever de lune"), Unclear Instructions (caesararum: "Confused traffic signal"), Unintended Race (Tom Thai: "China - Young Monks Racing (和尚赛跑)"), Unusual Locations (Forsaken Fotos: "Happy House side view"), Useful Props (Calsidyrose: "Compass Study"), Vehicles (State Library Victoria Collections: "Tandem bicycle"), Weather Input (Greg Ness: "Rainbow (Explore #392)").

B. Guide

The following pages reproduce the guide that I have developed after the majority of the work presented in this thesis was finished. The guide was created as part of the Magellan research project. For this reason, it talks about location-based experiences and not mixed reality games. However, it explains all of the Mixed Reality Game Cards and goes into more detail about the concepts depicted on them. The guide is designed to be studied before and after ideation card session. If needed, it can also be used during a session to clear up misunderstandings about cards or to gain additional ideas.

MAGELLAN

A Guide for Authors of Location-Based Experiences

Preface

So you are thinking of authoring a location-based experience or game?

It's a compelling idea – this new form of digital offering has tremendous potential to engage users in unusual experiences that mix digital content with real-world locations, people and props. With location-based experiences, the whole world becomes your arena, already richly populated with places, stories and characters for you to draw on. Your task is simply to bring it to life by layering digital media on top, and connecting it to the real world using mobile devices and location-sensing.

It sounds easy enough does it not?

The very novelty of location-based experiences, and especially situating them within the real world, however also makes them extremely challenging to design.

In particular, even if you have experience in designing conventional computer games, you will need to quickly learn about a whole series of new concepts to make location-based games that are actually compelling and viable.

We have written this guide to help people from a broad variety of backgrounds and prior experiences learn how to author location-based experiences, ranging from the interested amateur with little computing experience to professional game designers who wish to move over into location-based experience design.

Previous page:
I'd Hide You, Blast Theory

To support such a broadly ranging readership, we have split it into five independent parts. Whilst some might read our guide from start to finish, others might just dip into the elements that they need.

The guide as a whole draws on several decades of location-based experience design in the creative industries and academic research, allowing us to provide lots of real-world examples for you to learn from.

Part 1 of the guide is an introduction to the concept of location-based experiences. It explains what they are, and how they are created and experienced. We will do this by taking a look at interesting examples and by a look at the different elements that make and break location-based experiences.

Part 2 provides a summary of important opportunities for design that authors might find useful to know about. They are the building blocks of any experience.

Part 3 gives an overview of some high-level questions regarding the the detailed design of a chosen experience. They help to refine the design in more detail.

Part 4 confronts the author with a selection of common challenges that they should aim to avoid. They require a thorough reflection of the design.

Part 5 is the afterword of the guide and provides ideas for further reading, a glossary, image credits and background of the MAGELLAN project.

Collectively, parts 2, 3, and 4 of this guide cover 93 topics which are relevant to location-based experience design, and which are important for an author of these kinds of experience to understand.

These topics are summarised in a “quick reference” format which allows the reader to dip in and out of the guide and to just pick out those topics that they wish to learn about.

Table of Contents

Introduction

Location-based experiences make use of information about location to entertain or inform their users. They augment the physical world with the help of technology to create a new form of hybrid experience. Instead of using a controller like in a video game in location-based experiences the players are their own avatar. Location-aware technology is being used to track their position, and the system then reacts for example when they are close enough to a specific location.

Artists and researchers have been exploring the possibilities of these experiences offer for more than a decade, and have identified a broad range of approaches and applications. In recent years technology has made so much progress that now almost everyone carries a device with them which allows for rich location-based experiences.

More and more location-based experiences are being developed commercially. Tools that make it easier to create (or "author") have also reached a certain level of maturity, and it is now technically easier than ever to put an experience together.

In fact it can often be done without any requirement for expertise in a programming language at all.

However, creating an experience that is effective, engaging and exciting still requires a significant amount of capability on the part of the author or the authoring team.

Authors need an understanding of the enabling technologies and how to employ them while also taking into account what it means to stage a game in the real world.

A simple example?

To obtain a quick understanding of some of the opportunities and challenges inherent in location-based experience design, the reader might consider examining an instructive and interesting example of an existing experience. This is the Guardian Newspaper Street Stories app, available for both iOS and Android smartphones, and downloadable for free.

The screenshot of the central interface of this app is shown on the right. It shows a map superimposed with orange dots representing digital audio files.

http://www.theguardian.com/mobile/streetstories

To create this app, the authors have produced a series of digital audio recordings of intriguing historical stories that have taken place within Kings Cross, an area of London, in which the Guardian Newspaper's main office has been situated for several decades. By physically walking to the right location in Kings Cross whilst running the app, a user can listen to a recorded story and learn about the area. Audio recordings specifically reference buildings or other features that the user can see. This means that there is a purpose for walking to the location. Audio files are built into the app itself, so it can be used without working network coverage (as long as it is downloaded in advance of visiting the area).

To enable the linking of a digital audio track to a place, the user's smartphone detects where the user is, using any technology available to the smartphone, and passes this information to the app in a technology-independent form.

Typically, this process will make use of information provided through a network of satellites collectively known as the Global Positioning System. This might be augmented by other contextual information sensed by the smartphone, such as the proximity of known wireless networks, or the movements of the user.

There is an amount of uncertainty in the resultant location (e.g. the phone might only be able to position a user to within 30 metres). This particular app handles this by defining a zone on the map within which the digital audio becomes available – other approaches are available and will be considered later in this guide.

The app itself was produced using a web-interface called AppFurnace – this provides facilities to import digital media, to associate it with a map of locations, and to define the size of zones and the app behaviour that occurs as a user walks in and out of them.

Much of this configuration can be done without programming, through a simple drag-and-drop interface which allows for media such as text, and audio to be imported and linked.

Once created, AppFurnace apps can be distributed directly to users, or can be uploaded to a number of publicly-available app stores (requiring the payment of a small fee). AppFurnace apps automatically work on both Android and iOS, which means that authors only need to create one app, but does exclude the possibility of using features specific to either of these platforms.

Even though the assembly of this kind of app in an authoring tool such as AppFurnace is relatively simple, a very substantial amount of design and authoring effort is still required to produce an experience that is effective. In this example, the authors will have had to:

1. Identify and produce a map with an appropriate and interesting style.

2. Record high-quality audio presenting stories that are interesting and intriguing enough for users to want to spend their time listening to them.

3. Decide how to handle inaccuracies inherent in location information (GPS inaccuracy is influenced by factors such as tall building and inclement weather conditions, and can be explicitly controlled by the US military, who are the ultimate providers of the service).

4. Design a promotional strategy to support its uptake.

5. Understand how to finance the ongoing costs of supporting and distributing the App (which might increase very rapidly if the promotional strategy is effective, or if updates in smartphone technology mean that the app stops working).

Along with a great many other decisions!

Geocaching

Geocaching was invented in May 2000 when the US government removed “selective availability” from their GPS satellites. This meant that the precision of GPS for private users improved drastically from previously 100m to 10m.

In Geocaching anybody who wants to can take a small physical box and hide it wherever they please. The box is called a Geocache and contains a logbook and sometimes small trinkets or badges. The creator of the geocache then publishes the GPS coordinates on a Geocaching website. Sometimes players need to solve a riddle first in order to uncover the actual coordinates, other times the coordinates might not lead to the geocache directly but instead to further clues.

In order to play the game a geocacher travels to the coordinates where they will find the hidden geocache. They then sign and date the logbook and might take out one of the small objects and put in something new as exchange. They then place the geocache back to where it was previously.

Pokémon Go

Pokémon Go was published by Niantic in June 2016. Like in previous Pokémon games players have to find these elusive creatures and catch them. They can then train the Pokémon and battle other trainers and their creatures at Gyms.

The game is available for Android and iPhone devices. The main screen shows a map of the nearby area and the aforementioned Gyms as well as Pokéstops. The latter let trainers acquire bonus items when visited. Both types of locations are placed near interesting real-world places.

The main gameplay of Pokémon Go consists of walking around and hoping for a Pokémon to appear.

If they do the player can approach them. They then need to be caught in a simple augmented reality mini game where the player has to swipe their phone to throw a virtual ball. Depending on the quality of the throw and the strength of the Pokémon players will then catch it.

Geocaching vs Pokémon Go

We haven chosen to talk about Geocaching and Pokémon Go in this guide because they are both hugely popular location-based games. Interestingly enough they both follow rather similar gameplay. In the games players have to visit geographical locations where they are rewarded by acquiring (or finding) objects.

However there are also some very distinct differences between the two games. By comparing them we can find out a lot about location-based experiences in general.

Geocaching is less reliant on technology. While smartphones are ideal to use for geocaching, the only purpose of the phone is to display the location of the player and the destination.

Pokémon Go on the other hand was plagued by connectivity problems right after launch. The game requires a constant server connection in order to be able to spawn Pokémon and to evaluate other game actions.

Locations arguably play a more important role in Geocaching. In Pokémon Go the actual location is largely irrelevant and can easily be ignored by the players as they mostly care about the virtual component. The opposite is true for Geocaching. Here the destination location is crucial for the enjoyment of the game. Somebody might hide a geocache in an especially beautiful or mesmerizing location, and players will have to thoroughly look around to actually find the geocache that is hidden there.

In Pokémon Go players pay more attention to their phone. If there are plenty of Pokéstops around players want to make sure not to miss any. In Geocaching players only need to check their device to see if they are still on route to the destination.

In Pokémon Go all content is created and maintained by Niantic. Geocaching on the other hand only works because of the dedicated community that keeps preparing and hiding geocaches. In fact being a game master of sorts for other players is a lot of fun for certain players. They take great pleasure in knowing that someone is engaging with their creation.

Pokémon Go lends itself more than Geocaching to being played casually, for example while commuting. Game content is more or less available everywhere whereas Geocaching is rarely played spontaneously.

These are only some of the most obvious difference in how the games are set up and how players experience them. However both games also have some things in common besides the basic gameplay.

Pokémon Go as well as Geocaching are very well suited to be played in small groups. Players are not competing against each other. Quite the contrary, it is rather enjoyable to go geocaching together with a fellow player and then finding the geocache. Apart from Gyms Pokémon Go is not directly competitive either. Pokéstops give their rewards to all players and all players can catch the same Pokémon when it appears. Pokémon Go offers some competitive gameplay at Gyms but here players of the same team can collaborate and attack a Gym together. All in all, both Geocaching and Pokémon Go create very social experiences – but can also be enjoyed when playing alone.

Beyond maps

Experiences built around maps and items of digital media are now arguably well understood – a broad range of authoring tools are now available that can produce them, and a lot of prior examples exist for a potential author to learn from.

However, there also exist a large number of experiences, which are significantly more complex to design and author, and which require an even higher level of knowledge and skill on the part of an authoring team. These currently include experiences which allow users to work together on a task, or which span across a much larger range of locations.

Some of the most complex and interesting location-based experiences belong within an approach known as “transmedia storytelling”.

These experiences make use of real physical location, along with digital media presented through mobile devices and other technologies. They attempt to craft a narrative craft around these locations that attempts to immerse the users in an alternative, often entirely fictional reality. The assembly and support of transmedia storytelling experiences typically requires a large, diversely skilled team.

One large scale example of this kind of experience, which the interested reader might consult, is Year Zero. An example of an alternate reality experience is Year Zero, created to promote an album by Nine Inch Nails, and constructed around an alternate reality in which the US government were releasing a narcotic drug into the water supply.

The story was told through websites set up by the authors, but integrated interactions taking place in locations all connected to the band's touring schedule. As an example, a number of memory sticks were placed into toilets at one gig – these were picked up by fans, and contained secret messages that progressed the story.

Another example of an alternate reality experiences is the Malthusian Paradox (Urban Angel) that featured a plot in which the users have to undercover the truth behind a kidnapping, by engaging in activities at a variety of locations. In Ulrike and Eamon Compliant (Blast Theory) players take the role of a terrorist operating on the streets of Vienna.

The game Interference is only played by a small group of players that are trying to uncover mysterious failures in the local telecommunications network. The players put on blue overalls and were equipped with devices to pinpoint the anomalies.

The game then takes a sharp turn and after a while players see themselves uncovering a mystic kabal by techno shamans. After negotiating with an actor they acquire a bright red voodoo doll. They then have to control it by playing a bone flute in the hope of finding the right melody to close portals into a netherworld that have opened up.

The inclusion of locations but also of actors and physical objects allows designers to create much more engaging and personal experience than ones limited to the screen of a smartphone.

It is our belief that location-based experiences are stronger the more technology and real environment are seamlessly integrated with each other. After all, it is the rich potential of the physical world that distinguishes location-based experiences from traditional video games, so a design should play to the strengths of both.

It starts with an idea

Where to start when you want to author a location-based experience?

This is not an easy question to answer and we believe there are several valid ways. Initially, designing a location-based game is certainly not much different from creating any other game: You need a good idea.

Maybe you got inspired when you noticed a weird graffiti last time you went for a walk around your neighborhood. Or maybe you want to create a certain feeling within the players when they play your game. Other times you might have a specific location in mind you want to create an experience around.

There is not one single right way how to go about developing your idea. Everybody will have their own individual process that works best for them.

In order to help you think about all elements of the location-based experience we have identified 9 categories that cover the design space:

Locations – where it takes place

Physical – real world objects and more

Sensors – how to track the players

Technology – other digital elements

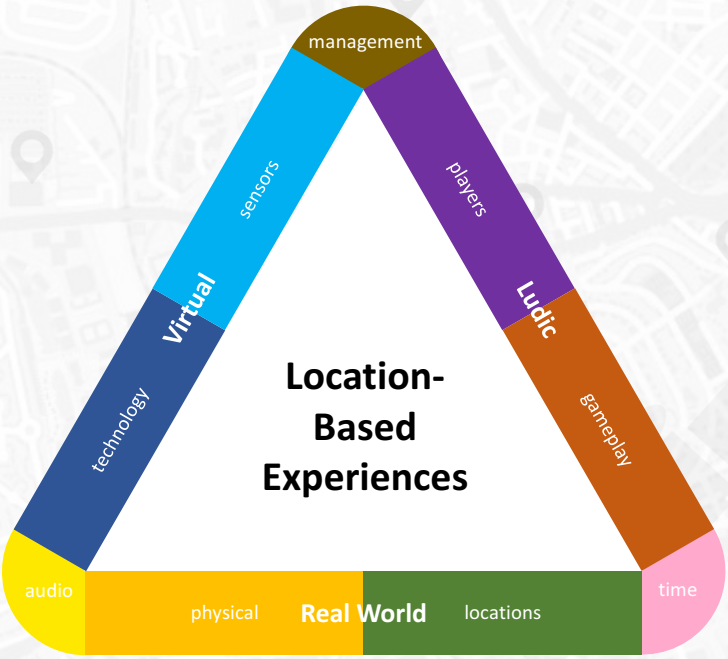
Gameplay – rules and mechanics

Players – how they interact

Audio – listening instead of seeing

Time – how they play out over time

Management – running the game



Locations

Location-based experiences already reveal in their name their defining characteristics: They take place in the real world. Board games and video games are always played at a very specific place that only exists for the game itself. Location-based games are not restricted like that. They make use of the city streets, take place in office buildings or schools, have players run around in a park, or send them on a trip with their bike. In a way these games take play from the private quarters of your home back into the public space.

Different games use locations in a different way. Some might populate the world with more or less randomly placed monsters that players have to catch. Others send players along a trail of famous and not so famous sights to reveal more about the history of a place.

Playing in the real world allows us to take a look at places we think we already know quite well. Instead, the game lets us explore the locations anew and we experience them from a new perspective.

It is important to think about how tightly one wants to connect a place with the game's content. It is easy to see how different an experience will be if it takes place on a parking lot of a supermarket, in a crowded old town, an abandoned factory, or a luscious forest. What is the meaning of the location within the context of the game? How is the experience taking into account the atmosphere of a place?

Constructing something to take place in public is also not without its challenges. Traffic, construction sites, weather conditions – none of this can be controlled.

Physical elements

Location-based experiences also have the opportunity to utilize a vast range of physical objects. Think about how much fun it is to roll a big bucket of dice in a board game or to slowly and deliberately place your Queen for a check-mate. It is a very satisfying feeling to move and manipulate these objects around, and location-based games can (and should!) incorporate these as well.

Players might have to plant seeds in a flowerbed for a game, use their flashlights while sneaking through a dark alley, unlock a safe just to find a VHS tape they can only watch when finding a functioning VCR elsewhere in the building. Just imagine reading the mysterious entries in the diary of a deceased scientist if it is an actual book and not just a text displayed on the screen of your smartphone.

Instead of watching a pre-recorded video of a witness statement, the same witness could be played by an actor reacting and improvising depending on what you say.

The physical world has the power to stimulate all our senses and can take on many shapes and forms.

What kind of physical props are you adding to the experience? How will giving the players an actual street map and not a digital one change their experience?

Sometimes the nature of the non-digital world will work against you. Like with locations you have less control over them. The weather can have a great impact on how the experience is perceived, and while you can easily copy any digital components, this is not as easy with physical elements.

Sensors

At the core of a location-based experience usually stand sensors. They are used to track what the user is doing, so that the game engine can react to it. There is a huge variety to choose from, and all of the different sensors have their own peculiar advantages and disadvantages. Some of them might be more well-known than others with GPS probably being the most pervasive.

A GPS receiver communicates with a fleet of satellites and can pinpoint its geo position within a few meters. However, GPS does not work indoors as it needs a line-of-sight to several satellites to work. Likewise it has problems in narrow alleys and near big bodies of water. Practically every phone has GPS built in and using it in the design is as easy as putting markers on a map. Be aware that the signal is often fluctuating!

NFC tags are rather cheap to acquire and register when a NFC reader is held close to them. Many phones (but not all of them) have NFC readers built it. You have probably used this technology if you have ever made a contactless payment or tapped a ticket barrier with an Oyster card.

We also find motion sensor inside modern phones, but they are also available separately. With them we can track how players move their limbs, so we can use it for very coarse gesture recognition.

Some less common sensors might measure the amount of light, the temperature, or the volume. Or we can hook them up directly to a player and use their heartrate, breathing rate or brain waves as an interesting and potentially surprising source of input for a game.

Technology

Technology allows us to create really compelling location-based experiences. Sensors are used to tell us about the position or state of a player, but other technology plays a crucial role as well.

Augmented reality (AR) is perhaps the most prolific example. Virtual 3d objects are placed in the environment and are then made visible by overlaying them on a camera feed or using head-mounted displays. Engaging AR is not that easy to create as the initial novelty factor wears off quickly. If AR does not add anything meaningful to the experience it will be seen as nothing more than some window dressing. In our experience AR works great when it gives users a sense of scale by being large so that they have to physically walk around whatever they are seeing and lean back to see the top.

Map interfaces are an easy way to show a player where they are and where they should go next. SMS can be used effectively as a more low tech but automated way for the player to interact with the game.

While smartphones are fantastic devices that enable experiences that would not be possible without them, they also disappointingly often take center stage and dominate the experience. Players are always looking down on their phones because this is where all the exciting gameplay happens. Instead of paying attention to the environment they play in, they are immersed in the digital world.

Technology also offers less invasive means of interaction. For example think about how using only audio completely changes the way players will experience the content and their surroundings.

Gameplay

Good location-based experiences combine the just described components into a coherent and captivating experience. We summarize this under the term “gameplay”.

Location-based experiences borrow a lot of mechanisms and play styles from other types of games. Certain types of interactions however have proven to be especially suited for a game played in the real world.

When looking at the gameplay of a location-based experience it can often be condensed to something rather simple like the following:

1. Walk to a location.
2. Do something at the location.
3. Walk to another location.

Many games require players to pick up a digital object at a location, or sometimes players will find clues that point them towards the next destination. Maybe players have to conquer the location in order to gain certain benefits. Other times location-based experiences tell a story that slowly unfolds at the locations that the players visit.

Keeping the core gameplay easy to understand and accessible is often crucial for the success of location-based experiences. It is often a good exercise to try to describe the envisioned game with only a few sentences. This helps to identify the core elements and main mechanics that the detailed design should try to highlight and strengthen.

Players

Players naturally are an important aspect to keep in mind. Are players working together or is it a competitive game? Some games also require roleplay or hand out (simple) costumes to the players.

Time

Location-based experiences require a lot of effort from the players. Therefore it is important to consider when and for how long they will be playing.

Audio

Audio is a very powerful but often neglected way of delivering content in location-based games. It allows players to experience their environment at the same time as the game content without having to focus on their device.

Management

While not part of the actual game design, the management of the overall experience is also not to be neglected. This for example includes whether it is important to observe players constantly while they play, how new content can be added to the game, and emphasizes the difficulty but crucial task of testing

Different Perspectives

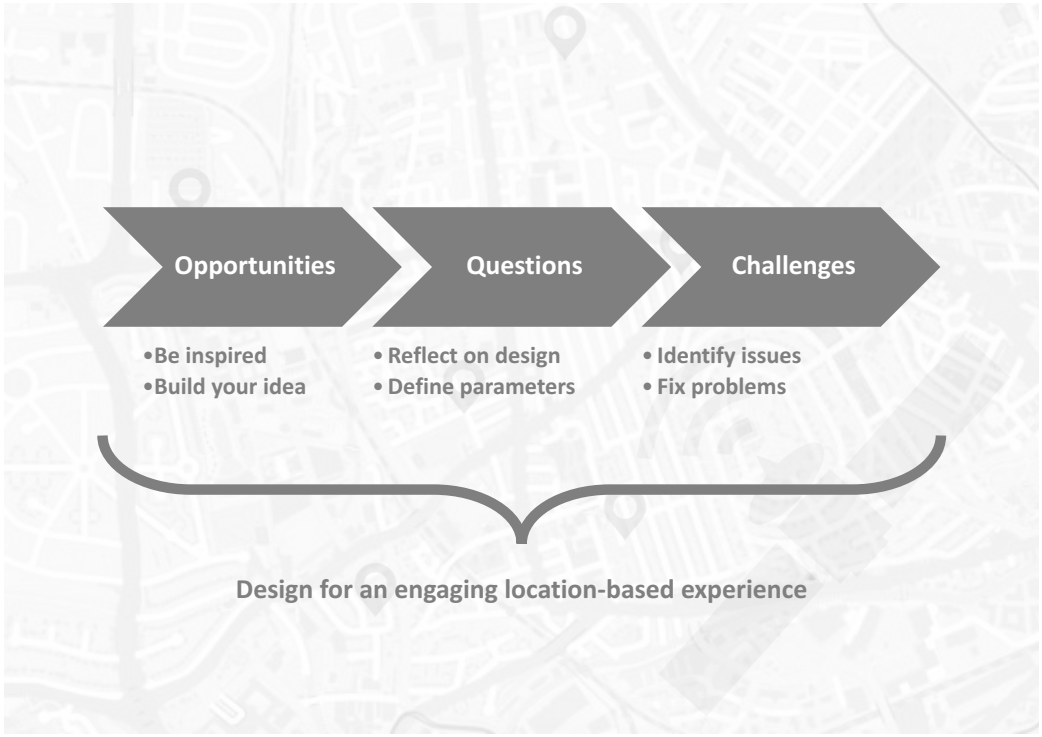
In the next sections of the guide we will take a closer look at these different categories. We have collected a total of 93 distinct topics and have described them in context of these categories. We suggest you browse through the different topics and read up on any that spike your interest. Each one is kept short so that it is easy to dip in and out of this guide at your own leisure. The topics itself are furthermore separated by three different perspectives. Together they provide a well-rounded overview of the possibilities.

Opportunities are illustrating the rich design space of location-based experiences and are derived from best practice examples of existing games and experiences. Together, these will describe the different elements of your design.

Questions take a more high-level approach. They help you reflect on your design and force you to define the boundaries and constraints of it.

Challenges are a collection of common pitfalls. These are issues that appear regularly within location-based experiences. You will have to consider whether these might apply to your design and how to overcome them.

In general we suggest you first only focus on the Opportunities to build your initial design. As a next step go through the Questions and see how your game changes. Lastly the Challenges might force you to rethink certain aspects of your design. Do not hesitate to go back to previous sections while you are developing your game design!


Opportunities
Questions
Challenges
•Be inspired
•Build your idea
• Reflect on design
• Define parameters
• Identify issues
• Fix problems
Design for an engaging location-based experience

Can You See Me Now?, Blast Theory

Opportunities

GAMEPLAY

Area Control

Players need to conquer locations to win or gain resources.

Explanation

The game area is divided into zones and the players battle each other for control over it. Some areas might be more valuable than others, either due to their strategic location or resources it produces. Usually players need to visit the area in question and perform a game action there to claim it.

Examples

- Players take control of WiFi networks by releasing a “virus” into them.
- Three teams battle for control of all the parks in a city.
- Players claim a location by defeating a monster left there by the current owner.

OPPORTUNITY

Collecting

Players search, pick-up, and collect game objects.

GAMEPLAY

Explanation

Valuable objects are placed in the game area. This can either be done deliberately or randomly, and some objects might be rarer than others. To collect the items players have to visit the location. A map might show all, some, or none of the items depending on whether players should explore or follow a track.

Examples

- Each gold coin can only be picked-up by the first player to do so.
- Fish only appear near rivers and lakes while fruit grows in parks.
- Newspaper clippings are scattered in the city that reveal clues when put together.

OPPORTUNITY

GAMEPLAY

Creativity

Players have to create new content and media during the game.

Explanation

Players do not need to be somewhat passive consumers of game content but can create their own. This can then be made available to other players to enrich the ever growing game world or as an ingame challenge. The type of content can be very diverse like photos, videos, audio clips, or written stories.

Examples

- Players submit poems in reaction to encounters in the game.
- The game requires players to take photos of trains to score points.
- Players share personal memories that they connect with the locations in their city.

OPPORTUNITY

Exergaming

The game requires acts of endurance, strength, or dexterity.

GAMEPLAY

Explanation

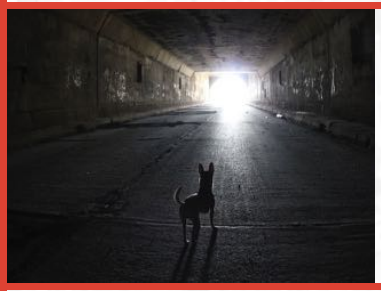
While location-based games usually require to walk from location to location, exergames put a special emphasis on physical tasks. They are reminiscent of children's games in how their mechanics require players to control their body. The resulting exhaustion makes these games greatly enjoyable.

Examples

- Players carry overly large and heavy boxes around the city.
- A player sprints through an obstacle course while another tries to follow.
- Players need to roll a virtual ball up a very steep street.

OPPORTUNITY

GAMEPLAY



Exploration

Players slowly uncover and examine the mysterious game area.

Explanation

Exploring new and exciting location is great element for location-based games. The real world surroundings engage the players directly or the game content forces them to reinterpret what they see. A mobile device is often only used for orienteering instead of constantly requiring attention.

Examples

- An abandoned factory has been equipped with technology in order to turn it into a haunted house.
- A narrator tells players the hidden truth of a seemingly normal place.
- The players search through a maze like system of tunnels.

OPPORTUNITY

Mini Games

Several small and different challenges make up the game.

GAMEPLAY

Explanation

Not all games employ the same overall game mechanics throughout. Sometimes it might be appropriate to introduce little hurdles that players have to overcome, with each of them requiring a different approach. This creates variety and challenges the players in different ways throughout the game.

Examples

- In order to defuse a bomb players have to cut the right wire.
- A remote-controlled robot is used to explore a contaminated area.
- Players have to win at a game of hopscotch to beat an opponent

OPPORTUNITY

GAMEPLAY

Performative Play

An audience is invited to watch and perhaps participate.

Explanation

The space the game is being played in can be used for a performance. The performance can be designed as the main goal of the game, or it is perceived as one due to extravagant props or choreography. When the game attracts spectators they might take on an active role and join the players.

Examples

- Players carry giant meeples across town in a game of Monopoly.
- The players need to encourage spectators to make loud noises.
- Players create music by jumping around between game spots.

OPPORTUNITY

Riddles

Players have to solve puzzles, riddles, and other mysteries.

GAMEPLAY

Explanation

Players use their creative mind or logical thinking to overcome obstacles. Some of the puzzles might be purely theoretical, allude to certain locations to visit, refer to the overarching plot, or even contain mechanical elements. The riddle might have a clear solution or be subject to interpretation.

Examples

- A shredded document needs to be reconstructed from its pieces.
- An encoded message contains a GPS position players have to visit.
- Players have to compare alibis and statements of suspects.

OPPORTUNITY

GAMEPLAY

Scavenger Hunt

Players travel between locations to find clues or treasures.

Explanation

The players are following a trail of some sort throughout the game. Directions slowly lead them towards the end point. On their way they encounter obstacles that will reward them if overcome. The winner might be determined by the fastest time, best performance, or a mixture of both.

Examples

- Players have a map that always directs them to the next point.
- Players need to solve riddles to obtain all parts of the map.
- Players have a choice between of paths that lead them along different routes.

OPPORTUNITY

GAMEPLAY

Strong Narrative

The game is mainly based on a story that needs to be uncovered.

Explanation

During the game a story unfolds that the players can follow by visiting different locations. The story is the focus of the game and can be told in various ways. Players might follow a linear storyline or perhaps are able to actively influence it with the decisions they make over the course of the game.

Examples

- Players reveal story elements out of order depending on where they go.
- Players find letters that an insurance company has written over the years.
- The plot changes depending on what players tell actors about their investigation.

OPPORTUNITY

PLAYERS

Alternate Reality

"This is not a game." Everything is in-game and in-character.

Explanation

The game pretends to not be a game. This way everything around the players might be part of the "conspiracy" which adds another layer to the experience. Game content is often hidden within normal looking environments, and outsiders might not notice it is part of the game.

Examples

- A website for a fictional company with background information.
- A Facebook profile which allows players to interact with a non-player character.
- A public speech or demonstration organized by the players.

OPPORTUNITY

Collaboration

Players are working together in teams and support each other.

PLAYERS

Explanation

Either all players work together against a common enemy, or they are divided into teams and have to battle each other. This enables a lot of player-player interaction and creates a social aspect within the game as team members need to communicate in order to effectively help each other.

Examples

- Players are automatically assigned one of four teams in order to keep everything balanced.
- A major mystery needs to be solved by all players working together.
- Players team-up spontaneously to jointly defeat the dragon.

OPPORTUNITY

PLAYERS

Costumes

Players dress up or use simple accessories to get in role.

Explanation

Costumes are a great way to show team affiliations. They are also a visual signal to other players that allows them to recognize each other in a public space. Wearing a full-body costume also helps players transition into the role they are playing in the game and make them feel more immersed.

Examples

- Players wear overalls that make them look like mechanics.
- Fake name badges give everyone an in-game identity.
- Foxtails worn on the back need to be torn off in order to catch a player.

OPPORTUNITY

Different Roles

Players have different abilities and tasks to perform.

PLAYERS

Explanation

In an asymmetric game not everyone has the same goals and means to achieve them. Instead players are specialized in order to create a more diverse game experience. This works well with opposing teams that fight against each other while following different game mechanics.

Examples

- Some players are hunting the majority of the other players.
- One team needs to defend their base while the other attacks.
- Each player can choose a specific role that comes with its own strengths and weaknesses.

OPPORTUNITY

PLAYERS

Online Participation

Players join without physically being at the game's location.

Explanation

Street players and virtual participants inhibit the same game space. Naturally this will create two groups with deviating powers that can either work directly against each other or forms teams across these boundaries. Street players might receive instructions or will be hunted by their virtual counterparts.

Examples

- Online players see all movement of the street players and also the invisible poisonous cloud.
- Street players livestream their view to the online players.
- Online players open and close doors to help or obstruct street players.

OPPORTUNITY

Roleplaying

Players take on new personalities and act accordingly.

PLAYERS

Explanation

Some games are driven by players immersing themselves in the roles they are taking on for the game. This might lead players to do something suboptimal or unexpected because "that's what the character would have done." The game might provide players with detailed character backgrounds and motivations.

Examples

- Players are time travelers and are astonished by modern times.
- One player is a traitor that will have to betray the others eventually.
- The game cannot be won as all players just try to create an interesting story together.

OPPORTUNITY

PLAYERS

Social Contract

Players honour rules despite them not being enforceable

Explanation

Instead of relying on technology to enforce the rules of the game, the players are instructed to follow them as part of a social contract. This relies on the sportsmanship of the players and works well with groups that know each other or games with limited durations at special events.

Examples

- Players are disallowed from running or using public transport.
- Players are told not to hide inside of buildings where GPS does not work.
- Internet searches should not be used to solve riddles.

OPPORTUNITY

Worldwide

Players are competing with each other all around the globe.

PLAYERS

Explanation

The game is not limited to a specific geographical place but is available everywhere in the world. In such cases the game content is usually not very tightly integrated with the real world as authoring it manually would be too time consuming. This creates a very large potential player base.

Examples

- Certain creatures are only available to catch in Australia.
- Players earn bonuses when visiting cities they have not played in yet.
- Players can trade their local produce globally in order to acquire the necessary resources to advance.

OPPORTUNITY

LOCATIONS

Fitting Locations

The atmosphere of a location supports the game activity.

Explanation

The digital content is designed in a way that emphasizes the real world environment. At the same time a location is chosen that is a natural fit for the game. It would be difficult to imagine the game being played elsewhere as both complement each other in an ideal way.

Examples

- Water creatures spawn near rivers and lakes.
- Players have to smuggle virtual drugs through real airport security.
- A love story plays out on a bridge with amazing views and ends with a wedding in front of a church.

OPPORTUNITY

Generated Locations

An algorithm creates locations based on defined characteristics.

LOCATIONS

Explanation

Locations can be created automatically if a database of locations can be accessed. Access to a database of locations is necessary, but then the game an be populated with locations based on this data. If the data is categorized it allows the creation of different types of locations for the game.

Examples

- Famous sights and monuments are turned into locations that spawn valuable bonus items.
- Postcodes are used to create the different game areas.
- Geotagged photos or Wikipedia entries can be used for content.

OPPORTUNITY

LOCATIONS

Headquarter

Players have a central base of operations to assemble and plan.

Explanation

A headquarter is a good way of bringing players regularly back together which allows them to exchange information. A headquarter can also be transformed into a atmospheric game space with detailed props, stationary computers, and actors to engage players. Game masters will have full control over it.

Examples

- Players are secret agents that report back to HQ whenever they have finished a mission in the field.
- The HQ allows tracking of all players so a commander can instruct them.
- Players heal damage and recharge their weapons when back at the HQ.

OPPORTUNITY

Subverted Locations

Game activities are in intentional opposition to the location.

Explanation

Instead of choosing locations that fit the theme of the game, the activities chosen to create a strong contrast with it. This is done to draw attention to the obvious disparity and/or to create awkward and unusual situations for the players. Subverting locations like this should be carefully considered before doing so.

Examples

- The game is played only at libraries and the player who makes the loudest noise wins.
- Players have to dance while queuing at a public and crowded bus stop.
- Players have to plant and grow flowers in a grey industrial area.

LOCATIONS

OPPORTUNITY

LOCATIONS

Unusual Locations

Players get to visit places they otherwise would not.

Explanation

Players appreciate exciting locations that the game takes place in. This is especially true for locations they might not normally be allowed to enter, or locations they did not know existed. The whole game might be staged at such a location, or only some parts of it for impactful scenes.

Examples

- The showdown of the game takes place on the roof of a skyscraper.
- A former battleship is transformed into a spaceship for the game.
- Players can visit the backstage area of the local theatre.

OPPORTUNITY

Actors

Non-player characters engage directly with players.

PHYSICAL

Explanation

Actors are ”in role” and will talk to the players. Unlike digital systems, actors are really good at improvising and can react in a very personal manner to players approaching them. They can also nudge players into the right direction and steer the game. They need to be well instructed so they know how to act.

Examples

- A wise man asking a riddle.
- Hunters that chase the players.
- Different characters are vying for the loyalty of the players.
- The boss gives instructions.
- A suspect needs to be interviewed.

OPPORTUNITY

PHYSICAL

Low Tech

The game employs old-fashioned but reliable technology.

Explanation

It is not necessary to always use smart devices. Some seemingly outdated tech can be used as valuable game elements. These often feel more “real” and are more intuitive to use than digital counterparts. They are also usually cheaper and are limited to the exact functionality that is needed.

Examples

- Hidden radio transmitters are broadcasting messages that players can only hear when near enough.
- A VCR needs to be repaired to play an important video tape.
- Players are given a polaroid camera to record evidence.

OPPORTUNITY

Set Construction

Scenery is being built or adapted to match the game.

PHYSICAL

Explanation

While some locations are already perfect as is, others might profit from additional constructions or set dressing to make them more lively. This can range from actual newly constructed buildings to just freshly painted furniture to match the theme. This allows the creation of truly unique scenery for the game.

Examples

- Props are added to a private house to turn it into a game location.
- Chalk lines and shapes are drawn on the floor to guide players.
- Candles and a fog machine are used to create an eerie atmosphere in a haunted house.

OPPORTUNITY

PHYSICAL

Useful Props

Simple objects support the players or add to the atmosphere.

Explanation

Basic tools and objects can be easily appropriated for the game and made a part of it. These extend the game actions into the physical world and make the experience more shareable for groups than a smartphone screen allows. The props should be purposefully chosen and enrich the experience.

Examples

- Players get a street map and pens to mark new locations.
- For a nightly episode players are handed flash lights.
- Players find hidden glass bottles that have handwritten messages inside.

OPPORTUNITY

Vehicles

Players use bikes, cars, or public transport as part of the game.

PHYSICAL

Explanation

The game does not consist of walking but is played with or inside other means of transportation. This changes the actions players can take as part of the game as they might need to focus on driving or cycling. Public transport removed their ability to change direction at will and requires more preplanning.

Examples

- Game locations are placed on bike trails in the countryside.
- Players have to conquer subway stations by visiting them.
- Players earn points for fuel-efficient driving.

OPPORTUNITY

PHYSICAL

Weather Input

The current weather influences the game state.

Explanation

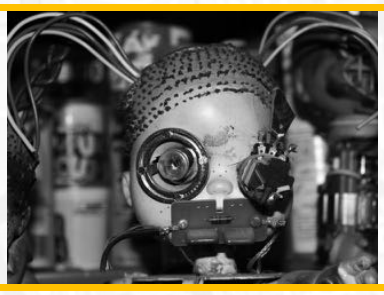
The weather conditions change how a game is perceived, e.g. whether it is enjoyable to be outside. The weather data can then be used to also affect the gameplay directly by having game objects react to it. The weather might influence their behavior directly or it might be used to accommodate players.

Examples

- Viruses multiply faster while it is sunny and move depending on the direction and strength of wind.
- Digital plants need rain to grow.
- During sunny periods more game content is generated outdoors while bad weather creates indoor content.

OPPORTUNITY

PHYSICAL



Technical Artifacts

Mundane objects are made interactive by adding technology.

Explanation

Technology can be hidden from sight by embedding it into previously normal objects. This makes these objects interactive and somewhat magical as it might not be fully obvious how they work. It also creates a more tangible interface for the technology and adds to the atmosphere of the game.

Examples

- A sound sensor inside a flash light forces players to shout to operate it.
- When a chest is opened the light sensor triggers a ghostly scream.
- Speakers behind a painting make it seem as if it is talking to the players.

OPPORTUNITY

TIME

Episodic Content

New missions are added to the game at regular intervals.

Explanation

It is sometimes a good idea to stretch out publishing new content. This allows additional production time but also assures that all players are progressing at the same pace through the game. The creators of the game can then also incorporate player interpretations of e.g. the narrative.

Examples

- Each month sees a new mission that is only available during this time.
- A story is told in 52 parts that are released throughout the year.
- Every four weeks a new neighborhood becomes the main area for the game.

OPPORTUNITY

Time Pressure

Players have limited time for an action or the whole game.

TIME

Explanation

Time constraints put players under stress and force them to act instead of overthinking their next move. The whole game might need to be finished within a certain time span, or time pressure is only applied to parts of the game where players have to deal with a problem while the clock is ticking.

Examples

- Portals are only open for 30s before they collapse again.
- Players only have 1h and need to decide which locations to visit.
- The health level of the players is deteriorating while they are inside the radioactive zone.

OPPORTUNITY

TIME

Timed Events

Players have to be at the right place at the right time.

Explanation

Some game actions are only possible at certain times of the day or days of the week. This might be done to improve the atmosphere of a scene or to encourage the players to revisit specific locations at different times. It is also a way to control when play will happen, so that everything can be prepared.

Examples

- Ghosts only appear after sunset.
- The big finale of the game will happen during the next full moon.
- The duel takes place at high noon.
- Monsters only appear in the park during opening hours.

OPPORTUNITY

Compelling Audio

Narration, music, and/or sound are core game elements.

AUDIO

Explanation

A focus on audio gives players more freedom to explore their surroundings as their eyes are not constantly checking a device, and so can be used to support and not distract from the environment. Great audio is also often cheaper and easier to create than high-quality images, videos, or 3D models.

Examples

- When arriving at a statue, it comes to live and tells a story.
- Players leave behind short audio clips for others to find.
- A voice instructs players where to go and gives awkward commands on what to do.

OPPORTUNITY

AUDIO

Mobile Soundtrack

Music and sounds change based on location and progress.

Explanation

Audio can greatly enhance the atmosphere of a scene or location. Music can be gradually or suddenly change depending on the desired effect. Sound can also be used as a feedback mechanic to show the current game state in an intuitive way or convey instructions to the players.

Examples

- A Geiger counter grows louder the more players get contaminated.
- Players approach a clearing in the dark forest and ominous music starts swelling.
- Players can only rely on a sonar for navigating.

OPPORTUNITY

Manual Interaction

Players have to scan QR codes, NFC tags, and other objects.

SENSORS

Explanation

A lot of games employ “checking in” mechanics. Doing this manually makes the activity more transparent and meaningful, and the players also have full control over it. This tracking works everywhere and is very reliable. It can also be used for collecting or identifying physical objects.

Examples

- Players are wearing tags that need to be scanned by their opponents.
- NFC tags are hidden on the back of paintings so players can use their devices to check if they are fake.
- When players enter a new room they trigger audio by swiping their phone.

OPPORTUNITY

SENSORS

Motion Tracking

Movement sensors measure orientation, gestures, or speed.

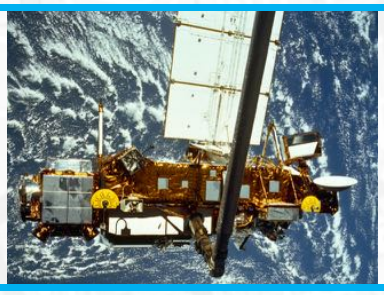
Explanation

Body movement can be used as an interesting physical game element. A small sensor can be directly attached to a player or an object for inconspicuous tracking, or alternatively a phone directly. The game can then require or disallow certain movements and measure their speed.

Examples

- Players compete in a dance competition against each other.
- Dynamite needs to be transported without shaking it too much.
- Players have to perform certain gestures to cast different magic spells.

OPPORTUNITY



Passive Tracking

Sensors track players automatically (GPS, Bluetooth, WiFi, …).

SENSORS

Explanation

This type of tracking happens in the background so the players do not have to perform any actions. The tracking can be continuous fine-grained (GPS), short range (Bluetooth, WiFi), or very coarse (cell ids). Players might be able to see the status of the tracking or it could be hidden from them.

Examples

- The game area is equipped with several Bluetooth beacons that allows indoor tracking of players.
- The game tracks player movement and randomly spawns gems nearby.
- GPS enables players to draw figures on a map.

OPPORTUNITY

SENSORS

Physiological Data

Blood pressure, brain activity, or heart rate are used as input.

Explanation

Sensors can track the natural reactions of the body and use these as an input for player actions. Players might be able to control these reactions within certain bounds for active control over the game, or they are a passive reflex depending on how the game is progressing for the player.

Examples

- Players have to stay relaxed to increase their attacking power.
- The more a player sweats the more health they regenerate.
- Players have to thwart a lie detector.
- Breathing speed controls the game.

OPPORTUNITY

Public Infrastructure

An algorithm creates content from WiFi, Bluetooth, or NFC ids.

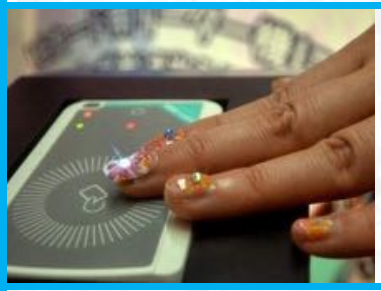
Explanation

Many technical devices found in public space can be appropriated to become elements in the game. These might be pre-installed and stationary, or belong to non-players. If a device has a some kind of id that can be read it will be converted into a game object. This allows players to interact with it.

Examples

- WiFi networks breed digital creatures that players collect.
- If an id ends in 0 the resulting creature will be poisonous.
- Ticket scanners in the bus are used by players to conquer those buses.

OPPORTUNITY



Stationary Sensors

Players carry smart tags and “check-in” at stations.

Explanation

Instead of carrying a smart device, players just get tags. These are scanned at terminals when players interact with them at a location or by actors they encounter. This is an easy and cheap way to provide for large amounts of players. It also enables players to focus on the real world and not their devices.

Examples

- Players wear name tags to identify them that can also be scanned.
- Players can make choices by checking in with either station A or B at each location.
- The tags are integrated in a necklace that all players got.

OPPORTUNITY

SENSORS

Wizard of Oz

Spotters observe players and manually trigger events.

Explanation

Instead of relying on tracking technology that might not always be accurate or sufficient enough, some of the game masters follow players around or patrol important areas. They then control the game based on this information. The game masters stay hidden so the players are unaware of being observed.

Examples

- A player is called on the phone as soon as they sit down on a bench.
- When the players say the correct passphrase, the door swings open.
- If gestures and incantation of an offensive spell are convincing, the game masters trigger an explosion.

OPPORTUNITY

TECHNOLOGY

Augmented Reality

3D models are placed into the environment in real-time.

Explanation

Augmented reality (AR) can be created by using head-mounted displays (like AR glasses) or by overlaying the camera feed of a handheld device with 3D objects or creatures (“magic lens”). True AR is attached to the real world and integrates with it by moving (or not moving) like their real counterparts.

Examples

- A virtual statue that is placed in the middle of the market square.
- A treasure chest is found in the basement of the castle.
- Players are haunted by a ghost that keeps appearing in their vision.

OPPORTUNITY

Global Gamestate

Player actions are kept in sync to prevent inconsistencies.

Explanation

In multiplayer games it is often important to make sure that the game state is consistent. This assures that players can influence each other and are affected by decisions of all players. It also allows game objects to only exist once in the whole game instead of having a copy for each player.

Examples

- Players broadcast their positions in real-time.
- A player picks up a potion and it disappears for everyone else.
- A trap is placed by a player and it gets triggered when a big group walks on top of it.

TECHNOLOGY

OPPORTUNITY

TECHNOLOGY

Peer-to-Peer

Players exchange information directly with each other.

Explanation

Peer-to-peer transfers are an effective way to make players physically interact with each other. It also has the advantage that the devices do not need to be connected to a server at the moment of exchange. If synchronization is necessary or desired this can be done at a later stage.

Examples

- Players negotiate a trade and bump their phones to exchange goods.
- A secret message is being passed on from player to player.
- Players reveal their secret identities in an act of trust to each other.

OPPORTUNITY

Seamful Design

Technical (or other) flaws are embraced as positive elements.

TECHNOLOGY

Explanation

Seamful design acknowledges that technology does not always work flawlessly. Instead, these shortcomings are turned into a crucial part of the game and seen as a design opportunity. This allows the game to work in conditions that others might struggle in that rely on perfect conditions.

Examples

- Players need to avoid getting a good GPS signal.
- Areas with no data connectivity are safe zones where players regenerate.
- Players can decide to spend some of their ingame currency for external battery chargers to extent playtime.

OPPORTUNITY

TECHNOLOGY

Public Display

Large screens are showing the game (or elements of it).

Explanation

The game can be seen on a large display that invites interaction with the game. Players might be able to interact with the game instantly by sending text messages or going to a dedicated website. The display could also show events happening elsewhere in the game that affect the players who are present.

Examples

- Remote players appear on the screen and try to solicit help.
- Players can pre-program robots with simple orders who then battle.
- Lights in different rooms of an office building gets switched on and off to simulate a low-res display.

OPPORTUNITY

Telephony

Players receive phone calls or text messages (manual or automated).

TECHNOLOGY

Explanation

Telephones provide a very easy and direct way of interacting with the players and no data connection is needed. A script can send automatic replies by analyzing the text it receives from a player. Phone calls can likewise be automated and scheduled for specific times with synthesized voices.

Examples

- Players call a number and listen to an answering machine giving clues.
- A player enters a shut factory and receives a SMS from their boss.
- A player sends a deciphered code via text and scores points for it.

OPPORTUNITY

TECHNOLOGY

Terminals

Stationary computers are available at certain locations.

Explanation

Players can use personal computers that are accessible at various locations in the game. Terminals allow for more dedicated applications as they can make use of keyboards and big screens for input and output. PCs are better suited to browse and inspect files of all sorts than mobile devices

Examples

- A password needs to be hacked to access critical files on a laptop.
- Players use a computer to inspect surveillance footage.
- From their headquarter computer players can contact mission control.

OPPORTUNITY

Open Authoring

Anybody can create new missions or tasks for the game.

Explanation

It is a great effort for game creators to prepare tailor-made content for different cities, especially if this requires knowledge of the actual physical space. Instead, this task is outsourced to the player base who can design their own content for the game and make it available to all players.

Examples

- A history teacher creates a trail for students in their home city.
- The tourist office designs a mission for players to visit the city sights.
- A player places riddles concerning train stations across the whole country.

OPPORTUNITY

MANAGEMENT

77

Puppet Masters

Game masters adapt the game depending on player actions.

Explanation

The players are being observed behind the scenes, and these game masters (GMs) have the ability to control what happens in the game. The might increase the difficulty, instruct actors to help players, or trigger specific game events when they think they will have the most impact on the experience.

Examples

- The GMs adjust the final plot twist to subvert player expectations.
- The game masters wait until all players are at the location before triggering the car chase.
- Players get lost so an actor is sent to make sure they get back on track.

OPPORTUNITY

MANAGEMENT

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Genesis of Cr0n, Urban Angel

Questions

GAMEPLAY

Beginning and End

How do players transition into and out of the game?

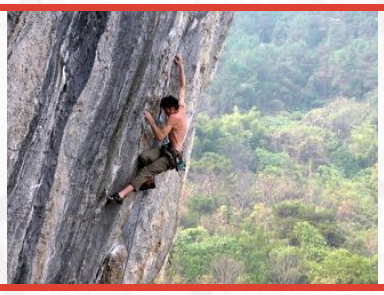
Explanation

Especially games that are setup like an event and try to create an immersive atmosphere also need to take into consideration how the game will start and what will happen to the players when it is over. When and how are people officially shifting into and out of being ingame?

Examples

- Players wait after entering a room and when they leave through another door the game has begun.
- Explanations are done in-character.
- After the game players are given time to detox and then debrief about their experience.

QUESTION



Challenging

What makes the game challenging? How difficult is it?

GAMEPLAY

Explanation

The difficulty level of a game needs to be carefully balanced. If it is too easy players will be bored while a high difficulty causes frustration. This of course also depends on the skill level of the players and their interests. What elements can be tweaked to change the challenge level?

Examples

- Players can steal treasures from their competitors.
- Players need to carefully choose which locations to visit as they cannot go to all of them.
- Puzzles require players to pay close attention to the environment.

QUESTION

GAMEPLAY

Core Concepts

How can the game be described in one or two sentences?

Explanation

Being able to summarize the most important elements of a game helps to identify the main idea and what makes the game unique and exciting. This could be game mechanics, specific locations, the overall style or content of the game. These can then be emphasized while dropping other less important features.

Examples

- A game about collecting cute creatures that are hiding all over the city. Players then train them and battle other players.
- Players will explore an abandoned bunker and stop the insidious plans happening there that are slowly being revealed to them.

QUESTION

Experience Flow

How do players journey through the game?

GAMEPLAY

Explanation

Different players will follow different trajectories through the game. What are the expected steps players go through and what effects to they have? Some games will force players down a specific path while others give them more freedom to explore the game in whatever way they like.

Examples

- A player visits a location and then takes a break in a nearby café before continuing the game.
- Locations need to be visited in order.
- Players can focus on different aspects of the game depending on their preferences.

QUESTION

GAMEPLAY

Fun and Joy

Why is the game fun to play?
What is engaging about it?

Explanation

Generally, games should be engaging to play. What are the elements that will really excite the players and make them come back? These can be seemingly small elements of the original game, but it might be worth exploring them in more detail. What parts of the game will create memorable experiences?

Examples

- Actors really engage with the players and create emotional scenes.
- Players are racing to win but can be sabotaged up until the last second by their opponents.
- Players laugh a lot about the weird creatures they meet.

QUESTION

Main Mechanics

What are the most important game mechanics?

GAMEPLAY

Explanation

Just looking at the actual gameplay, what are the mechanics that make or break the game? They should work as smooth as possible and be put under scrutiny to consider other options. This also means that other mechanics might not be needed or should be extended to become important themselves.

Examples

- Picking up monsters and bringing them back to the headquarter.
- Chasing other players.
- Talking to actors to delve into the story and uncover the mystery.
- Walking around taking photos.

QUESTION

GAMEPLAY

Theme and Story

What is the overall content of the game? How is that conveyed?

Explanation

Games have themes. Some games will put the theme at the forefront, others will leave it as a backdrop. The design of the content should reflect the theme of the game. Equally important are the game mechanics that should support the chosen theme. What is the theme? And is it the most appropriate one?

Examples

- A film noir game where the whole interface is in black and white and voice overs replace written text.
- Cartoony characters tell a light-hearted story about friendship.
- Players lose in a game about climate change when their battery dies.

QUESTION

Number of Players

How many players are needed for a single game session?

PLAYERS

Explanation

What does “multi” in multiplayer mean exactly? Do players need a specific amount of opponents or can the game scale the number of players? Do any of the game mechanics need adjustment when there are very few or very many players? What are the optimal numbers of players?

Examples

- Teams must have 3 members.
- The game only works if there is an even number of players.
- The game needs at least 10 players.
- If players drop-out during the game it will break the gameplay.

QUESTION

PLAYERS

Target Group

What are the typical players like? How is the game made for them?

Explanation

Does the game target a specific group of people? How does it take their likes and dislikes into account? A game might be targeted at a specific age group, casual or serious players, or special interest groups. In any case the game should have a coherent design so that it does not mix different styles of play/content.

Examples

- A game made for families with children on a day out in the park.
- A game that needs to be played intensely over the course of 4 weeks.
- A game for people interested in the local history of a place.

QUESTION

Indoor or Outdoor

Can the game be played in both? Should it? What would change?

LOCATIONS

Explanation

The chosen type of sensor often limits where a game can be played. With some changes most games can be moved inside a building, or from inside on to the city streets. This will of course greatly affect how the game is being played. But maybe the new setting is a more interesting fit for the game idea?

Examples

- Ghosts haunt the streets of a city but also one specific house.
- Staging a game indoors allows more control over the environment for set dressing or hiding technology.
- Being outdoor give players more freedom and things to explore.

QUESTION

LOCATIONS

Locations

What role are the locations playing? How important are they?

Explanation

Easily the most defining element of location-based games. How tightly are the locations integrated with the game content? Does it matter which ones were chosen, or could the game be played elsewhere without losing any meaning? Are the locations an important element of gameplay or just a backdrop?

Examples

- A Robin Hood game in Nottingham where players visit important places from the tale.
- The game leads players to buildings designed by the same architect.
- Each location was chosen to mirror the emotions of the narrative.

QUESTION

LOCATIONS

Size of Area

How large is the game area?
Should it be bigger or smaller?

Explanation

The size of the area determines how much time players will have to spend getting from one location to another. The size affects the density of content that players can engage with. The number of players that will roam the area at the same time should also be taken into consideration.

Examples

- In a very small area players will constantly run into each other.
- Large areas not only require but also invite more exploration.
- The game is played along the whole length of a pedestrian shopping street, but not in any side streets.

QUESTION

PHYSICAL

Nothing Physical

Does the real world play a meaningful role in the game?

Explanation

A location-based game should integrate the environment in an substantial way with the technology. Why does the game need to be played at and with the locations? How would the experience change if it was a purely digital game? How could the real world or physical objects play a stronger role in the game?

Examples

- Riddles are thematically unrelated to the locations where they are found instead of referring to them and their history.
- The game could be played on a treadmill as the locations only add “walking” to the experience.

QUESTION

TIME

Duration

How long is a game session? Should it be longer or shorter?

Explanation

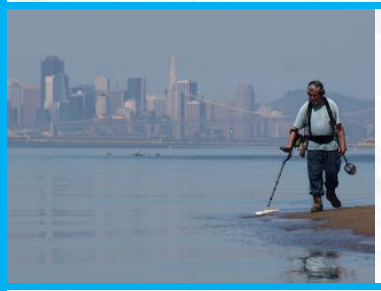
Some games have a fixed duration and one should consider if the anticipated duration is appropriate for the amount of content and probable player activities. If not restricted, how long are players expected to play each time they engage with the game? Will there be enough meaningful interaction for them?

Examples

- Shorter game sessions can be more focused but also more stressful.
- Longer sessions allow time to think but might feel dragged out.
- Players might want to play while idle.
- Time requires a certain commitment.

QUESTION

SENSORS



Suitable Sensors

How would other sensors change the game?

Explanation

There is usually one obvious choice of sensor to use for the game, for example an outdoor game often defaults to GPS. But could the game also be implemented with a different type of tracking? How would the qualities of a different sensor change the gameplay? What type of sensor is really the best choice?

Examples

- Bluetooth beacons and WiFi can tell if a player is within an area or not.
- NFC tags require players to actively register at a location which can be an interesting game action.
- Instead of voice recognition players unlock a door by waving their hand.

QUESTION

Game Server

How much data needs to be exchanged with the server?

TECHNOLOGY

Explanation

Does every action of all players need to be synchronized with the game server? Does the current position need to be updated constantly? Some games might also require players to download a lot of content during the game instead of already deploying it during installation. How crucial is the game server?

Examples

- Pre-recorded videos are being downloaded when needed.
- The player's position is used by the server to check if they are near a trap placed by another player.
- Photos taken by the player are uploaded to the server.

QUESTION

TECHNOLOGY

Nothing Digital

How could the game be played without tech? Why is tech needed?

Explanation

Technology can enable exiting location-based games. However should the game rely on that much technology? Are there game elements that might be more engaging when done without any technology? Each use of technology in the game should be well motivated and meaningful.

Examples

- Instead of displaying riddles on a phone screen they are printed on large posters at the game locations.
- A digital map is replaced with paper.
- Live actors replace multiple-choice dialogues with avatars.

QUESTION

Observing Players

Is it important to know what the players are doing while playing?

Explanation

Some games need more attention from the game masters than others. This might be because there are many moving parts, so something might go wrong. Or game masters need to know the position of all players to be able to trigger events. How will players and their actions be tracked?

Examples

- Players cannot find the hidden entrance to the basement, so the game masters give them a hint.
- Players always broadcast their GPS position which the game masters can see on an interactive map. Here they can also see their health levels and inventories.

QUESTION

Malthusian Paradox, Urban Angel

Challenges

GAMEPLAY

Feature Creep

Does the game try to include too many different elements?

Explanation

It is often tempting to add a lot of cool features and mechanics to a game. If this goes overboard it makes the game not only harder to understand and more complicated to play, but also increases development effort. It is usually advisable to focus on the really defining characteristics and cut other parts.

Examples

- Each location has completely different game mechanics.
- Listing all the different game actions takes an overly long time.
- The game features more than five Opportunities that feel essential.

CHALLENGE

Unintended Race

Will players who always run be more successful?

GAMEPLAY

Explanation

A race often happens when a game has competitive elements where players have an advantage when they arrive early at a location. These conditions will benefit players who are physically fit and willing to run. This can turn a game that is intended to be played casually into an exhausting test of speed and endurance.

Examples

- The players have to solve the mystery within 1 hour.
- There is only a limited amount of things to pick up and collect.
- Players can shake off their pursuers by sprinting towards safety.

CHALLENGE

PLAYERS

Critical Mass

Will there be enough players to sustain the game?

Explanation

Location-based games have the disadvantage that players usually need to be in the same physical space for them to interact with each other. This limits the potential amount of team mates and opponents. Interested players might never be able to experience the full game because they are alone.

Examples

- The game relies on trading items, but there is nobody in range to exchange them with.
- The game does not support finding other players in the vicinity.
- The game can only be played at a very specific location.

CHALLENGE

Real World Rules

Does the game (area) tempt players to ignore social rules or laws?

PLAYERS

Explanation

If the game places content in restricted or private areas, the players will believe that it is ok to access these nonetheless. They will feel that the game "told them to" and this way gave them permission. This might also be a problem if the game is played at sensitive locations that have a special meaning outside of the game.

Examples

- Players chase ghosts on a cemetery.
- A rare gem spawns in a garden.
- Taking a shortcut through private property will help players win.
- Playing the game while driving fast helps catch more monsters.

CHALLENGE

PLAYERS

Unclear Instructions

How easy is it for the players to understand what they have to do?

Explanation

Controlling a game by walking around is still new to most players. While intuitive in theory, it takes some getting used to and some elements might be difficult to explain. It is less effort to quickly try out a video game at home than a game where you have to leave your house and get to a specific location.

Examples

- Players are not told what they should do at the various locations.
- Players do not know which of the many locations to go to first.
- The game fails to explain the location-based elements properly.

CHALLENGE

Accidents

Is the game area dangerous due to traffic or rough terrain?

LOCATIONS

Explanation

When players are immersed in the game they might not pay enough attention to their own safety. They are distracted and become careless. Games that require spontaneous and quick actions are more likely to cause such accidents. Does the game promote such behavior? How can dangerous situations be avoided?

Examples

- A very rare item appears on the other side of a busy street, but will vanish again after a minute.
- Players chase each other in a game area with lots of little steps and other trip hazards.
- The footpath is slippery due to rain.

CHALLENGE

LOCATIONS

Bland Locations

Are the chosen locations exciting and meaningful?

Explanation

Just because locations need to be visited by the players does not mean they will actually find them engaging. There is nothing special about the locations and they are completely interchangeable. Does the game point out something interesting about the locations or incorporate them in an unusual way?

Examples

- The game leads players from a car park to a supermarket.
- The game is played in the hallways of a generic office building.
- The locations have been randomly placed around the city center.

CHALLENGE

Disruption

Does the game affect non-players in the game area?

LOCATIONS

Explanation

How much does the game disturb the environment that it is played in? This not only depends on the sheer amount of players but also on their behavior while playing the game and how the game makes them interact with the environment. Are they easy to identify as players or will they be unnoticeable?

Examples

- Players run around a crowded shopping mall.
- Players take shortcuts through flowerbeds.
- A public square is completely occupied by players that make it hard to walk across it.

CHALLENGE

LOCATIONS

Dynamic Places

Will the locations stay accessible and unchanged?

Explanation

If a game is staged in a public place, control of the location is out of hands of the game masters. This means that there is always the danger for something unforeseen to happen. Suddenly the crucial part of the environment the location was selected for is no longer accessible or completely removed.

Examples

- The market square is occupied by a fun fair.
- The police has cordoned off certain streets due to a demonstration.
- The park is closed after dark.
- Trees are being cut down.

CHALLENGE

Getting Lost

How likely is it that players will wander in the wrong direction?

Explanation

Players have the freedom to explore the game area and they might make some wrong conclusions or decisions and end up walking somewhere uninteresting. It is then both time-consuming and exhausting for them to get all the way back, in addition to the frustration of visiting the wrong place.

Examples

- Players misinterpret some clues and set off for the bus terminal instead of the train station.
- All locations of the game are visible on the map, but only some can be interacted with at this point.
- The game area has no boundaries.

CHALLENGE

LOCATIONS

LOCATIONS

Long Distances

How engaged are the players while between game locations?

Explanation

What are players doing while they walk from one location to the next? Are the distances short enough so that walking does not unwillingly become the main activity of the game? Players might lose engagement if they have too much idle time between game events at the different locations.

Examples

- Players are alone and the locations are 20 minutes apart on foot.
- The interactions at the different locations are really short.
- Players have to walk back and forth between the same locations over and over again.

CHALLENGE

Overcrowding

What happens when too many people play at the same time?

LOCATIONS

Explanation

Too many players at a location will cause delays when players have to queue until the location is “free” again. Any physical game objects will also only be usable by a limited amount of players at the same time. Apart from boredom and frustration waiting will also take players out of the game experience.

Examples

- Players have to write a letter on the only two available typewriters.
- Players all rush to a location directly after work because it closes soon.
- The scary atmosphere is ruined because too many players have gathered and are laughing.

CHALLENGE

LOCATIONS

Relocation

How difficult is it to move the game to a different location?

Explanation

If the digital content is tightly integrated with the chosen locations, the game cannot be moved to another place easily and maybe not at all. The content needs to be adjusted to the new environment and the story might need drastic rewrites. Alternative locations might be very far from each other.

Examples

- The game can only be played in a pedestrian zone.
- Voice actors refer to places by name.
- The game requires that a statue of a conqueror is near a hospital.
- Locations need to be visited in order.

CHALLENGE

Rain and Snow

How does bad weather and cold affect devices, players, and safety?

PHYSICAL

Explanation

Bad weather will make players less eager to spend time outdoors. This is less of an issue where players travel between locations and then spend time inside of these. Other games will have their main gameplay happening on the streets and players might not be prepared for averse weather conditions.

Examples

- Constantly checking a device is less appealing when it is cold or raining.
- Warm clothing will make players sweat easily.
- Batteries suffer in cold conditions.
- The ground gets slippery.

CHALLENGE

PHYSICAL

Sunshine

Will bright sunlight make the screen and interface unreadable?

Explanation

While good weather is usually preferable when playing outdoors there are also negative sides to it. Digital screens will become harder to read which might make it rather difficult for players to engage with the content. Overly warm weather will also exhaust players more and might not fit the mood of the game.

Examples

- Players chase each other and have to check the map constantly.
- The interface has very low contrast.
- Players need to read a lot of text that is shown only on screen.
- The game uses see-through glasses.

CHALLENGE

AUDIO

Noise

How do loud noises from the environment impact the game?

Explanation

There are a lot of sources of noise in an urban environment. This might make it hard or impossible for players to hear sounds that should alert them to game events. Likewise players might not be able to understand important audio output due to constant or irregular background noise in the environment.

Examples

- There is a construction site nearby that forces actors to almost shout.
- The game is played during a music festival.
- Players cannot wear headphones because they share devices and/or need to talk to each other.

CHALLENGE

SENSORS

Inaccurate Sensors

How are the inherent sensor flaws affecting the game?

Explanation

Each type of sensor has specific advantages and disadvantages. This usually includes availability, range, precision, price, or reliability. Being aware of these flaws is crucial so the game can be designed in a way that the issues are not affecting the gameplay in a negative way.

Examples

- GPS does not work indoors, has problems in narrow alleys, and drains the battery.
- Not all phones have NFC readers.
- Computer vision tracking requires high-powered devices or becomes very laggy.

CHALLENGE

Battery Life

What elements of the game are draining the battery?

TECHNOLOGY

Explanation

There are many different causes for battery drain. GPS, 3D, data transfer, or camera feed all consume a lot of energy. This reduces the potential play time, and might stop people from playing the game altogether if they are using their own devices. Battery life might also vary drastically by device.

Examples

- An augmented reality view is always active while playing.
- The phone constantly exchanges data with the game server.
- The contrast of the interface is really low so that screen brightness always needs to be set to maximum.

CHALLENGE

TECHNOLOGY

Confusing Interface

Is the interface easy to understand and use for new users?

Explanation

Location-based games employ different interaction strategies than traditional videogames. They are also played while moving around. This makes it more demanding for players to understand what they have to do and how to do it. The interface should help players and not be overly complicated.

Examples

- Critters, power-ups and traps all share very similar icons.
- The game just shows an empty map because no locations are nearby.
- Players cannot tell if their action failed because of a mistake or due to a technical failure.

CHALLENGE

Gimmicky Tech

Is technology used in a meaningful way or just for the sake of it?

Explanation

A cool new technology might serve as an initial inspiration for a game. However it needs to be ensured that the use of the technology is also warranted by the game itself. Any initial novelty will wear of quickly if the technology does not offer additional value to the experience and is an integral part of the design.

Examples

- Augmented reality is only used because it looks great.
- The game would be more stable without constant server updates.
- The phone is only used to show a map and information about any locations the players get to.

CHALLENGE

TECHNOLOGY

TECHNOLOGY

Phone Zombies

Will players be staring at their screens most of the time?

Explanation

The focus of the game is the digital screen. The real environment is just a backdrop to the player actions and everything important happens on the device. Players need to constantly check it in order to not miss anything that might happen. The game offers extensive visual content

Examples

- Players need to look at the map so they can see where to go.
- Virtual monsters appear randomly and frequently and require catching.
- Video clips found at locations push the story forward and they are several minutes long each.

CHALLENGE

Unengaging AR

Are the strengths and weaknesses of AR taken into account?

Explanation

Augmented reality content should be meaningfully integrated with the real environment. If AR objects do not interact with the world around them they quickly become unexciting. Imprecise tracking also weakens the illusion if the objects are not expected to behave erratically.

Examples

- A virtual pillar seems to be moving due to unstable GPS positioning.
- The AR object is brightly colored although the game is played in a dimly lit alley.
- An AR monster floats in front of the players even while they are moving.

CHALLENGE

TECHNOLOGY

Unstable Connectivity

How does the game continue without a data connection?

Explanation

There will always be areas of the game were connectivity is unstable, slow, or non-existent. Players will use different providers with different speeds and coverage. Will the game still be playable or will it break down when players cannot connect to the server? Are there ways to prevent such frustration?

Examples

- The game is played in a remote area with only little cell coverage.
- The game always needs confirmation from the server for any player action.
- Videos are streamed on demand.
- The map only updates when online.

CHALLENGE

TECHNOLOGY

Testing

How hard is it to test the game?
What needs to be done on site?

Explanation

While developing a location-based game it is necessary to test it under real conditions “in the wild”. Only this way the true impact of sensors and the effect that the real world locations have on the game can be evaluated. This is a lot of effort but crucial for understanding how the final game will play.

Examples

- The GPS reception at the game area is very limited due to tall buildings.
- Players can choose different paths between the various locations.
- The game will take place during a big public event.

CHALLENGE

MANAGEMENT

Uncle Roy All Around You, Blast Theory

Afterword

Further reading

If you are interested in a more academic perspective surrounding these game we recommend the book “Pervasive Games: Theory and Design” by Markus Montola, Jaako Stenros and Annika Waern.

In addition we have compiled a non-exhaustive list of experiences we have either worked on ourselves, enjoyed playing, or that inspired various sections of this guide. They are a great source to broaden your understanding of location-based games and well worth checking out.

2.8 Hours Later, Amazing Race, AR Quake, Before the Satellite Detects You, Big Urban Game, BotFighters, Blowtooth, Can You See Me Now?, Cargo, Chromaroma, Day of the Figurines, Epidemic Menace, Ere Be Dragons, Feeding Yoshi, Fortnight, Genesis of Cr0n, Geocaching, Grand Push Auto, Guerilla Gardening, Human Pacman, I’d Hide You, I Love Bees, Ingress, Insectopia, Interference, Johann Sebastion Joust, Love City, Malthusian Paradox, Mister X Mobile, Momentum, Mystery on Fifth Avenue, Pac-Manhattan, Pokémon Go, REXplorer, Rider Spoke, Savannah, SCVNGR, Shadow Cities, Shelby Logan’s Run, Shhh!, Street Stories, The Beast, The Game of Assassination, The Monitor Celestra, Tidy City, TimeWarp, Uncle Roy All Around You, Vem Gråter, Year Zero, Zombies Run.

Moving on

We hope this guide has given you a good overview of the different elements that are important to keep in mind when creating location-based experiences.

The guide itself was developed as part of the MAGELLAN research project by members of the Mixed Reality Laboratory of the University of Nottingham.

Do not hesitate to contact us if you have any further questions or feedback.

You might also want to check out our Design Cards for Location-Based Experiences – a deck of physical playing cards that are extending this guide and are a great tool for collaborative design.

But now it is time for you to get going and create some location-based experiences!

MAGELLAN project

MAGELLAN's overall vision is to enhance the creativity of game designers by establishing a web platform for cost-effectively authoring, publishing, executing, and experiencing location based games. This unique integrated web-based infrastructure is targeted at both skilled professional authors, but also at everyday authors without deep technical skills. MAGELLAN is underpinned by scientific research into the principles and technologies of creative and location-based experiences in order to ensure that the platform is innovative while also extending our broader scientific understanding of creativity.

The MAGELLAN project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement 611526.

http://www.magellanproject.eu

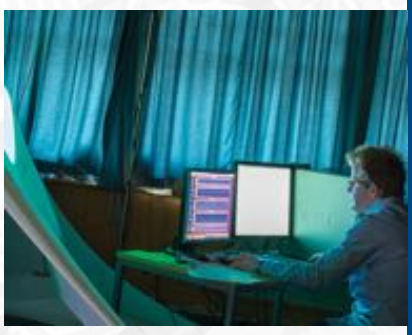
Mixed Reality Lab

The Mixed Reality Laboratory (MRL) was established in 1999 at the University of Nottingham, and is an interdisciplinary group exploring the potential of ubiquitous, mobile and interactive technologies to shape everyday life. The laboratory is now home to sixty academics, research associates and PhD students.

The MRL creates interactive technologies to enhance everyday life. Our research is grounded in the field of Human-Computer Interaction. We combine an interdisciplinary approach (linking to the Social Sciences and Humanities) with an intra-disciplinary approach (with areas such as Distributed Systems, AI, Vision and Formal Methods) to enable an end-to-end methodology in which we both develop novel digital technologies, but also deploy and understand them 'in the wild'.

Our focus on everyday life extends beyond the workplace to encompass technologies for the home, the workplace and for culture and entertainment.

http://www.nottingham.ac.uk/mrl



Glossary

Activities: The process of being engaged in some game-related task. This could vary considerably in complexity, from merely exploring the game environment to completing complex puzzles to fighting aliens.

Assets: any component that can be used to create some aspect of the scenario or game (images, sounds, texts, videos, 3D elements, behaviours, scenario bits, activities…)

Authors: Those responsible for creating/modifying/adding game structure and content.

Entities: An object within the game that encapsulates additional attributes or behaviours, usually by utilizing assets. Typically, this would involve giving selected assets meaning within the game scenario. For example, an image of a monster is an asset, it has no inherent behaviour, but the monster being portrayed in a game scenario may typically trigger reactions from the participant (they may have to fight with it or avoid it), even though all you see of the monster is an image.

Events: Usually more an aspect of programming terminology, but still relevant to generic gameplay. It denotes a specific (more specific than an activity for example) action or incident generated by the system or participant. Typically, it denotes an instance where the game architecture has to respond to something having happened. For example, a user entering a specific location and triggering some content generation or a user interacting with their mobile device in order to complete a game task (this may generate multiple events).

Geolocation: The real-world geographic location of an object.

Geospecific activity: linked to a particular location.

Geotypical: typical of a general location but not referring to any specific location.

GPS - Global positioning system.

GSM - Global system for mobile communications.

LARP - Live action role-playing game.

LBG - Location-based game.

Mixed Reality - The interleaving of some aspects of the virtual world with some aspects of the real/physical world, such as live video feeds in a virtual environment.

NPC - Non-player character.

Participants: Those actively participating in the gameplay.

Pervasive Games - Games that extend or pervade out into the real world, or an amalgamation of the digital with the physical.

POI: Point of Interest.

Seams: The boundaries or limits associated with mobile technology. This may manifest as limited network coverage or areas of poor signal strength for example. Seamful design attempts to incorporate or visualise these limitations to the participants.

Simulation: The act of modelling the system (or part of) in a controlled environment to test and measure the effectiveness of the outcome.

Trajectory - A pathway through space and/or time denoting the route undertaken by a participant in a particular experience.

UX: User experience. A participant's feelings on utilising a system or product.

Zones: Geographic areas.

Credits

This guide was written and designed by Richard Wetzel with some texts by Stefan Rennick Egglestone and Pat Brundell.

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Next page:
Rider Spoke, Blast Theory