

**INFERRING SOCIAL CONTEXT FROM OBSERVING THE  
BEHAVIOUR OF OTHERS**

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## ABSTRACT

Past research tells us that individuals can infer information about a target's emotional state and intentions from their facial expressions (Frith & Frith, 2012), a process known as *mentalising*. More recently, it has been found that this ability extends to inferring the events that caused the facial reaction (e.g. Pillai, Sheppard, & Mitchell, 2012; Pillai et al., 2014), an ability known as *retrodictive mindreading*. In the current thesis, we enter a new territory where a series of experiments was conducted to investigate whether people (perceivers) can guess a target's social context by observing their response to emotional stimuli. The core findings were: 1) perceivers were able to discriminate whether the targets were alone or observed by another person, 2) without any knowledge of the social context or what the targets were watching, perceivers judged whether targets were hiding or exaggerating their facial expressions, and their judgments discriminated between conditions in which targets were observed and alone, and 3) perceivers' eye movements also systematically discriminated between conditions in which targets were observed and alone. Perceivers were thus able to infer – explicitly or implicitly - a target's social context by observing their emotional response. Therefore, the findings demonstrate that people have the ability to use other people's minds as a window onto a social context that could not be seen directly.

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# **CHAPTER ONE:**

## **GENERAL INTRODUCTION**

### **Overview**

We are constantly required to draw information from various sources when interacting with others in order to understand and engage with them. Some of this information is observable or available through our senses, but some is only accessible (indirectly) through the mind of others (Achim, Guitton, Jackson, Boutin, & Monetta, 2013). The ability to ascribe and interpret the mental states (i.e., beliefs, intentions, emotions) of others is known as ‘mentalising’ which is important for our daily social interactions since these mental states guide people’s actions/behaviour (Frith & Frith, 2006; Slors & Macdonald, 2008). It allows us to predict the behaviour of others and in turn guide our own behaviour during social interactions, to be empathetic towards others (Schnell, Bluschke, Konradt, & Walter, 2011), it affects our ability to cooperate (Sally & Hill, 2006), to compete with and manipulate others (Sher, Koenig, & Rustichini, 2014), and to determine what caused the mental state (Gallese & Goldman, 1998). Premack and Woodruff (1978) coined the term ‘theory of mind’ in reference to this ability to infer and represent mental states from others and the self. The last 30 years of research into mentalising abilities has mainly focused on discovering how crucial theory of mind is in an individual’s development into a fully functional human being (Burt, Obradović, Long & Masten, 2008).

Arguably, research in the field of theory of mind has neglected the question of how accurate people (perceivers) are in mentalising and instead has focused on the processes involved during mentalisation (Zaki & Ochsner, 2011). This approach contrasts with work on person perception which has concentrated on factors that affect how accurately people make

interpersonal judgments. This area of research in social accuracy is much inspired by Darwin's argument that human behaviour contains various functional properties which assist our adaptation and evolution over the millennia (Kappas, 2002). For decades, researchers have attempted to understand people's ability to interpret facial expressions and behaviour to infer various mental states and personality traits (e.g. Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997; Ekman, 1965).

Recently, researchers have begun to investigate whether people are able to infer the cause of a mental state after observing and interpreting the behaviour of others, something that Gallese and Goldman (1998) called 'retrodictive' mindreading, a form of mentalising. This allows us to access and learn things about the world through the minds of others without having to directly experience it ourselves. The types of information that humans can infer from observing the behaviour of others is still a relatively new area of research, and the research described in this thesis aims to further our understanding of this ability.

Kraut (1982) claimed that facial expressions of others provide information about the social contexts and environment which caused the reaction in a target. Many studies have investigated how people behave differently (usually focusing on facial expressions) in various social situations; however there is a lack of research which directly examines individuals' ability to identify social contexts from the behaviour of others. In other words, how able are we at inferring the social context (e.g. the presence or absence of the experimenter) that modified the target's reactions from merely observing the target's behaviour?

This thesis begins with an overview of the theories of mentalising and past research in the area of social accuracy, and how these two fields of research should be combined in order to create a more comprehensive explanation and understanding of people's ability to mentalise

(Chapter One). In Chapter Two, we will review recent research conducted in the area of retrodictive mindreading to examine people's ability to make inferences about the cause of the target's reactions towards the experimenter's behaviour, leading on to a description of the general aims of this research. Chapters Three to Seven report the experiments conducted and its findings, and Chapter Eight offers an interpretation of the findings.

### **1.1 How Do We Mentalise? - The Development of the Theories of Mentalising**

Since the ability to mentalise is crucial for human development, there has been a long debate about when and how humans develop a theory of mind. Recent research has suggested that the basic components of mentalising develop during infancy, while past research in the area of theory of mind suggest that we only start to acquire fully developed mentalising abilities around the age of four (Achim et al., 2013; Frith & Frith, 2003). The onset of research into theory of mind and the debate surrounding it began when Premack and Woodruff (1978) reported experimental evidence that chimpanzees have the ability to detect intentions. The authors highlighted two main assumptions about when it is considered that a person or animal has a theory of mind. The assumptions are: 1) in order for a person to infer mental states from the behaviour of others, one must have some knowledge of the other's mind, and 2) to gain this knowledge one needs to have a theory since mental states are not directly observable and we use this system to predict the behaviour of others (Povinelli & Preuss, 1995; Slors & Macdonald, 2008). Furthermore, Premack and Woodruff's paper raised the question of how we might be able to investigate the assumption that a person has knowledge of the minds of others. This discussion culminated in focus on tasks that test false belief since beliefs are representations which may or may not be accurate (Onishi & Baillargeon, 2005). Dennett (1978) argued that in order to

successfully demonstrate that one has a notion of another's mind; one must be able to acknowledge that others may hold and act on false beliefs. This led to the development of one of the most widely used false belief tests: the 'unexpected transfer' task formulated by Wimmer and Perner (1983). This task was devised to examine at what age typically developing children begin to understand that others can hold a false belief, thus demonstrating that the child has a theory of mind. The task involves children being told a story of a child named Maxi who places a chocolate bar in cupboard x before leaving the room to play. Maxi's mother then moves the chocolate bar from cupboard x to cupboard y. Participants were asked where Maxi will search for his chocolate bar when he returns home. Children who answer correctly that Maxi will look for the chocolate bar in cupboard x demonstrate that they understand that Maxi can have a mind of his own which holds a different representation of reality to the one the children hold themselves. The findings showed that only a few children aged four were able to make a correct judgment, while those three years of age performed worst; in contrast, those aged five and above were able to respond correctly. Therefore, Wimmer and Perner (1983) concluded that children above age five have developed a theory of mind.

Perner, Leekam, and Wimmer (1987) then created a new false belief test – the 'deceptive box' task - where children are shown a familiar candy container and are asked to guess its content. After the children gave the correct response (i.e., candy), the experimenter then revealed an unexpected item inside (e.g. pencils, crayon). The children are asked then to predict what another child who had no knowledge of the contents of the container would say. Similar to Wimmer and Perner's (1983)'s findings, children aged three were not able to put aside their own beliefs and knowledge of reality and gave the wrong answer, while older children were able to acknowledge another child's false belief, and gave the correct response. Even with further

modification to these tasks to create simpler versions, the findings still show that the development of theory of mind has a fairly predictable path. Wellman, Cross, and Watson's (2001) meta-analysis of data from false belief tasks demonstrated that children from around the age of four are able to respond correctly, thus suggesting that children at four years old begin to grasp the concept of false belief, allowing them to predict the behaviour of others without being swayed by their own knowledge of the reality. These false belief tasks represent what are known as first-order mentalising tasks which typically require the child participant to estimate the belief state of a third party (Baron-Cohen, Leslie, & Frith, 1985).

As mentioned earlier, though, recent studies have suggested that younger children may already have developed the basic components of mentalising. Some studies have suggested that young children struggle with the standard false belief tasks because of the excessive demand on the child's linguistic or cognitive abilities (Bloom & German, 2000; Onishi & Baillargeon, 2005). For instance, Garnham and Ruffman (2001) modified the false belief task by asking children aged between two to four to listen and watch the story being enacted, and all that was required from the participants was to look at where the first character will search for the toy after returning to the room. The study demonstrated that most children looked at the correct location, indicating that these younger children have some implicit understanding of false belief. Onishi and Baillargeon (2005) then proceeded to test 15-months old infants' competence in mentalising by devising a simpler version of a nonverbal false belief test. Infants were shown that an item was placed in one of two boxes by an agent, and this object was moved to the other location. This change of location could be viewed by the infants but not the agent. The agent then retrieves the object in either the original location where he placed it or they retrieve it from the current location of the object. The findings indicated that infants looked significantly longer when the

agent reached for the object in its current location, suggesting that the infants were ‘surprised’ and expected the agents to search for the object according to the agent’s beliefs of where the object is (and not where it really is). Onishi and Baillargeon’s (2005) study supported the idea that children below age four have the capability to understand false beliefs. Further evidence of infants’ false belief understanding has been obtained through various tasks with infants as young as seven months old (Baillargeon, Setoh, Sloane, Jin, & Bian, 2014).

So, why is it that infants are capable of understanding false beliefs but fail false belief tests at ages three to four? It has been suggested that these false belief tasks place considerable demands on executive-functions (Baillargeon et al., 2014; Perner & Roessler, 2012). This account suggests that children have difficulties inhibiting their own knowledge of the reality when asked to give a verbal response during the false belief tests. Moreover, Apperly and Butterfill (2009) suggested a ‘two-systems’ theory of mind in which infants, children and adults have the necessary competence for mentalising but the capacities for infants and children are limited to simple tasks such as face recognition, gaze following, emotion processing, and so on. Older children and adults on the other hand have the capacity for reasoning in more cognitively demanding theory of mind tasks (Apperly, 2012).

Researchers then extended from first-order mentalising tasks to second-order tasks which take into account what the other person in the task thinks about the thoughts of a third person presented in the story (i.e., The child participant is asked to estimate what character A thinks character B is thinking). For example, A is with B and A watches B place an object in a box before they leave the room together. Then, C changes the location of the object in the absence of A and B. Unknown to A; B returns to the room and finds the object in the new location. The participant is asked where A thinks B thinks the object is, thus, making this false belief task a

more elaborate one than the previously described first-order tasks. Studies found that children six to seven years of age are able to pass second-order mentalising tests (Baron-Cohen, 1989; Miller, 2009; Perner & Wimmer, 1985). Therefore, it is clear that we become more competent in complicated mentalising as we grow older.

Studies that used advanced mentalising tasks which examine individuals' understanding of higher-order mental states supported the concept that people are more able to understand the minds of others with age. These studies investigated people's understanding of higher-order mental states such as white-lies (Happé, 1994), and faux pas (Baron-Cohen, O'Riordan, Stone, Jones & Plaisted, 1999). Children aged eight to ten are more able to solve faux pas tests as they get older (Banerjee, Watling, & Caputi, 2011). The most well-known test is the social stories task, which involves stories portraying daily situations (Channon & Crawford, 2000).

Participants are required to explain the indirect statements made by the main character of the stories; in order for participants to succeed, it is necessary for them to infer the mental states of the character, such as those associated with irony. Performance from children aged 12 on social stories tasks were below ceiling suggesting that we continue to develop our mentalising abilities beyond this age (O'Hare, Bremner, Nash, Happé, & Pettigrew, 2009).

However, there is a lack of research in the development of theory of mind processes beyond early childhood. According to Dumontheil, Apperly, and Blakemore (2010), there are a few reasons for this; 1) tasks created to test theory of mind are not suitable for older children and adolescents since ceiling effects could mask any further development, and 2) the tasks created do not demonstrate how theory of mind is used in daily actions and decisions. However, the relationship between the ability to mentalise and certain cognitive processes continues to develop

beyond childhood, thus, researchers have continued to investigate adults' development of theory of mind.

Studies examining adults' ability to infer mental states showed that adults often make errors when evaluating statements that involve ascribing mental states with several embeddings (e.g. "Simon thought Jim would believe that Susan thought Edward wanted to marry Betty") (Rutherford, 2004). Moreover, studies have found that adults tend to make more errors when performing on another task simultaneously which were designed to utilise the working memory and other executive functions (e.g. McKinnon & Moscovitch, 2007). Therefore, although the ability to mentalise is crucial for our daily interaction, even as adults, people still make errors when ascribing mental states to others.

Keysar, Lin, and Barr (2003) argued that although adults have the ability to ascribe mental states to others, they do not always fully utilise this ability (i.e., adults do not reliably use their inferences of mental states to interpret the behaviour of others). Furthermore, Keysar et al. (2003) stated that adults' ability to mentalise is not fully incorporated to allow 'spontaneous, non-reflexive use.' Keysar, Barr, Balin, and Brauner (2000) devised a referential communication task where adult participants are required to take into account the perspective of a 'director'. Participants are shown a 4×4 grid containing various objects in different slots. Participants are instructed by the 'director' to shift certain objects around the slots of the grid. Some of the slots were covered, so the director could only see some of the objects, but not all that were visible to the participants. Some of the instructions given required participants to interpret with the knowledge of the director's limited perspective. Although participants were able to understand that the director has a different view, participants often failed to use this knowledge to interpret the instructions. Furthermore, recent studies by Samson, Apperly, Braithwaite, Andrews, and

Bodley Scott (2010) and Qureshi, Apperly, and Samson (2010) used a computerised task where adults were shown a number of red circles in a room with an avatar, and some of the circles were visible to the avatar and some were not. Adult participants were required to make a judgment about the avatar's perspective. The results are similar to Keysar et al.'s (2000) where adults found it difficult to judge another's perspective when it is different from their own. In Samson et al.'s (2010) study, it was found that adult participants responded slower and made more errors when asked to make self-perspective judgments, hence they were not able to ignore what the avatar was seeing. This suggests that adults use rapid processes when taking into account what others see, since even with rapid processing, it is still sufficient to interfere with the participants' self-perspective judgments. Hence, the findings from these studies illustrate that adults still make errors in their judgment.

Hindsight bias is another such example of adults' error in judgment whereby people overestimate the likelihood of an outcome after gaining knowledge about the said outcome (Bernstein, Erdfelder, Meltzoff, Peria, & Loftus, 2011; Fischhoff, 1982). This phenomenon was first investigated by Fischhoff and Beyth (1975) where participants were asked about the possible public events during President Nixon's overseas trips. Participants were asked to rate the probabilities of the possible outcomes before the trip, and again after the trip. Findings showed that participants recalled having performed more accurately than they actually did. These hindsight bias tests usually have one condition where participants who are aware of the outcome, were then asked to predict what others who are not aware of the outcome would think. The bias occurs when the knowledge of the outcome influences participants' judgements by overestimating the state of knowledge of the naïve others. This inability to inhibit or ignore one's own knowledge is a component of many tests of theory of mind in young children (Bernstein,

Atance, Meltzoff, & Loftus, 2007). Therefore, hindsight effect and theory of mind are related since both involve misattribution of knowledge to the less informed self and perspective taking. The hindsight effect is shown to be a robust effect across various settings and populations (Guilbault, Bryant, Brockway, & Posavac, 2004; Hawkins & Hastie, 1990; Pohl, 2007).

## **1.2 Theories of Mentalising**

Various theories have been developed over time to explain how the process of mentalising works, and these theories are usually divided into two categories; theory-theory and simulation theory. Below, we briefly describe these two theories.

### **1.2.1 Theory-Theory**

Researchers who subscribe to ‘theory-theory’ believe that children are born with the abilities and skills that they build upon from their experiences with people and the environment around them (Gopnik and Wellman, 1992; Meltzoff, 1999). Therefore, the social interactions and environment are vital in the development of a person’s mentalising skills and abilities. This account takes a more conceptual approach whereby children and adults are seen to have a conceptual understanding of mental states (i.e., beliefs, knowledge, etc.) and these concepts are used to form predictions, explanations and justifications of the behaviour of others (Apperly, 2012). These concepts are seen as a “large number of universally quantified conditional statements, conditions with the conjunction of the relevant explanatory factors as the antecedent and the relevant explanandum as the consequent” (Churchland, 1991). Moreover, theory-theory states that the process of mentalising “is not dependent on knowledge of one’s own mind” (Michlmayr, 2002), all one requires are the rules and concepts which can then be used to

calculate and form explanations and predictions of the behaviour of others. Hence, the process of mentalising is based on a folk psychology perspective where people understand the minds of others through a set of rules and laws that “connect the explanatory conditions with the behaviour explained” (Churchland, 1990). We use this theory throughout our daily social interactions without much awareness of the principles which formed the theory; hence the process of mentalising is seen as implicit in nature (Michlmayr, 2002). Findings from studies that show young children’s gradual improvements in mentalising tasks as they grow older support the view that simpler concepts emerge earlier and provide a foundation for more sophisticated concepts (Apperly, 2012).

However, this account is challenged when research found infants as young as seven months were sensitive to another person’s mental states, as well as false beliefs (Baillargeon, Scott, & He, 2010; Kovács, Teglas, & Endress, 2010), since theory theorists suggest that young children below the age of four are unable to pass false belief tasks because of a ‘conceptual deficit’. Furthermore, although theory-theory shows that adults have the ability or the concepts to mentalise, this does not give much explanation as to how adults understand the minds of others, specifically the processes involved, therefore suggesting that there is more to mentalising than just conceptual knowledge (Apperly, 2012).

### **1.2.2 Simulation Theory**

Those who champion simulation theory on the other hand, argue that in order for a person to successfully interpret and understand the mental states of others, one needs to simulate the other person’s behaviour or feelings (Gallese & Goldman, 1998). Gordon (1986) suggested that in order to predict the behaviour of others, we need to answer the question, “What would I do in

that person's situation?" Perceivers do this by engaging within the cognitive and somatic processes they would experience themselves when observing a person's behaviour or experience of an internal state (Preston & de Waal, 2002). Perceivers simulate by inputting the pretend mental states and behaviour of the target observed into their own decision-making system to mentalise the target's behaviour, hence perceivers use their own mental apparatus when understanding the minds of others (Michlmayr, 2002). In other words, we put ourselves in the shoes of others in order to mentalise or understand their behaviour and mental states. Thus, simulation can also be seen as 'perspective-taking or 'role-taking' in Piaget's theory which helps conquer children's egocentrism (Michlmayr, 2002). Therefore, those who champion simulation theory argue against theory-theory's explanation that we understand the minds of others through the employment of theories, rules and calculations. Instead, simulation theorists suggest that we use our own minds and knowledge to simulate the actions of others in order to understand them (Michlmayr, 2002). Gordon (1996) describes theory-theory as 'cold' since its methodology utilises intellectual processes which are dependent on concepts, rules and calculations. On the other hand, simulation theory is seen as a 'hot theory' since perceivers use their own emotional and mental resources to reason the behaviour of others. Moreover, simulation theorists suggest that the shift in young children's ability to pass false belief tasks is due to an increase in their executive function ability which enables children to perform better at the mentalising tasks over time (Shanton & Goldman, 2010). Simulation theory is supported by research which demonstrated that from observing others, people often adopt the facial expressions (Dimberg, Thunberg, & Elmehed, 2000), bodily postures (Chartrand & Bargh, 1999), and target's self-reported emotional states (Neumann & Strack, 2000).

The discovery of mirror neurons in the frontal and parietal cortex in macaques (Rizzolatti & Craighero, 2004) has opened up research in the area of social cognitive neuroscience and its findings have provided further evidence for simulation theory. It is demonstrated that the mirror neuron system is activated not only when people perform an action, but also when they observe another person executing an action. Some studies even claimed that mirror neurons can explain various aspects of social cognition, from imitation to theory of mind (Frith & Singer, 2008). Moreover, studies in emotional contagion show that exposure to facial expressions such as disgust (Wicker et al., 2003) or fear (Morris et al., 1996) elicits activity in the same brain regions as direct contact to stimuli which provoke these responses. Therefore, Gallese and Goldman (1998) suggested that the function of the mirror neuron system may be linked to the simulation theory by stating that perceivers experience similar effects in their system when observing a target performing an action as when performing the action themselves, thus enabling the perceiver to infer the mental states of the target. Researchers also linked the mirror neuron system to mentalising by speculating that a deficit in the system might explain the dysfunction in mentalising that we see in autism. For example, Iacoboni & Dapretto (2006) argued that when the mirror neuron system was disrupted, this would affect one's ability to generate any internal representations of others through simulation, hence inhibiting one's ability to mentalise.

Gallese (2003) stated that the basic function of the mirror neuron system is often automatic and is involved in inferring simple mental states such as facial expressions. This is also known as low-level mentalising whereby people engage in automatic mental and behavioural mimicry when interacting with others (Goldman, 2012). Hence, the function of the mirror neuron system can be seen as a form of low-level mentalising. High-level mentalising on the other hand is more complex and involves top-down reasoning where individuals attribute

mental states based on prior knowledge and the mental states (Shanton & Goldman, 2010). This type of simulation process involves the use of imagination. Furthermore, this helps explain how people re-enact or recreate an experience without having to directly observe the target (Goldman, 2012). This high-level mentalising can also be used to explain the errors individuals make when mentalising. This could be due to perceiver's lack of information about target's initial mental states or it might be that the perceiver is unable to inhibit his own mental states during simulation. Thus, evidence from hindsight bias studies demonstrates when the perceiver fails to inhibit their own mental states during simulation; it will then lead to egocentric biases (Shanton & Goldman, 2010).

Overall, research conducted in the area of theory of mind revealed an abundance of information about the development of mentalising from a young age till adulthood. It also demonstrated how we still make errors when understanding the minds of others, thus suggesting that we may not be as skilled at mentalising as we would hope. In addition, studies from theory of mind research have discovered something about the processes underlying mentalisation, especially from the cognitive perspective with a rise in research in the area of cognitive neuroscience in order to further explain the mechanisms involved.

### **1.3 How Able Are We At Mentalising? - Mental State Recognition & Empathic**

#### **Accuracy**

The researchers from the mentalising perspective focused on the underlying processes of how perceivers infer the mental states of others, ignoring the question of how accurate perceivers are at making these inferences. It is imperative to know how well we are at understanding the

minds of others since accurate inferences lead us to behave according to the requirements of the situation (Zaki & Ochsner, 2011).

Before studies on how perceivers process mentalising became popular, researchers in the field of social psychology focused mainly on investigating the sources of accurate judgments of interpersonal traits and other aspects of person perception. The aim of this was to better understand the characteristics of a good perceiver. These accuracy studies varied from perceivers' ability to recognise emotional facial expressions to inferring personality traits of the targets, or perceivers' ability to predict the target's behaviour (Zaki & Ochsner, 2011). Here we will briefly discuss some of the studies conducted in this area of research.

### **1.3.1 Emotional Facial Expressions Recognition**

The importance of how accurate or how able we are in mentalising has led researchers to investigate this in various ways over the last decades. One of the most examined areas is people's ability to read facial expressions. This does not come as a surprise since we tend to pay more attention to facial expressions than any other nonverbal signals such as body language (Noller, 1985). Even as infants, we prefer to look at faces than other complex stimuli, indicating that we are biologically prepared from an early age to focus on faces for social information (Fantz, 1961; Woodhead, Barnes, Miell, & Oates, 1995). The recognition and understanding of emotional facial expressions has been characterised as easy (Ekman, 1975), innate (Izard, 1994), categorical (Calder, Young, Perrett, Etcoff, & Rowland, 1996), and immediate (Ekman, 1997). In addition, it was demonstrated that four month old infants are able to discriminate between the basic emotional expressions such as happiness and sadness (Serrano, Iglesias, & Loeches, 1992).

Ekman and Friesen (1971) suggested that there are six basic emotions (i.e., anger, disgust, fear, happiness, sadness, surprise). Ekman (1972) and Izard (1971) then demonstrated that photographic stimuli of targets expressing these basic emotions can be accurately recognised at above chance level by various cultures, suggesting that these emotions are universally recognisable. A large body of research has since claimed that mental states can be inferred from facial expressions. These researchers usually employ photographs of targets posing various emotional facial expressions as the stimuli, and perceivers are then asked to guess what emotion the target was expressing or feeling. People's ability to recognise emotions has been tested across different ages, cultures and backgrounds demonstrating that perceivers are able to do this systematically (Elfenbein & Ambady, 2002; Russell, Bachorowski, & Fernandez-Dols, 2003).

Another aspect of emotional facial expression recognition is whether there are any gender differences between male and female perceivers. Early studies revealed inconsistent results as to whether female perceivers are actually more accurate at recognising emotional expressions (Coleman, 1949). Other more recent studies showed no differences in performance between the genders (e.g. Grimshaw, Bulman-Fleming, & Ngo, 2004; Rahman, Wilson, & Abrahams, 2004). However, some researchers have suggested female perceivers are better at identifying the emotional faces expressed by female targets (Hoffman, Kessler, Eppel, Rukavina, & Traue, 2010), a suggestion ruled out by Hall, Carter, and Horgan (2000). Another factor that researchers suggested could explain female perceivers' advantage over male perceivers in recognising emotional expressions is that female perceivers perform better with less intense expressions than the male perceivers (Hall & Matsumoto, 2004). This might suggest that female perceivers are not only more accurate in recognising less intense emotional expressions, but they are more sensitive to them (Hoffman et al., 2010; Montagne, Kessels, Frigerio, De Haan, & Perrett, 2005).

However, this effect was not found in perceivers of both genders when recognising typical and exaggerated emotional expressions (Hoffman et al., 2010; Kessler et al., 2005; Rahman et al., 2004).

Baron-Cohen, Wheelwright, and Jolliffe (1997) began exploring people's ability to recognise complex mental and emotional states which includes another group of emotions known as social emotions. Some of the complex mental states include admire, guilt, regret, and so forth. Baron-Cohen et al. used photographs of targets' whole face, the eyes alone and the mouth alone. Perceivers are then given a choice of two mental states to choose from. The study found that for the basic emotions, perceivers are better at recognising the expressions when viewing the target's whole face; as for the complex mental states, perceivers performed significantly better when viewing the eyes region alone than the mouth region and viewing the eyes was as informative as the whole face. The authors concluded that perceivers who focus more on the eyes region will outperform those who do not when inferring mental states of others.

However, one of the troubles with facial expression recognition studies is when the targets were asked to express the same emotion at varying degrees of intensity; not surprisingly, perceivers were more accurate when viewing intense expressions. Hence, this creates the question of how reliable and valid are the results of studies which used exaggerated and posed emotional facial expressions. Do perceivers rely on matching the expressions to an idea they have in mind as to what resembles an emotional expression or do perceivers mentalise the emotions the target was feeling? Thus, more and more studies have started to employ more spontaneous expressions of emotions as the stimuli, and some of these studies found a decrease in the likelihood of perceivers inferring the correct emotion (Motley & Camden, 1988; Russell et al., 2003; Yik, Meng, & Russell, 1998). Furthermore, the typical emotional facial expression

recognition task requires perceivers to choose one answer from a list of emotions, and when perceivers are provided with more options, it lowers their accuracy rates (Banse & Scherer, 1996); and when perceivers are allowed to answer in an open-ended question format, it lowers their accuracy even further (Russell, 1994). Hence, by removing the categories of responses, perceivers find it more difficult to accurately identify the emotional expressions, which lead us to question whether these facial expression recognition studies actually measure our ability to recognise emotions.

Overall, based on the large body of research conducted in the area of emotional facial expressions recognition, we can say that to some degree humans possess the ability to recognise and understand various emotional expressions in order to guide our own behaviour in various social interactions.

### **1.3.2 Empathic Accuracy**

Empathic accuracy, a term coined by Ickes (1997, 2003), refers to how accurate a perceiver is in mentalising. Ickes' empathic accuracy research paradigm involves perceivers inferring the feelings or thoughts of the target in the video stimuli. The participants usually interact with another participant, and they are then asked to report their feelings and thoughts at various points on their video recordings separately, as well as the thoughts and feelings of their partner at the points where their partner had stated having a thought or feeling during their own review of their video recordings. Hence, this paradigm allows researchers to investigate interpersonal sensitivity during an interaction between people. Raters then compare the responses provided to create an index of empathic accuracy (Ickes, 2009). One of the benefits of this paradigm is that it allows researchers to create a more natural social environment when

recording the targets, thus generating more naturalistic, unscripted and non-posed behaviour from targets. Ickes (2003) referred to this as “everyday mind reading” since it measures how well people infer mental states when interacting with others. This paradigm allows researchers to assess interpersonal accuracy based on people’s holistic judgments of target’s expressive behaviour (Ickes, Stinson, Bissonnette, & Garcia, 1990; Ickes, 2001). This dyadic version has been adapted to a standardised format where perceivers can be tested using a set of audio-visual stimuli where accuracy is determined by comparing perceivers’ ratings with the self-reported thoughts and feelings provided by the targets in the stimuli (Hall & Mast, 2007).

This paradigm also opened up the opportunity for researchers to investigate what are the vital cues for perceivers to achieve accuracy in mentalising. One of the studies which examined this was conducted by Hall and Mast (2007) where they presented the stimuli with different cue modalities (i.e., full video, transcript, audio, and silent video). Perceivers were given different instructions (i.e., infer feelings and thoughts, infer thoughts only, infer feelings only). The findings of the study suggest that verbal information led to higher accuracy, followed by vocal nonverbal cues, and finally visual nonverbal cues. In addition, when perceivers were asked to infer feelings only, they shifted the attention toward visual nonverbal cues from verbal ones, and the opposite effect when perceivers were asked to infer thoughts.

Moreover, this paradigm was also used to examine individual differences and situational predictors of accuracy of emotion perception (Zaki & Ochsner, 2011). For instance, Pickett, Gardner, and Knowles (2004) investigated whether individuals who have a higher need to belong (i.e., the desire to establish interpersonal attachments) would be more accurate in inferring mental states by employing the empathic accuracy paradigm. The study found that perceivers’ scores of social connectedness predicted their empathic accuracy and accuracy in facial

expression recognition. The researchers thus concluded that the more we have the need to belong and connect with others, the better we are at mentalising.

In summary, research in the area of mental state recognition and person perception shine the light on people's ability and capacity in mentalising, specifically in how accurate we are in understanding the minds of others. A large body of research in this area has focused on emotional facial expression recognition, which led to the discovery of the as and the universality of recognising them. Eventually, researchers began to develop more naturalistic methodology to measure individuals' ability to attribute mental states. This allowed further investigations into individual differences in the ability to mentalise, and how changes to the procedure could affect perceivers' judgments which led us to question the reliability of these studies in measuring people's capability in mentalising.

#### **1.4 The Limitations of Theory of Mind and Person Perception Research**

West and Kenny's (2011) truth and bias (T&B) model states that in perceiver's judgement, "perceptions are determined by truth or reality." West and Kenny then went on to state that when studying accuracy in person perception, one must define and measure the truth in order to investigate how strongly the truth affects judgment. The definition and measurement of truth in this sense depends on the research question, the methodology, and the context in which the judgments are made. West and Kenny used Ickes' empathic accuracy paradigm as an example of good practice in measuring perceivers' accuracy in a dyadic interaction; the 'truth' in this example is the target's self-report of his or her feelings and thoughts since the research focuses on whether perceivers are accurate in inferring the target's feelings and thoughts. In this case, accuracy is measured by comparing the perceiver's inference with the targets' self-reports

of their own thoughts and feelings upon watching the video recording of their own interaction. This assumes that what the targets report as their feelings and thoughts at specific points of their recorded behaviour actually represents what they were really feeling and thinking at that point in time. Yet the targets' self-reports may be affected if the targets are unable to remember what they were truly feeling and thinking in that they might actually base their self-reports on observing their own behaviour in the video recordings. This might not differ categorically from asking a perceiver to observe the target's behaviour in the video and then infer the target's thoughts and feelings. Therefore, this paradigm might not actually satisfy West and Kenny's truth condition.

In conclusion, the research in person perception accuracy suggests that humans have the ability and tendency to make interpersonal inferences when interacting with others, especially from facial cues. It also indicates that people's behaviour reflects their emotions, personality traits, as well as their intentions. However, one of the problems with this area of research is that it violates West and Kenny's (2011) truth condition since in the majority of these studies the target's true mental state is imponderable and perhaps unknowable. So, how can we develop a task in which the perceiver's interpersonal judgment is compared against an objective fact?

Theory of mind research, which focuses more on examining the processes involved in mentalising rather than how able or accurate people are at mentalising, also violates West and Kenny's (2011) 'truth condition'. This is because in order to understand the processes involved, we have to compare perceiver's performance with the actual mental state the target was experiencing, and this is unknowable. Therefore, the conclusions drawn from theory of mind research are questionable since these conclusions are based on tasks where perceivers' performance is measured in a way that is similar to that of person perception. There is no way we

can know for sure of the target's true mental state, and so, the perceiver's performance is based on either the target's self-reports or on a set of prototypical responses that are mapped out without having to take into account the target's mental state. Therefore, the procedure we propose in this thesis focuses on perceiver's ability to infer the cause of the target's mental state which enables us to draw valid conclusions since it satisfies West and Kenny's (2011) truth condition.

The mentalising tasks described here have helped us to understand the basics of mentalising, but they often fail to test individuals' full capacity to mentalise that resembles our day-to-day interaction (Achim et al., 2013). Hence, researchers have begun to create more ecologically valid tasks that require participants to use the immediate environmental cues and their prior social knowledge in order to mentalise (e.g. Barnes, Lombardo, Wheelwright, & Baron-Cohen, 2009; Golan, Baron-Cohen, Hill, & Golan, 2006; Ickes et al., 1990). These researchers shifted from the use of static photographic stimuli to dynamic stimuli to present more realistic depiction of the targets. Not only are dynamic stimuli more representative of daily social experiences, but it allows experimenters to investigate perceivers' ability to identify subtle expressions and behaviour, thus enabling us to learn more about people's capacity and flexibility in understanding others' minds. Moreover, the stimuli used in these studies usually involve actual or video footage or virtual reality avatars (Achim et al., 2013). This provides further contextual information about the environment the target is in which is something lacking from photographic stimuli, thus creating a more complex and realistic mentalising task. Therefore, the stimuli and procedure we used in the experiments described in this thesis embrace Achim et al.'s (2013) suggestion of using a more ecologically valid task in order to investigate our full capacity in mentalising while capturing the complexity involved in the process.

As suggested by Zaki and Ochsner (2011), by combining the strengths of both areas of research – theory of mind and social accuracy – it allows us to understand not only how able perceivers are at mentalising, it also provides an understanding of the underlying process. In other words, linking behavioural or neural cues that a process has taken place with perceivers' accuracy in mentalising allows us to further understand the functional and adaptive nature of mentalising in our daily social interactions.

In the next chapter, we will introduce a new paradigm which enables researchers to measure perceivers' accuracy, in a context where the truth condition is satisfied, in a more naturalistic setting. This proposed paradigm also demonstrates how mentalising is functional and adaptive since the task requires perceivers to use the minds of others in order to learn about aspects of the world that they have no direct access to.

## **CHAPTER TWO: OUTLINE AND CENTRAL QUESTIONS**

### **2.1 Beyond Traditional Mentalising Tasks**

As discussed in Chapter One, tests of mentalising usually require perceivers to attribute a mental state in a context where the target's true mental state is unknown and therefore it is not possible to compare perceivers' responses with the target's true mental state. We also discussed the need to create a more naturalistic procedure that allows us to measure people's ability in mentalising, as well as understanding the underlying processes involved. Ickes' (1997, 2003) empathic accuracy procedure comes close to achieving this with the only problem being that it relies on target's self-report of their own mental states as the point of comparison for gauging the perceiver's accuracy.

North, Todorov, and Osherson (2010) created a procedure which satisfies West and Kenny's (2011) 'truth condition' while investigating perceivers' ability to infer the preferences of targets after observing targets' spontaneous facial expressions. By focusing on targets' preferences instead of unobservable mental states, North et al. (2010) were able to measure perceivers' performances based on an objective criterion (i.e., basing perceivers' accuracy on targets' preferences), thus improving on the traditional empathic accuracy methodology of relying on target's self-reported mental states to calculate perceivers' accuracy in making social judgments. Furthermore, North and colleagues' method of collecting the stimuli creates naturalistic behaviour that could be more representative of day-to-day facial expressions compared with the posed and exaggerated expressions used in past research. Eight targets were discretely video recorded as they viewed a series of images. Targets rated their preferences over

48 pairs of images which were divided into four categories (people, cartoons, paintings, animals). Targets were given five seconds to respond to each pair of stimuli. These target stimuli were then edited (each clip was three seconds long with the exception of the cartoon category, where each stimulus was seven seconds long), producing a total of 768 video stimuli. Subsequently, these were shown to a group of perceivers who were asked to decide whether the targets preferred the first or second image. The perceivers were assigned randomly to view one of the four categories (people, cartoons, paintings, animals), each viewing a total of 96 pairs of stimuli, except for the cartoon category, with only 48 pairs of stimuli. Perceivers then judged the target's preferences after viewing each target's 12 pairs of video stimuli. Perceivers were then asked to rate the target's expressiveness.

Results indicated that perceivers were systematically correct in inferring the target's preferences, but their ratings of target expressiveness did not correlate with the success in guessing the target's preference, except when targets viewed cartoon stimuli. Targets were more expressive in the cartoon category than in response to the other stimuli and uniquely in this case the level of expressiveness (as judged by perceivers) correlated with perceivers' success in estimating target's preference. Moreover, perceivers were generally more accurate in estimating target preferences for cartoons than for other stimuli which might be a sign that target preferences were more strongly differentiated for these particular stimuli. Consistent with this possibility, the findings suggested that it was easier for perceivers to infer preferences for stimuli that were preferred by majority of the targets, again suggesting that stronger target preferences were easier for perceivers to detect than weaker preferences. The paradigm thus extended Ickes' interpersonal empathic accuracy by avoiding the need to label target's mental states, and without having to rely on target's subjective report on their own mental states. Moreover, by relying on

brief samples of targets' behaviour as stimuli, North and colleagues' study demonstrates that people have the capability to make accurate judgments of others based on samples of spontaneous behaviour.

Building on the many strengths of North and colleagues' (2010) study, there seems to be opportunity to develop their procedure to reach its full potential. Arguably, perceivers could simply classify the targets' positive or negative expressions to infer their preferences without having to consider any mental states. Indeed, the task presented by North et al. is one in which perceivers effectively had to decide which expression is more positive out of the pair of stimuli in order to make a judgment of the targets' preferences. In that sense, the study does not contribute much to the investigation of humans' mentalising capabilities, its functionality and its adaptability. The following paradigm that we will be introducing takes a step further into this investigation, where the nature of how the target stimuli are created produces more complex, spontaneous and subtle behaviour, thus demonstrating perceivers' ability to make more complex inferences from targets' reactions, the mechanisms involved and its functionality.

Cassidy, Ropar, Mitchell, and Chapman (2013), Cassidy, Mitchell, Chapman, and Ropar (2015), Pillai, Sheppard, and Mitchell (2012) and Pillai et al. (2014) devised a new procedure – a retrodictive mindreading task designed to examine a perceiver's ability to infer the cause of the target's reactions. Retrodiction was introduced in the context of simulation theory where simulation is not only used to predict the mental states of others, but can also be used to infer mental states that have already occurred (Gallese and Goldman, 1998). In other words, it is a backwards inference to a mental state based on behaviour being observed currently (Pillai et al., 2012).

One of the first studies that demonstrated retrodictive mindreading is Robinson and Mitchell (1995)'s study which investigated three to five-year old children's ability to mentalise. Participants were told a story about identical twins who were playing with a ball. The twins jointly put the ball in Location A and then one of the twins we don't know which left the scene. In the presence of the remaining twin, the ball was then moved to Location B. Finally, the absent twin returned and another protagonist asked them to fetch the ball. In response, each went to a different location and the experimenter then asked the observing child participant to infer which twin went to Location A (the empty location) – was it the twin who was present throughout or the twin who left the scene for a while? Children were able to successfully infer that the twin who searched the original location (Location A) must be the twin who was absent from the room when the ball was shifted. This demonstrated the ability to retrodict since participants must consider the twin's previous mental state (i.e., lack of knowledge that the ball had been shifted to a new location) in order to explain the observed behaviour.

Cassidy et al. (2013, 2015) and Pillai et al. (2012, 2014) extended from Robinson and Mitchell's (1995) concept of using our own knowledge of the possible reactions people could have to a certain scenario to create a retrodictive mindreading paradigm. This paradigm relies on the concept of by merely observing people's behaviour and reactions, we are then able to decipher from the range of possible events that could have occurred to cause the behaviour/reaction. In other words, perceivers observe the target behaving or reacting in a certain manner, and then use simulation to imagine the possible scenarios that could have led the target to behave this way. The retrodictive mindreading paradigm draws from Goldman and Sripada's (2005) reverse simulation framework where they suggested perceivers process their own mental state in reverse, in order to attribute the antecedent event which reflects the target's mental state.

Goldman and Sripada's (2005) framework also proposed that in order for perceivers to retrodict, they first mimic the target's behaviour in order to experience the target's mental state. The perceivers then use their own mental state from mimicking the target, to infer the target's mental state.

Cassidy et al. (2013) used the retrodictive mindreading paradigm as a new and naturalistic emotion recognition task to assess people's ability to recognise subtle emotions. They cited Millikan (2005)'s argument that the process of recognising emotions does not rely on inferring the target's emotion, rather it depends on observing the target's emotional reaction and then attempting to make sense of the reaction after the event, a process also known as retrodictive mindreading. Hence, Cassidy et al.'s (2013) study examined perceivers' ability to accurately infer the gift (homemade novelty, chocolate, monopoly money) the target received based on the target's reaction when receiving the gift. Furthermore, perceivers were asked what they thought the targets felt upon receiving the gift. Twenty-one targets were video recorded as they interacted with the experimenter, in this case, receiving a gift from the experimenter. These videos were then edited and shown to perceivers as stimuli. Since perceivers gave free responses when asked about the target's emotion, these data were coded into four categories (i.e., positive, negative, pretend, and confused). The results demonstrated that perceivers were able to correctly infer the gifts the targets received above chance level, thus suggesting that they understood which emotional reactions were appropriate for the various gifts received.

Cassidy et al. (2013) raised the possibility that perceivers may not need to infer the emotion of the target when retrodicting the event that caused it. However, the findings of their study suggested otherwise; when perceivers correctly guessed the target's emotion, they also tended to accurately judge the gift received, and when they inferred the wrong emotion, they also

made a wrong judgment about the gift received. Hence, the relationship between the judgments of the emotion and gift received suggested that perceivers need to interpret the target's emotions in order to infer the antecedent event.

Cassidy, et al. (2015) extended this study to examine how well perceivers make retrodictive inferences depending on whether target stimuli were videos or static photographs capturing the apex of their reaction on receiving the gift. The experiment was divided into two sessions – one for the dynamic stimuli and one for the static stimuli. Perceivers were asked to infer the gift the targets received, and the emotion the targets experienced upon receiving the gift. The static photographs appeared on the screen without any time restrictions until the perceivers responded. As with the results in Cassidy et al.'s (2013) study, perceivers were able to infer systematically the gifts the targets received, thus suggesting that the perceivers associated the appropriate emotions for the specific condition. However, there were differences in performance between the conditions when comparing between static and dynamic stimuli. Perceivers diagnosed with autism performed significantly better in recognising genuine and feigned positive emotions for static stimuli than dynamic, but were less accurate for the confused emotional reactions. This finding implied that dynamic information is required for autistic individuals when understanding confused emotional reactions, while static images were more effective when interpreting genuine and feigned positive emotions. Cassidy and colleagues (2015) suggested that these findings could be explained by the variability in targets' behaviour for the various emotions. By presenting a static image of a genuine or feigned emotional reaction, the stimulus only represents the emotion consistent with the gift without any mixed reactions such as that of transforming from a confused one to a fake smile for the monopoly money condition. Therefore, Cassidy and colleague's (2015) study demonstrated the underlying

difficulties of emotion processing for individuals with autism, and how the nature of the stimuli could have a significant impact on the perceivers' mentalising ability.

One of the benefits of the retrodictive mindreading paradigm, similar to North et al.'s (2010) task, is that it closely resembles real-life scenarios where people understand the behaviour of others without having to label the mental state. As mentioned previously, the retrodictive mindreading paradigm allows researchers to investigate people's ability to infer subtler and more complex behaviour and emotions, since it is uncommon and complicated to label a person's behaviour with specific mental states when the behaviour can represent a mix of thoughts and emotions. Thus, by labelling behaviour, it may interfere with people's spontaneous ability to mentalise (Pillai et al., 2012). Furthermore, by measuring perceivers' performance in judging what caused the target to behave a certain way, it allows researchers to compare performance against an objectively correct response without having to rely on cataloguing the inner mental states of targets (e.g. emotions). In addition, this paradigm also employs the use of dynamic stimuli instead of static images, where target's spontaneous reactions towards the experimenter are recorded, creating subtler and more ecologically valid stimuli (Pillai et al., 2012).

Like Cassidy et al. (2013), Pillai et al. (2012) used the retrodictive mindreading paradigm to investigate perceivers' ability to infer what happened to targets based on a brief sample of targets' reactions. The study used video stimuli of targets' natural reactions to four different social scenarios involving the experimenter: 1) Joke: experimenter told a simple joke to the target (e.g. "Why did the woman wear a helmet at the dinner table? Because she was on a crash diet!"), 2) Waiting: the experimenter kept the target waiting for approximately five to eight minutes while she busied herself with various tasks (e.g. making a phone call) in front of the target, 3) Story: experimenter shared a story of a series of unfortunate events that happened to

her earlier the day (e.g. flash drive malfunctions), and 4) Compliments: experimenter complimented the target at the start of the experiment (e.g. “You’ve got really good hair, what shampoo do you use?”). Forty target videos were edited into shorter clips (duration between 3.64 to 8.96 seconds) and muted. The clips were edited based on the most expressive reactions. Perceivers were then shown a short video clip of each of the four scenarios to give them a better idea of the conditions. Perceivers then watched the video stimuli and were asked to infer the antecedent scenario based on their observations of the targets’ behaviour. The study demonstrated that perceivers were able to systematically infer the cause of targets’ behaviour, suggesting that we were sensitive enough to infer that what happened caused a subtle and spontaneous reaction towards a third party. This led Pillai and colleagues to suggest that this retrodictive ability that we possess enables us to make sense of the behaviour of others, and to benefit indirectly from their experiences. One could argue that perceivers merely ‘matched’ targets’ behaviour to the appropriate scenario without having to mentalise at all. However, this seems implausible since the behavioural reactions varied between targets for the different scenarios, therefore making it difficult for perceivers to simply match a scenario to a specific reaction.

From Pillai et al.’s (2012, 2014) and Cassidy et al.’s (2013, 2015) studies, it is clear that adults are capable of discriminating the cause or antecedent event from briefly observing the spontaneous behaviours of others. This implies that by being able to retrodict, we are able to use the minds of others to access a part of the social world that is not directly observable to us, thus, demonstrating the functionality of mentalising. Aside from predicting the behaviour of others through mentalising, we are able to use this skill to infer what happened previously to the target without having to witness or experience the event first-hand.

What else could we learn from observing the behaviour of others? How else is this ability to understand the world through the minds of others beneficial? As infants, we have learned that by following the eye gaze of others, we not only demonstrate that we could acknowledge that there might be something else happening outside of our own world or view, but we are able to use this knowledge from observing others to learn about the physical world. Such ability emerges very early in development in a basic form known as 'social referencing' where people use emotional information to understand "an event that is otherwise ambiguous or beyond that individuals' own intrinsic appraisal capabilities" (Sorce, Emde, Campos, & Klinnert, 1985). Sorce et al. (1985) used a modified visual cliff as the ambiguous event, and 12-month old infants were observed to examine whether they would look at the mother's face, and use the mother's emotional expression to guide their behaviour to either approach or avoid the deep side of the cliff. The study demonstrated that if a mother expressed joy or interest, most infants would cross the deep side, but not when the mother expressed fear or anger. When in the absence of depth, few infants gauge the mother's reaction, and those who did, hesitate when the mother expressed fear. Therefore, at a very young age, we are able to interpret an adult's facial expression to determine whether an aspect of the world is safe or dangerous which in turn has the effect of regulating one's approach and avoidance behaviour towards that particular aspect of the world. Thus, we are able to broaden our own understanding of both the physical and social world through the minds of others.

In addition, as a child observes his/her parents' behaviour towards another individual, the child is able to learn whether the individual is approachable or considered as a threat. Therefore, from observing the behaviour of others, we are able to learn about the traits of a third party based on the way others react towards them. Moreover, by observing others we can learn about a third

party as well as a social situation or the physical world without having to directly experience any potential errors or harm.

The experiments described in this thesis employed the retrodictive mindreading paradigm to look into another broad area of investigation – perceivers’ ability to infer social context (i.e., targets were observed by experimenter, targets were left alone) that moderated targets’ reactions when watching various movie clips. Instead of focusing on the nature of the social interaction, the studies conducted for this thesis focus on an aspect of the interaction – the presence or absence of an experimenter – which has an even subtler and indirect effect on the targets’ emotional reaction to a stimulus. This will be further elaborated later in this chapter.

## **2.2 Social Context and Mentalising**

There has been a large body of research on the effects of social context on behaviour (e.g. Ekman, 1972; Fridlund, 1991; Zaalberg, Manstead, & Fischer, 2004). These studies have mainly focused on how individuals behave and express themselves differently based on the social context they are experiencing. Some individuals are seen as highly expressive and others are more reserved in various social situations (Lee & Wagner, 2002). In addition, studies have also investigated peoples’ facial expressions when they are left alone in order to observe ‘spontaneous’ behaviour without any social influences (Wagner & Lee, 1999). Kraut (1982) argued that facial expressions can thus indirectly provide information about the environment and social conditions which evoked these expressions. Furthermore, Kraut (1982) stated that if emotional facial expressions have evolved to allow individuals to communicate with one another, then one can assume that these behaviours are strongest and most informative when expressed in the presence of others. Fischer, Manstead, and Zaalberg (2003) added that not only

does social context influence the way people behave, but our behaviour also influences the social context we are in. Therefore, it is not surprising that there have been a large number of studies focusing on the effects of social context on nonverbal behaviour, especially with respect to facial expressions. However, it is imperative to point out that the studies reported in this thesis do not focus on the effects of social context on the behaviour of targets – this is something we already know about from past research; instead we are interested in examining *perceivers' ability* to detect the social context which moderated the targets' behaviour.

The studies conducted in this area of research have found that individuals tend to inhibit or exaggerate their behaviour when in the presence of others depending on the emotions felt (e.g. Killbride & Yarczower, 1980; Kraut, 1982). For instance, individuals who are experiencing negative emotions (e.g. anger, disgust) tend to inhibit their expressions (Spain, Eaton, & Funder, 2000) when in the presence of others, but exaggerate their behaviour for positive emotions (e.g. happiness, surprise - Buck, 1984; Ekman & Friesen, 1975). One of the more well-known studies in this area was conducted by Ekman (1972) who demonstrated this social context effect on behaviour with Japanese and American participants. Participants were asked to watch neutral and distressing films, either alone or in the company of an experimenter. There was no evidence of any difference between the two groups of participants in their expressions when they were alone. However, for the observed condition, Japanese participants tended to smile more than American participants when viewing distressing films.

Ekman attributed this difference in behaviour to cultural differences in display rules which are a set of rules for the types of behaviour deemed appropriate by society for various social situations (Ekman & Friesen, 1969). According to Ekman and Friesen (1969, 1975), display rules can affect our facial expressions in six different ways: intensifying, inhibiting,

masking (hiding a felt emotion with another expression), neutralising, simulation (expressing without any felt emotion), and qualifying (adding an expression to a displayed emotion).

Reissland and Harris (1991) stated that there are three requirements when using display rules: 1) individuals must have the knowledge of the types of facial expressions deemed appropriate for a specific social context, 2) they must be willing to control their facial expression, and 3) they must possess the ability to display the appropriate expression. Therefore, it seems that social context does influence people's behaviour, especially their facial expressions; hence this will not be part of our investigation and instead we will focus on *perceivers' ability* to determine the social context by observing targets' behaviour. This is an area in which relatively little research has been conducted to date in examining how capable people are in interpreting how the behaviour of others is moderated by different social contexts (Philippot & Yabar, 2005).

### **2.3 Gender Differences and Mentalising**

There has been a longstanding debate on whether there are any differences in performance between male and female perceivers in mentalising. Folk psychology has always supported that females are better mind readers than males (Krach et al., 2009). Furthermore, past research has demonstrated that females have better emotional understanding than males (Dunn, Brown, & Beardsall, 1991), and that females displayed more frequent and developed form of mental-state talk than males (Hughes & Dunn, 1998).

This difference in performance between genders led Baron-Cohen (2002) to propose the Empathising/Systemising (E/S) theory of Psychological Sex Differences where a typical male brain is viewed to be more systematic (i.e., able to derive underlying rules that govern the behaviour of a system) while a typical female brain is viewed to be more empathising. Baron-

Cohen and Wheelwright's (2004) study further supported this theory when they found that females scored higher than males in the measure of one's ability to empathise. In addition, females scored higher than male perceivers in the "Reading the Mind in the Eyes" test (Baron-Cohen et al., 2001). A meta-analysis on gender differences in emotion recognition from facial expressions found that 80% of the studies showed a female advantage (Hall, Carter, & Horgan, 2000). However, recent studies have found no gender differences in emotion recognition (Grimshaw, Bulman-Fleming, & Ngo, 2004). It was suggested that the inconsistency across studies may be due to the differences in the nature of the stimuli used (e.g. intensity of the expressions) (Hoffman, Kessler, Eppel, Rukavina, & Traue, 2010). Moreover, Ickes, Gesn, and Graham (2000) argued that gender differences in empathy-related tasks are only found when perceivers are aware that they are being measured on an empathy related quotient, and/or when empathy related gender-role obligations or expectations are made obvious during the task.

With theory of mind tasks, Banerjee (1997) investigated gender differences on the development of theory of mind and found that girls performed better than the boys on a task which measures the understanding of emotional display rules and in one of two conditions on an 'appearance-reality' task. Similarly, Bosacki and Astington (1999) showed that 11-year-old females performed better in the assessment of story characters' feelings and motives than the male participants. A few studies with adults have found some evidence that females were better at mentalising than males (e.g. Baron-Cohen & Hammer, 1997; Baron-Cohen, Jolliffe, Mortimore, & Robertson, 1997). However, other studies failed to find this female advantage (Jarrold, Butler, Cottington, & Jimenez, 2000). Additionally, Gopnik argued that hundreds of theory of mind studies with children found no gender differences were found (Nash & Grossi, 2007).

Due to the conflicting nature on whether females are better mind readers than males, the studies described in this thesis will investigate whether there are any gender differences in performance. This will shed a light on whether the female or male perceivers are better at inferring social context from observing the target's behaviour or both genders will yield a similar pattern of results.

#### **2.4 Eye-Tracking and Mentalising**

Joint attention is crucial for the development of social relationships with others (Freeth, Foulsham, & Kingstone, 2013). Since joint attention is often achieved in the visual modality, understanding people's eye movement behaviour as they perceive faces and the behaviour of others is vital and may provide information about their ability to mentalise (Hernandez et al., 2009).

One of the main methods of examining eye movement behaviour is eye-tracking (Karatekin, 2007). Eye-tracking enables an unobtrusive and continuous measure of visual and cognitive information processing (Lykins, Meana, & Kambe, 2006). Since visual attention can be defined as selectively attending to information from one region at the cost of other regions in the same visual field (Henderson, 1992), research in the area of visual attention has primarily focused on fixations (i.e., periods of time when the attended region is relatively still) (Lykins et al., 2006). For instance, Stoesz and Jakobson (2014) showed that children fixate less on dynamic faces than adults after adding more characters to a stimuli, suggesting that the processing of socially complex scenes are more challenging for children than adults (Holmqvist et al., 2011). Moreover, research in eye movements during face perception have demonstrated that people fixate longer on internal features (i.e., eyes, nose, mouth) than external features (i.e., hair, ears,

forehead, face contour) (Althoff & Cohen, 1999; Itier & Batty, 2009). Various studies have found that people attended to the eye region the most as compared to the other facial features when perceiving various factors such as facial expressions, identity, and gender (e.g. Baron-Cohen, 1995; Henderson, Williams, & Falk, 2005; Itier & Batty, 2009; Schyns, Bonnar, & Gosselin, 2002).

We developed the ability to use the eyes and face of others as a source of social information when attributing the mental states of others at an early age (Itier & Batty, 2009). For instance, Baron-Cohen (1995) found that a four-year old is able to infer that someone is thinking about something when they looked upward, to nothing in particular. Baron-Cohen, Wheelwright, and Jolliffe (1997) and Baron-Cohen, Wheelwright, Hill, Raste, and Plumb (2001a) created the 'Reading the Mind in the Eyes' task using photographs of only the eye region to evaluate adults' ability to mentalise, and also in children (Baron-Cohen, Wheelwright, Spong, Scahill, & Lawson, 2001b). The task involves participants to choose one out of four mental states (e.g. jealous, puzzled, reassuring) that best describes the stimulus of the eye region. This task is particularly useful in discovering any impairment in mentalising for clinical populations such as individuals with autism spectrum disorders. This prompted Baron-Cohen and colleagues (1997, 2001a) to suggest that gaze direction is vital for mentalising.

Recent research in theory of mind began to use implicit theory of mind tasks to further our understanding of the way we process social events (e.g. Kovács, Téglás, & Endress, 2010; Onishi & Baillargeon, 2005). For example, Southgate, Senju, and Csibra (2007) found that two-year-olds preferred to look at the location which the actor believes the ball to be during a free-viewing false-belief task. With a growing number of eye movement research revealing that infants as young as seven to 15 months old have an understanding of the mental states of others

(e.g. Onishi & Baillargeon, 2005; Surian, Caldi, & Sperber, 2007). This challenges the long-standing view that children are only able to pass the false belief task from the age of four (Perner & Lang, 1999). This led to Apperly and Butterfill's (2009) proposal that there are two distinct systems used to develop one's theory of mind. The first system is responsible for the monitoring of the mental states of others in the social world which developed earlier and operates implicitly, independent of the development of executive function and language. The second system is responsible for conscious (explicit) theory of mind inferences, and is dependent on domain-general cognitive functions.

Pillai et al. (2012, 2014) and Cassidy et al. (2013, 2015) have incorporated eye-tracking with their studies in order to understand how people infer the causes of a reaction by studying perceivers' eye movement behaviour. Both of Pillai et al.'s (2012, 2014) studies revealed that perceivers varied their eye movements according to the scenarios the targets were experiencing, therefore suggesting that perceivers discriminate between the scenarios on an implicit level, by employing different eye movement strategies for different scenarios. In Pillai and colleagues' (2012) study, perceivers tended to focus on the mouth in preference to the eyes of the targets across all four scenarios. However, for the waiting scenario, perceivers preferred to attend to the eyes more than the mouth of the targets when compared to the other three scenarios, implying that the targets' eye region captures the attention of perceivers more in the waiting scenario than for the other scenarios. Pillai et al. (2012) suggested that the increase in duration of fixating on the eye region might have been caused by the eye gaze behaviour of the targets in the stimuli. Targets in the waiting scenario seemed to be distracted by their surroundings more than in the other scenarios. Therefore, perceivers are influenced by cues in targets' behaviour, which might cause them to attend to the regions that will provide the most relevant information when

mentalising. Pillai et al.'s (2014) study demonstrated similar eye gaze patterns for the story, joke and compliment conditions except for the waiting condition where perceivers focused on the mouth and eyes region equally.

Cassidy et al.'s (2013) study also demonstrated that perceivers' eye gaze patterns differed depending on the gift the targets received. Perceivers tended to focus more on the mouth than the eyes when observing targets who received the homemade novelty and chocolate as gifts. Conversely, they attended to the eyes more than the mouth for the monopoly money condition.

In summary, eye-tracking studies give us an insight to where perceivers tended to fixate when observing the target's behaviour. Moreover, research in theory of mind has begun to use eye-tracking as part of their investigation to further understand the development of theory of mind. These studies also showed that by examining people's eye movement strategies, we are able to learn about the visual processes when people mentalise and that we are sensitive to the behavioural cues of others which in turn impact our ability to mentalise.

## **2.5 Aims of the Thesis**

As explained, with the retrodictive mindreading paradigm, researchers are now able to explore people's ability to mentalise on the basis of subtle and spontaneous behaviour of others. By employing this paradigm, we are able to learn not only about perceivers' mentalising capabilities, but the processes involved in making these inferences. The research described earlier in this chapter demonstrated that we are able to use the minds of others to learn indirectly about the social world. The experiments presented in this thesis focus on further exploring this capability that we possess, but instead of focusing on what we are able to infer from a target's interaction with an experimenter, we aim to investigate a more complex and subtle aspect of

social interaction – are we able to detect the absence or presence of a person (i.e., the social context) from observing its effects on the target’s behaviour?

Since a large body of research have focused on how social context modifies one’s behaviour, it will be useful to examine people’s ability to detect the social context (i.e., its modification in behaviour). It is useful to know whether we have the ability to detect social context since this will influence the way we would approach a social situation, whether the environment is a friendly or threatening one, whether the unobservable third party is someone who is trustworthy or threatening. We believe that people are able to make these judgments based on the studies in the area of social context. Since people behave according to the social context they are in, either due to their awareness of the social display rules, or their intention to react differently in various social situations because of self-preservation, by being aware of how we ourselves react to different social contexts, we could use this knowledge to simulate the target’s mental states, in order to infer the social context which modified the observed behaviour. Therefore, we have employed the retrodictive mindreading paradigm in this thesis.

In addition, we have incorporated the use of film clips to evoke certain emotional reactions during the creation of the target stimuli in order to provide a context which targets have something to react to, and how these reactions are modified by the presence or absence of the experimenter. Therefore, the study described in Chapter Three will focus on the development of the target stimuli, as well as, whether perceivers’ emotion recognition judgments are sensitive to the social context the targets experienced. Chapter Four focuses on investigating perceivers’ ability to explicitly discriminate the social contexts, and this experiment led us to suppose that targets’ expressiveness may affect the perceivers’ inferences of the social contexts. Based on research conducted in the social context area, it is often shown that people tend to inhibit their

expressions of negative emotions when in the presence of others than when they are alone, whereas for positive emotions, people tend to exaggerate their behaviour in the presence of others than in the absence of others. Therefore, one of the experiments described in Chapter Four investigates perceivers' ratings of targets' expressiveness and whether their ratings reveal any discrimination between the two social contexts. Two pilot studies were created in Chapter Five to examine whether there is a direct relationship between perceivers' judgments of the social contexts, and their ratings of targets' expressiveness.

As demonstrated by Cassidy et al.'s (2013, 2015) and Pillai et al.'s (2012, 2014) studies, it is worthwhile to measure perceivers' eye movement strategies since it reveals a rich set of information about the processes perceivers employ when mentalising. Hence, the experiments described in Chapter Six are replications of those in Chapter Four, with the addition of eye-tracking and limiting the number of target stimuli used to help focus the investigation of perceivers' capability in discriminating social context from observing the behaviour of targets. This led to creating subtler target reactions as stimuli in order to gauge the robustness of perceivers' ability to infer social context, and whether the mere presence of an experimenter who was not directly observing the targets is sufficient for perceivers to detect that the target was accompanied (Chapter Seven).

Perceivers' explicit judgments of the social context in these experiments will inform us of their accuracy rate, in other words, their ability in using the minds of others to learn about the unobservable social context. As explained in Chapter One, it is useful to not only learn about how accurate people are at making social judgments, but how they made these judgments. Hence, the eye-tracking technique will be used to give us an insight into perceivers' sensitivity to the social context experienced by targets, and whether such sensitivity is implicit in their eye

movements. In addition, since there may be gender differences in perceivers' ability to mentalise, the experiments described in this thesis will look into this factor to examine whether it will have any impact on perceivers' performances.

## **CHAPTER THREE: STIMULUS DEVELOPMENT**

### **3.1 Introduction**

The present study adapted the retrodictive mindreading paradigm used in Pillai et al.'s (2012) and Cassidy et al.'s (2013) studies. Since this research focuses on perceivers' ability to infer social contexts from observing a brief sample of targets' behaviour, when creating the target stimuli, we draw upon an area of research which has been widely investigated – the effect of various social contexts on the behaviour of individuals, especially facial expressions. Most of the studies conducted in this area of research use movie clips as the emotional stimuli (e.g. Ansfield, DePaulo, & Bell, 1995; Zhang & Parmley, 2011) and the role of the observer in creating a social context.

In the current study, we employed this method of using movie clips to evoke emotional reactions from targets that we loosely assumed were associated with Ekman's six basic emotions (i.e., anger (irritation), disgust, fear, happiness (amusement), sadness, surprise) and neutral as the targets experienced two different social contexts (i.e., alone, observed). It is neither easy nor ethical to cause a target to become angry but it is perhaps more acceptable to make them irritated. This was achieved by presenting a video clip containing a repetitive noise and image which probably caused irritation instead of anger. Similarly, it is not easy to evoke happiness through a video clip but we can evoke the feeling of amusement through a funny scene from a comedy TV show. One of the advantages of using Ekman's basic emotions as a point of reference to compile movie clips was that it provided a set of expected reactions from targets, and this might have narrowed targets' behaviour into categories.

The main aim of the research was not to investigate whether perceivers were able to infer the emotions targets experienced, instead we investigated whether perceivers were able to identify the social context the targets were experiencing. In this chapter, we focus solely on how the target stimuli were developed to be used in later experiments.

In Experiment 1a, participants were asked to rate various movie clips which best represent the basic emotions, of which two video clips per emotion were selected for Experiment 1b. This stage resembled that of a validation process where the video clips selected in this experiment would be used in the next experiment as stimuli. In Experiment 1b, targets' reactions to the movie clips as moderated by the social contexts were recorded and edited to be used as target stimuli. Lastly, in Experiment 1c, perceivers were asked to identify the emotions targets were experiencing to validate the effectiveness of the stimuli developed, and whether perceivers' responses revealed any differences between the two social contexts targets experienced.

### **3.2 Experiment 1a: Validation of Movie Clips**

The aim of this experiment was to narrow down the most effective set of movie clips to evoke irritation, disgust, fear, amusement, sadness, surprise, and neutral from targets in the stimuli development stage. In addition, this stage ensured that the clips selected were not subject to experimenter bias since the clips selected were not solely based on the experimenter's decision or intuition of what was considered as the effective clips to evoke the selected emotions. By asking participants to rate the intensity of the emotions felt from viewing the video clips, we were able to pinpoint the most and least effective clips. This also ensured the effectiveness and established confidence in the movie clips to evoke the targeted emotions since the selected video

clips would be based on the consensus of a group of individuals. Once the movie clips were chosen, they were then edited and presented to the targets in Experiment 1b.

### **3.2.1 Participants**

Twenty-four university students (17 females, 7 males) between the ages of 18 to 30 years ( $M = 20.1$ ,  $SD = 2.4$ ) volunteered to participate in the study. Written informed consent was obtained from all participants, and the experiment was approved by the University of Nottingham Malaysia Campus Ethics Committee.

### **3.2.2 Materials and Apparatus**

Thirty-four video clips were obtained from various movies and YouTube with the intention of evoking seven different emotions (i.e., irritation, disgust, fear, amusement, neutral, sadness, surprise - see Appendix 1 for the complete list of video clips used). The movie clips were all freely available and varied in duration between one to 13 minutes long. For every emotion, five different video clips were presented with the exception of neutral with only four video clips (links to the clips are provided in the reference section). These videos were divided randomly into two sets and were presented via PsychoPy (Version 1.74.01; Peirce, 2012) on a 18.5-inch HP Compax LE1902x monitor with a resolution of 1366 x 768 pixels at a data sampling rate of 60 Hz. Participants were then asked to fill in the response sheet after viewing each clip.

### **3.2.3 Design**

This study was a between-subjects design in which participants were randomly divided into two groups to view one of the sets of 17 different movie clips.

### **3.2.4 Procedure**

Participants sat in front of the desktop at a distance which was comfortable for them. The movie clips were presented using PsychoPy in a randomised order. Every clip was only shown once. After watching each clip, participants filled in the response sheet and were asked to select how they felt when viewing the video clip from a choice of seven alternatives (i.e., anger, disgust, fear, happy, neutral, sad, surprise). They were also asked to rate on a 7-point Likert scale, the intensity of the emotion evoked from viewing the clip, and to briefly describe the scene from the video clip which evoked the emotion they stated. These responses were used to assist with the selection and editing of the most effective movie clip. Upon completion, participants were debriefed.

### **3.2.5 Results and Discussion**

The data were coded for the frequency of the emotions selected for each clip and intensity ratings were averaged across the number of participants who selected the same emotion for each clip (Table 1). The brief descriptions provided by the participants were coded based on the segments of the clips mentioned.

Table 1

*Frequency of the emotions selected for each clip (mean intensity) for Experiment 1a.*

Emotion/ Clip	Anger	Disgust	Fear	Happy	Neutral	Sad	Surprise
Anger 1	6 (4.6)			4 (4)	1 (4)		1 (7)
Anger 2	7 (4.86)				5 (4)		
Anger 3	1 (5)			4 (3)	4 (4)	3 (3)	
Anger 4	9 (4)				3 (4)		
Anger 5	8 (4.63)				4 (4)		
Disgust 1		9 (6.56)	3 (6.67)				
Disgust 2		11 (5.64)	1 (5)				
Disgust 3		10 (5.1)			1 (4)		
Disgust 4	1 (6)	10 (6)	1 (7)				
Disgust 5		12 (6.08)					
Fear 1			11 (6.55)				1 (7)
Fear 2			10 (5.7)				2 (4.5)
Fear 3			10 (5.7)				2 (6.5)
Fear 4		1 (4)	8 (4.88)	1 (5)			2 (4)
Fear 5		1 (7)	7 (5.29)				4 (5.75)
Happy 1				12 (5.83)			
Happy 2				12 (5.42)			
Happy 3				12 (5.5)			
Happy 4				11 (5.27)	1 (4)		
Happy 5				12 (6.08)			
Neutral 1	1 (4)				8 (4)	2 (2.5)	1 (2)
Neutral 2				2 (4)	9 (4)		1 (6)
Neutral 3				2 (4)	10 (4)		
Neutral 4				1 (6)	10 (4)	1 (5)	
Sad 1						12 (6.5)	
Sad 2						12 (6.09)	
Sad 3						12 (6.17)	
Sad 4						12 (5.33)	
Sad 5				2 (5)		9 (6)	1 (5)
Surprise 1	1 (5)		4 (6.25)				7 (5.33)
Surprise 2		2 (6.5)	2 (4.5)				8 (5.13)
Surprise 3			3 (3.67)		1 (4)		8 (6.38)
Surprise 4			7 (6)				5 (5.6)
Surprise 5			5 (4.4)	1 (5)			6 (5.33)

A total of 14 video clips were selected. These video clips shared the highest consensus and intensity among participants and this was done by dividing the mean intensity with the number of participants who selected the same emotion. The following movie clips were selected: two clips from YouTube to evoke irritation (anger) (metallicKuma, 2009; Shurken12345, 2008), a clip from the movie 127 Hours (Colson & Boyle, 2010), and Excision (Lewis & Bates Jr., 2012) to evoke disgust, two clips from Insidious (Blum, Peli, Schneider, & Wan, 2010) to evoke fear, two scenes from the TV series, FRIENDS (Bilising-Graham, et al., 2004; Buckner & Halvorson, 2004) to evoke amusement (happiness), two clips from the documentary Secrets of Middle-Earth: Inside Tolkien's 'Lord of the Rings' (Bott & Gormlie, 2003) were chosen to evoke neutral, a scene from Marley & Me (Netter, Rosenfelt, & Frankel, 2008) and a Thai advertisement (Thai Life Insurance, 2011) to evoke sadness, and lastly, a clip from Britain's Got Talent (Hurford-Jones, 2009) and an advertisement from Germany (mrsmithereen, 2005) were selected to evoke surprise.

The selected clips were edited with Windows Live Movie Maker to a shorter duration based on the brief descriptions provided by participants, and a 15 seconds black screen was added before the start of every clip as a resting period between clips for targets in later experiments.

By selecting the movie clips based on participants' ratings, it ensured the effectiveness of the clips and avoids the problem of experimenter bias. One of the limitations of this experiment was that participants were given a choice of seven emotions to select from. This lack of flexibility in responding may have swayed participants' answers from what they genuinely felt from watching the video clips. Therefore, to obtain a more accurate and reliable representation of participants' mental states from viewing the clips, participants should be allowed to freely

respond, and from there we could narrow their responses to fewer categories and ask another group of participants to choose the response that best matches their mental state. Moreover, by forming a list of categories based on participants' description of their mental states, it would provide a closer representation of the way people describe their mental states in real life than using the list compiled by Ekman which might seem rather constrained in some instances.

However, the purpose of this research is not necessarily to evoke the six basic emotions; rather, these emotions are just a point of reference in creating stimuli that will allow us to determine if perceivers who observe the reactions of targets watching the movie clips can guess whether they were alone or being observed. On that basis, the 14 movie clips selected for future experiments seem fairly effective in evoking the targeted emotions.

### **3.3 Experiment 1b: Development of Target Stimuli**

The focus of this experiment was to create a set of dynamic stimuli to be used in future experiments. Participants for this experiment – from here on referred to as the targets – were instructed to watch the movie clips selected in Experiment 1a as they were subjected to two social conditions (i.e., observed by the experimenter, left alone in the room). Targets' reactions were recorded throughout the experiment.

#### **3.3.1 Targets**

Forty-three students (22 males, 21 females) aged between 18 and 24 ( $M = 19.5$ ,  $SD = 1.7$ ) were recruited from the University of Nottingham Malaysia Campus. Targets were of different nationalities: 31 Malaysians, 2 Chinese, 2 Pakistani, 2 Indians, 1 Singaporean, 1 Egyptian, 1

Syrian, 1 English, 1 Sri Lankan, and 1 South Korean. Written informed consent was obtained from all targets.

### **3.3.2 Materials and Apparatus**

The selected 14 movie clips were presented in full screen in a randomised order via PsychoPy (Version 1.74.01; Peirce, 2012) on a HP Elite Book 8460p laptop. The laptop's HD Webcam was used to record the targets during the experiment. Targets sat approximately 0.6 meters from the laptop's screen to ensure that the targets' face, neck and shoulders were captured.

### **3.3.3 Design**

This experiment used a repeated-measures design where all targets watched all 14 video clips and were subjected to both social conditions (observed, alone).

### **3.3.4 Procedure**

A spacious room within the School of Psychology was used. Targets were tested individually and sat with their back against a white wall, while the experimenter sat across the table. Upon arrival, targets were informed that the task was to watch various video clips and rate what they felt from each clip. Every target experienced two conditions (i.e., observed, alone) presented in a counterbalanced order. For the 'observed' condition, the experimenter sat across the table from the target ostensibly to observe target's behaviour as they watched the videos. During the observation, the experimenter was wearing a lab coat, scribbled notes on a clipboard and made no communication with the target. In the 'alone' condition, the experimenter left the

target alone in the room to watch the videos after making an excuse to leave (*“I have an important phone call to make, I’ll be right outside, just come and look for me once you’re done”*).

The 14 video clips were divided into two blocks for the two conditions (i.e., observed, alone) with seven clips in each block designed to evoke certain emotions (i.e., irritation, disgust, fear, amusement, neutral, sadness, surprise). The clips were presented only once in a randomised order using PsychoPy. The presentation of the two blocks of video clips was counterbalanced across targets to avoid any confound in the content of the videos and the emotions across the conditions. Since the aim of the study was to record targets’ spontaneous behaviour, the webcam was set to record when targets entered the room, hence they were unaware that they were being filmed when completing the task.

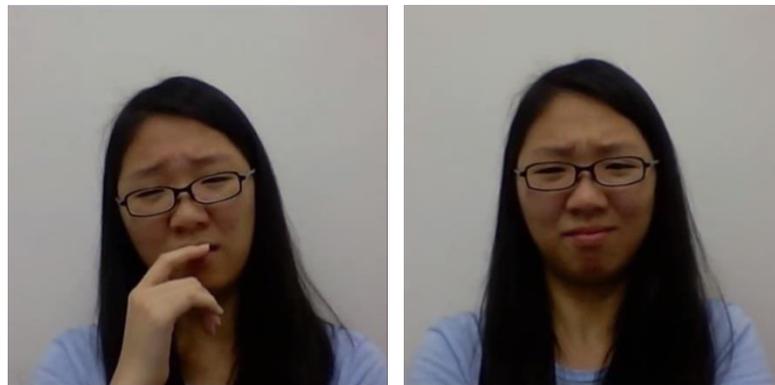
As a ‘decoy activity’, after each video, targets had to select a response out of seven choices (anger, disgust, fear, happy, neutral, sad, surprise) that best represented their emotion from watching the video, and rate the intensity of the emotion on a 7-point scale, 1= *least intense* and 7 = *most intense*. These responses were presented on the screen in a rating scale format, and targets responded by using the mouse.

Upon completion of the task, targets were debriefed about the true nature of the experiment, and given the opportunity to ask questions. Written consent was obtained from targets to use their recorded behaviour for subsequent parts of the research.

### **3.3.5 Editing**

The video recordings of targets’ behaviour were edited to capture their reactions using video-editing software – Windows Live Movie Maker and VirtualDub (Version 1.9.11; Lee,

2010). The reactions for each video clip were edited based on the descriptions made by participants in Experiment 1a as the most emotionally intense part of the video clip to prevent any experimenter bias in selecting the most reactive behaviour. The edited clips were muted in case the audio revealed the context the targets were experiencing. They varied in duration between two to 14 seconds. The video frame was cropped to 500 pixels for both width and height, showing only the target's head to the top of their shoulders against a white wall (Figure 1). The rate of presentation was 29 frames per second. Only videos of Asian targets were used, out of which ten (five males, five females) were randomly selected. The use of Asian targets only was not intentional but due to the use of convenience sampling during the recruitment of targets. Therefore, a total of 140 videos were used as target stimuli, where every target had 14 videos generated that comprised of two videos for each of the seven emotions.



*Figure 1.* Examples of target stimuli. Target was watching videos that were intended to evoke the feeling of disgust when target was alone (left) and observed (right).

### **3.4 Experiment 1c: Testing the Effectiveness of Target Stimuli**

This experiment was designed to investigate the effectiveness of the target stimuli developed in Experiment 1b, and perceivers' sensitivity to the social contexts the targets were

experiencing by asking perceivers to infer the emotions based on targets' reactions. The main focus of this experiment was not to investigate whether perceivers could identify the emotions experienced by the targets; rather we concentrate on perceivers' sensitivity to whether the targets were observed or alone based on targets' reactions.

Past research (e.g. Ansfield, 2007; Ekman & Friesen, 1982) has mainly focused on how people express their emotions in different social contexts. For instance, many have found that individuals tended to express more in the company of others than alone when experiencing positive emotions (e.g. happiness, surprise) and people express less when experiencing negative emotions (e.g. disgust, fear) in the presence of others as compared to when they were alone. In addition, research examining the function of facial expressions – whether they are a “readout” (Buck, 1984) of a person's internal state (i.e., emotions) or they are an expression of one's social intentions (behavioural ecology view) (Fridlund, 1991) indicated that facial expressions are influenced by various factors which include the person's social intentions and internal mental state. Hence, the function of facial expressions should not be viewed as exclusive to one factor or the other. Drawing from these studies, we hypothesised that perceivers' responses in identifying the emotions the targets were experiencing would be influenced by the social conditions the targets were in.

### **3.4.1 Participants**

Fifty-five (26 males, 29 females) university students between 18 and 32 ( $M = 22.5$ ,  $SD = 2.6$ ) were recruited for this experiment. Perceivers were of different nationalities: 39 Malaysians, 1 Chinese, 7 Sri Lankans, 4 Vietnamese, 1 South Korean, 2 Indians, and 1 Sudanese. Six of perceivers' (2 males, 4 females) data were excluded from the analysis due to technical error

during the recording of the responses or because they stated that they knew one or more of the targets personally. All perceivers gave their written informed consent to take part in the experiment.

### **3.4.2 Materials and Apparatus**

A total of 140 target stimuli created in Experiment 1b were presented randomly in two separate blocks (male targets, female targets) using PsychoPy (Version 1.74.01; Peirce, 2012). Each stimulus was only displayed once. The task was conducted on a 14-inch screen, HP Elite Book 8460p laptop.

### **3.4.3 Design**

This experiment was a 2 (Condition: observed, alone)  $\times$  7 (Emotion: irritation, disgust, fear, amusement, neutral, sadness, surprise) repeated-measures design with gender of perceivers as a between-subjects factor.

### **3.4.4 Procedure**

All perceivers were tested individually in a controlled environment where they were instructed to identify which emotion the target in the video was expressing. The presentation of the two blocks of stimuli was counterbalanced across perceivers. After each stimulus, perceivers had to select the emotion the target in the stimulus was expressing from a choice of seven responses presented in a rating scale format by using the mouse (Figure 2) at their own pace. The responses were recorded automatically by PsychoPy. A fixation point (+) appeared in the centre of the screen for two seconds after every response before the presentation of the next stimulus.

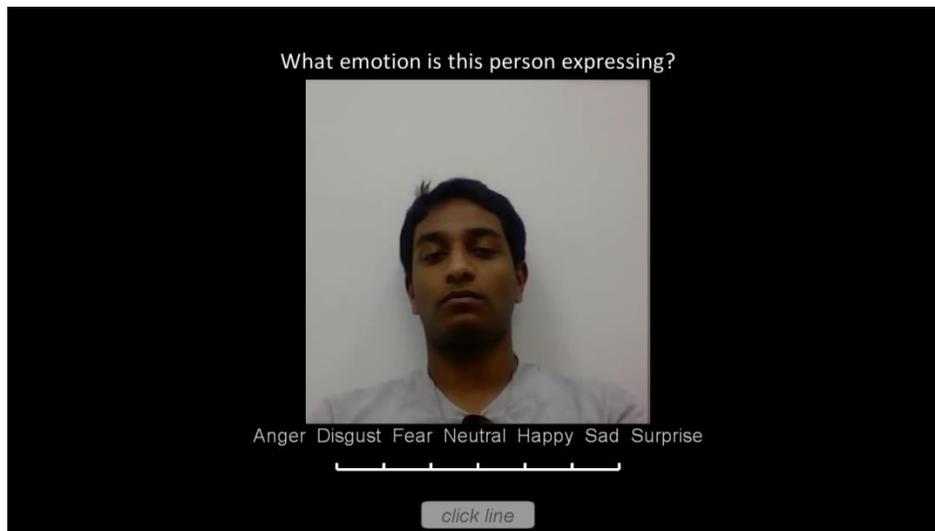


Figure 2. Screenshot of the task in Experiment 1c where perceivers had to select the emotion they thought the target was expressing by selecting one of the seven choices.

### 3.4.5 Results and Discussion

To examine whether perceivers' judgements of the emotions expressed by targets were influenced by the social conditions targets were experiencing, the responses were scored based on perceivers' correct responses for each stimulus, and these scores were grouped for the seven different emotions for the two different conditions.

One-sample t-tests were conducted on the accuracy rates for the seven different emotions for both social conditions to investigate whether perceivers were able to perform above the level of chance, with a test value = 1.43. The test value was 1.43 because there were a total of 10 targets for each emotion and condition, and if perceivers performed at the level of chance, they would be correct 1 out of 7 for each stimulus. It was found that for all emotions and conditions, perceivers were able to make correct judgments above chance ( $ps < .001$ ), with observed and fear with a  $p$ -value  $< .05$ , and the exception of when targets were observed and irritated being significantly below chance ( $t(48) = -8.04, p < .001$ ), while for alone and irritated ( $t(48) = .67, p =$

.50), alone and surprise ( $t(48) = 1.15, p = .26$ ), and observed and sad ( $t(48) = .11, p = .91$ ), perceivers did not perform significantly above chance.

However, the main focus for this experiment was to investigate whether perceivers' judgments of targets' emotions were influenced by the social conditions targets experienced, and whether there were any gender differences in perceivers' performance, and not on how accurate the perceivers performed on the emotion recognition task. A 7 (Emotions: irritation, disgust, fear, amusement, neutral, sadness, surprise)  $\times$  2 (Conditions: observed, alone)  $\times$  2 (Gender of Perceivers: male, female) ANOVA was conducted. Effect sizes are reported as  $\eta_p^2$  for ANOVA results and are interpreted as follows;  $\geq 0.01$  is considered a small effect,  $\geq 0.06$  a medium effect, and  $\geq 0.14$  is a large effect (Cohen, 1992). There was a large significant main effect of Emotions,  $F(4.10, 192.69) = 228.67, p < .001, \eta_p^2 = .83$ , and large significant interaction between Emotions and Conditions,  $F(4.34, 204.19) = 20.03, p < .001, \eta_p^2 = .30$  (Figure 3). Posthoc paired samples  $t$ -tests indicated that perceivers were significantly more accurate when targets were alone than observed for irritation ( $t(48) = 4.88, p < .001$ ), disgust ( $t(48) = 4.14, p < .001$ ), fear ( $t(48) = 2.11, p = .04$ ), and sadness ( $t(48) = 5.38, p < .001$ ), while for amusement ( $t(48) = -6.05, p < .001$ ), neutral ( $t(48) = -2.11, p = .04$ ) and surprise ( $t(48) = -5.16, p < .001$ ), they were significantly more accurate when the targets were observed than alone. This demonstrated that perceivers' judgments of the emotions expressed by targets were influenced by the social contexts the targets experienced. It appears that perceivers' were more accurate when targets were observed than alone for the positive emotions (i.e., amusement, surprise) and neutral, and the opposite for negative emotions (i.e., irritation, disgust, fear, sadness). Is it possible that perceivers were making their judgments based on targets' expressiveness which were affected by the different social conditions and the emotions experienced? If so, this is consistent with previous studies

which found that individuals tended to be more expressive with negative emotions when alone than in the company of others, and vice versa for positive emotions.

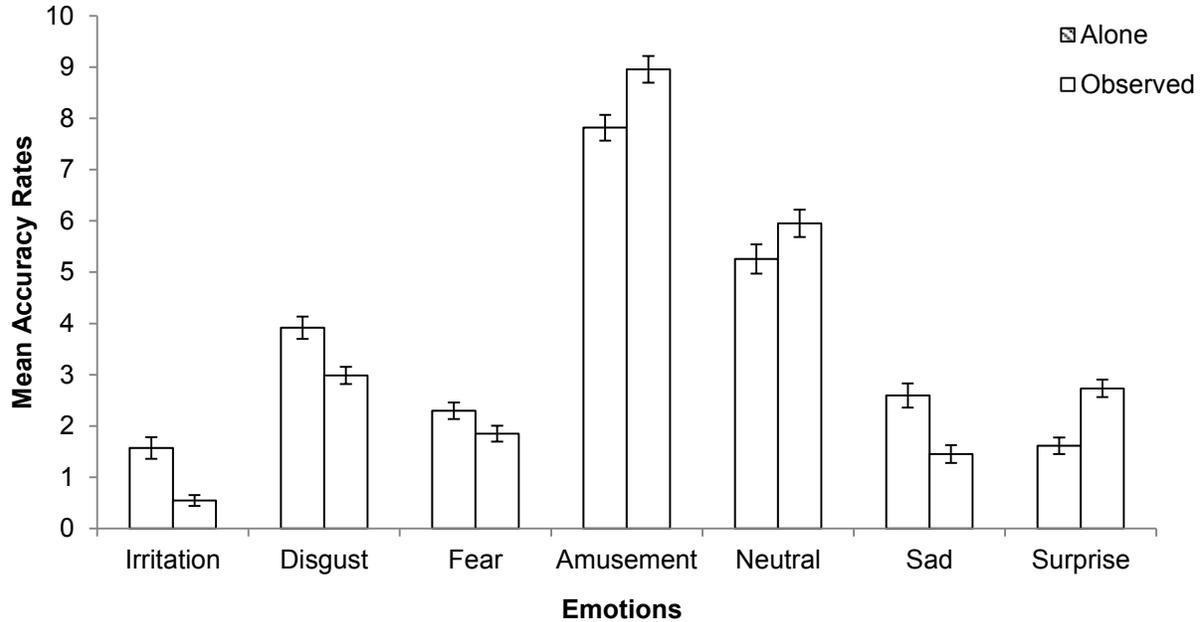


Figure 3. Mean accuracy rates for the seven emotions and social conditions in Experiment 1c. Standard errors of the mean are represented by the error bars.

There was a medium significant interaction between Emotions and Gender of Perceivers,  $F(4.10, 192.69) = 3.33, p = .01, \eta_p^2 = .07$  (Figure 4). Posthoc independent samples *t*-tests revealed that female perceivers were more accurate than male perceivers in judging targets reacting to fearful videos ( $t(47) = -5.07, p < .001$ ). Pairwise comparisons of the estimated marginal means with Bonferroni adjusted  $\alpha$  levels of the main effect of Emotions revealed that there were significant differences between perceivers' correct responses, except between fear and sadness, fear and surprise, and between sadness and surprise.

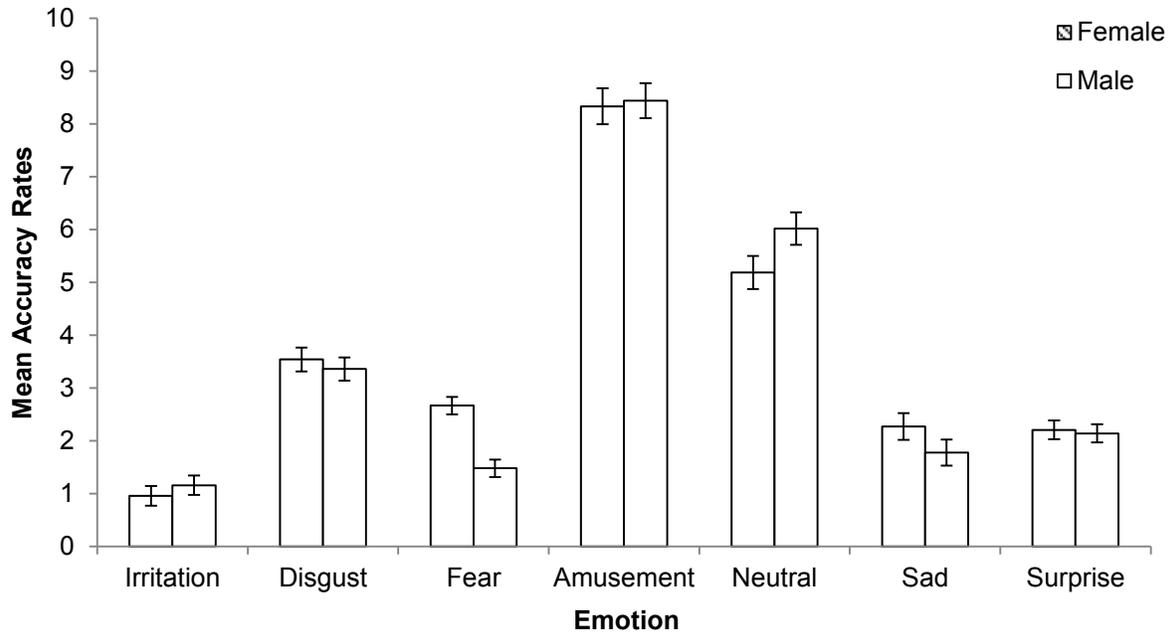


Figure 4. The mean accuracy rates of male and female perceivers for the seven emotions in Experiment 1c. Standard errors of the mean are represented by the error bars.

There was no significant main effect of Conditions,  $F(1,47) < 1, p = .37$ , no significant interaction between Conditions and Gender,  $F(1,47) < 1, p = .89$ , and no significant interaction between all three factors,  $F(4.34, 204.19) < 1, p = .62$ .

Overall, perceivers' judgments of the emotions expressed by the targets demonstrated that perceivers were sensitive to the social contexts the targets experienced. This was supported by the variations in accuracy rates between the emotions and social conditions targets experienced. These findings reflect Hess et al.'s (1995) argument that facial expressions are affected by different factors which include the target's emotions and social conditions. Hence, the function of facial expressions can be seen as a representation of the person's internal state and social intentions. This implies that perceivers' judgments of the emotions targets were expressing were influenced by the social context the targets experienced, suggesting that

perceivers are able to not only interpret the emotional expressions of others, but that their level of success in doing so is also dependent on the social contexts the targets were experiencing. Furthermore, this demonstrated the effectiveness of the target stimuli where perceivers were able to gauge the emotions of the targets and this judgment is influenced by the social contexts which modified the targets' behaviour.

**CHAPTER FOUR:**  
**INFERRING SOCIAL CONTEXT AND EXPRESSIVENESS OF TARGETS'**  
**BEHAVIOUR**

The findings of Experiment 1c described in the previous chapter, suggested that perceivers' judgments of targets' emotional displays were moderated by the social contexts (i.e., observed, alone) the targets experienced. Moreover, perceivers' accuracy rates varied across the different emotions and social contexts, which led us to question whether perceivers' judgments relied on the targets' expressiveness. In this chapter, we examined perceivers' ability to correctly identify the social contexts based on targets' reactions (Experiment 2), and whether perceivers' ratings of the intensity of targets' reactions are influenced by the target's social context (Experiment 3).

#### **4.1 Experiment 2: Inferring Social Context**

The aim of this experiment was to investigate perceivers' ability to correctly detect the social contexts (i.e., observed, alone) based on a few seconds of targets' emotional reaction (i.e., irritation, disgust, fear, amusement, sadness, surprise, neutral). In addition, this experiment also took into account the role of gender differences in the ability to interpret the targets' behaviour.

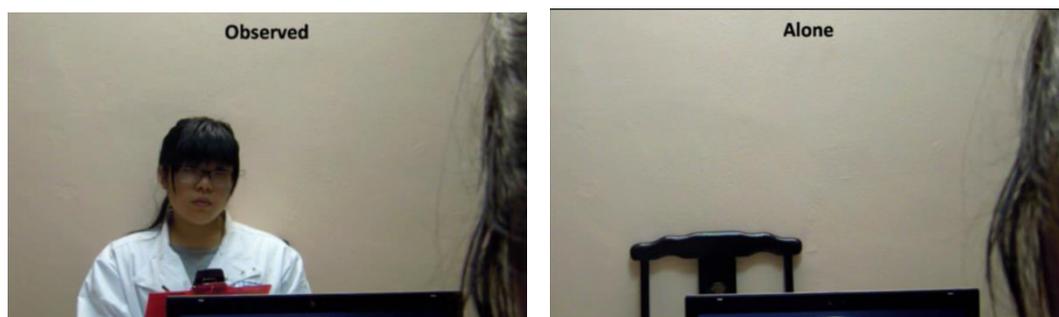
##### **4.1.1 Participants**

Fifty-one students (25 males, 26 females) aged between 17 and 36 ( $M = 20.2$ ,  $SD = 3.9$ ) were recruited from the University of Nottingham Malaysia Campus. Participants comprised of various nationalities: 42 Malaysians, 2 Indians, 2 Mauritians, 1 Indonesian, 1 British, 1

Kazakhstani, 1 Pakistani, and 1 Egyptian. Written informed consent was obtained from all participants. However, eight (six males, two females) of the participants noted that they knew one or more of the targets personally and their data were eliminated from the analysis.

#### 4.1.2 Materials and Apparatus

To demonstrate the two possible social contexts the targets experienced, the experimenter's behaviour during the stimuli development stage (Experiment 1b in Chapter Three) was recorded using a Nikon Coolpix S5100. The experimenter sat across the table from a confederate who acted as a target. The video camera was positioned next to the confederate, aimed at the experimenter to record how the social condition appeared from the perspective of the target. These recorded video clips were edited using VirtualDub (Version 1.9.11; Lee, 2010) and Windows Live Movie Maker. The clips were five seconds long with the audio muted, and were labelled at the top centre to indicate the social condition (observed, alone, see Figure 5). The video clips were 856 pixels in width and 480 pixels in height, with a rate of presentation at 29 frames per second.



*Figure 5.* An example of the stimuli presented to perceivers before viewing the target stimuli in Experiment 2 (Left: Observed condition, Right: Alone condition).

The 140 target stimuli created in Experiment 1b as described in Chapter Three were used in this experiment. The stimuli consisted of five female and five male targets reacting to videos that might elicit irritation, disgust, fear, amusement, sadness, surprise and neutral in two different social conditions (i.e., observed, alone). These stimuli were presented randomly in two blocks (i.e., male faces, female faces) via PsychoPy (Version 1.74.01; Peirce, 2012) on a 14-inch screen, HP Elite Book 8460p laptop.

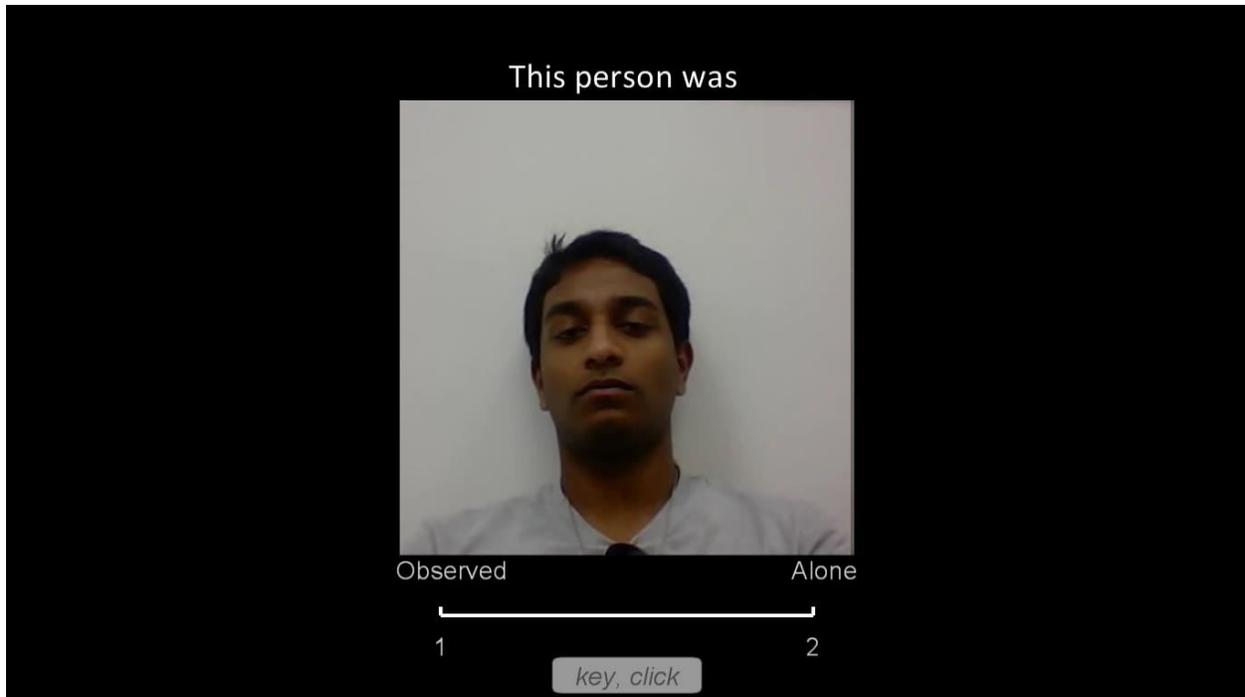
### **4.1.3 Design**

This experiment employed a 7 (Emotions: irritation, disgust, fear, amusement, sadness, surprise, neutral)  $\times$  2 (Conditions: observed, alone)  $\times$  2 (Gender of Perceivers: male, female) design where all perceivers were shown the same set of stimuli.

### **4.1.4 Procedure**

Perceivers were tested individually in a quiet room. They were presented with two blocks of stimuli which were counterbalanced across perceivers. Before the start of the experiment, perceivers were shown two videos of the experimenter's behaviour in the observed and alone condition to give perceivers an idea of the social conditions the targets experienced. Perceivers were instructed to rate whether the target was alone or observed for each of the 140 video stimuli based on the target's behaviour. A fixation point (+) was presented in the centre of the screen for two seconds to direct perceivers' attention to the screen where the next stimulus would appear. The stimuli were presented in a randomised order with each stimulus only viewed once by the participants. After every clip, perceivers were given a two-alternative forced choice question to decide whether the target was alone or observed, and were required to answer using the mouse

(Figure 6). The responses were recorded automatically by PsychoPy. Participants were allowed to answer each question at their own pace.



*Figure 6.* A screenshot of the task in Experiment 2 where perceivers had to select the social condition the targets experienced after watching each stimulus.

#### **4.1.5 Results and Discussion**

To examine whether perceivers were able to correctly detect when targets were observed or alone above the level of chance, responses were coded based on the number of correct responses for each stimulus. Table 2 shows the mean accuracy rates for the different emotions and conditions. One-sample t-tests were conducted on the accuracy rates with a test value of five, and it was found that perceivers were able to perform significantly above the level of chance when targets were observed when watching the irritation, neutral and sadness videos, and when targets were alone when watching the disgust and fear videos. However, accuracy rate does not

account for any biases in perceivers' responses (i.e., tendency to select one response over the other), thus, the responses were then coded based on the number of times perceivers responded 'observed' for the different emotions and conditions.

Table 2

*Mean accuracy rates (Standard Deviations) for the seven Emotions for Observed and Alone condition for Experiment 2.*

	Mean (SD)	
	Alone	Observed
Irritation	5.49 (2.26)	5.98 (1.73)
Disgust	3.80 (1.45)	4.79 (1.96)
Fear	6.00 (1.81)	4.79 (1.95)
Amusement	4.63 (2.37)	5.11 (2.66)
Neutral	4.65 (1.73)	5.91 (2.36)
Sadness	5.58 (2.30)	5.91 (2.42)
Surprise	5.37 (1.89)	4.79 (1.64)

A 7 (Emotions: irritation, disgust, fear, amusement, neutral, sadness, surprise)  $\times$  2 (Conditions: observed, alone)  $\times$  2 (Gender of Perceivers: male, female) ANOVA was conducted. Effect sizes are reported as  $\eta_p^2$  for ANOVA results and are interpreted as follows;  $\geq 0.01$  is considered a small effect,  $\geq 0.06$  a medium effect, and  $\geq 0.14$  is a large effect (Cohen, 1992). There was a medium significant main effect of Emotions,  $F(2.91, 119.49) = 3.29, p < .05, \eta_p^2 = .07$ , and a large significant main effect of Conditions,  $F(1, 41) = 6.61, p < .05, \eta_p^2 = .38$ . The main effect of Conditions was due to perceivers judging that the targets were observed

significantly more often when that was true than when it was not true. Pairwise comparisons of the estimated marginal means with Bonferroni adjusted  $\alpha$  levels of the main effect of Emotions revealed that perceivers tended to judge that the targets were observed significantly more for neutral than fear. In addition, there was a medium significant interaction effect between Emotions and Conditions,  $F(6, 246) = 3.36, p < .005, \eta_p^2 = .08$  which suggests that the discrimination of social conditions varied between the emotions (Figure 7). Posthoc paired-samples  $t$ -tests revealed that perceivers significantly discriminated between observed and alone for three emotions: irritation,  $t(42) = 3.53, p < .005$ , fear,  $t(42) = 2.08, p < .05$ , and sadness,  $t(42) = 5.49, p < .001$ .

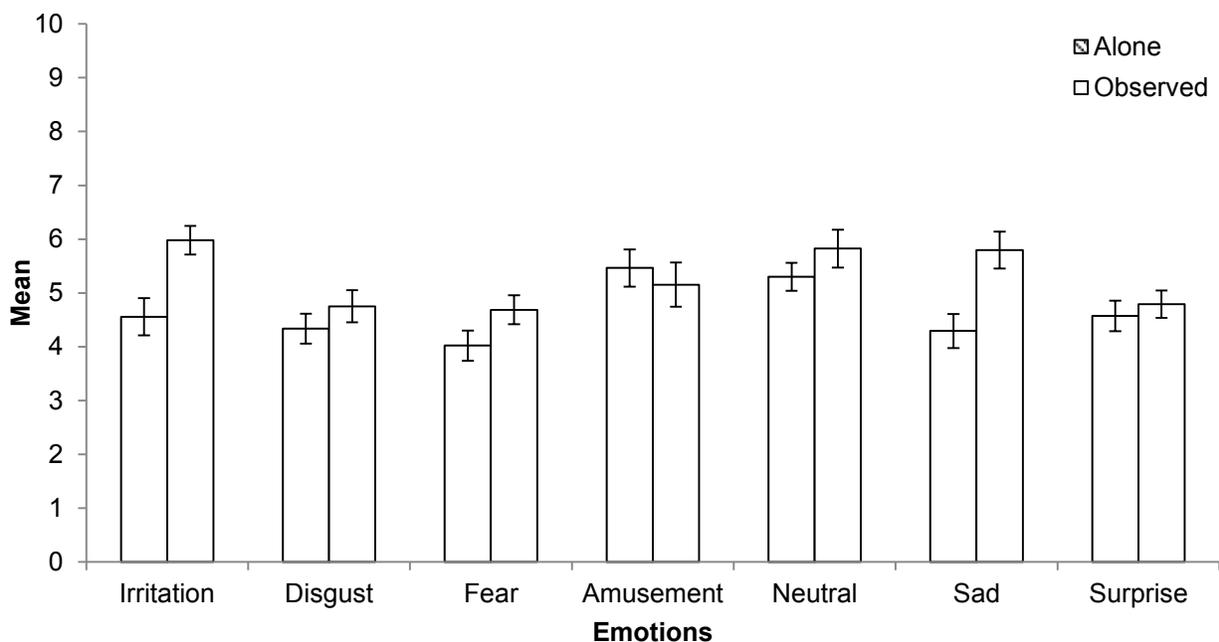
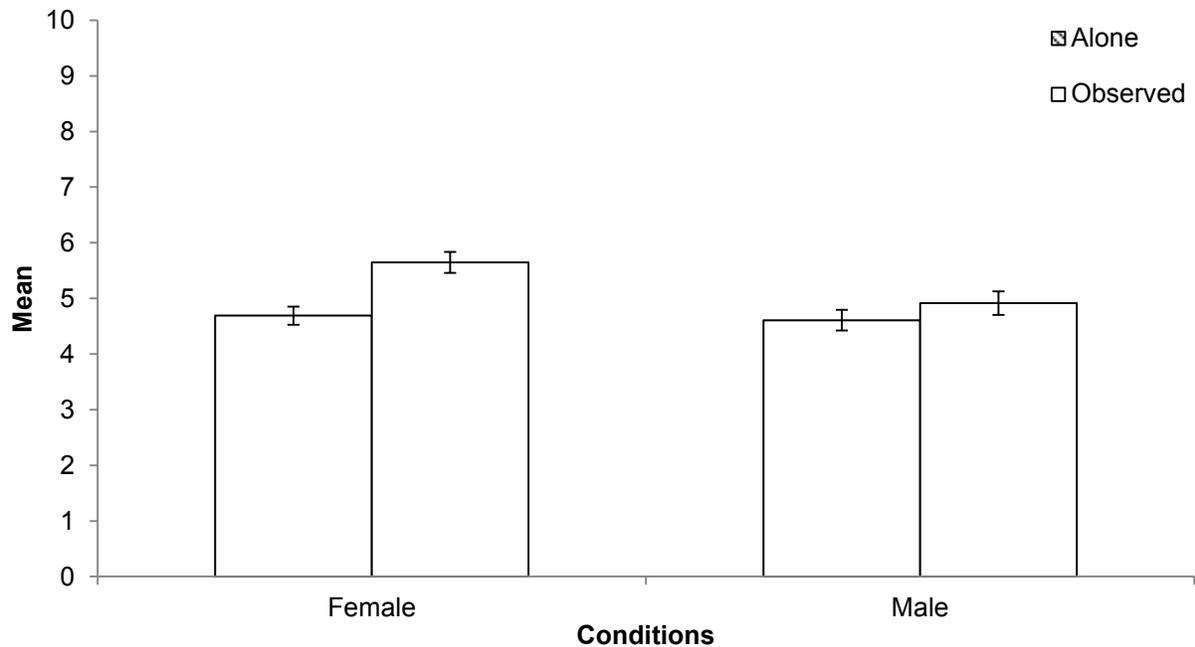


Figure 7. Mean number of times perceivers responded ‘observed’ out of 10 for alone and observed conditions in Experiment 2. Standard errors of the mean are represented by the error bars.

There was a medium significant interaction effect between Emotions and the Gender of the Perceivers,  $F(2.91, 119.49) = 4.37, p = .006, \eta_p^2 = .096$ . Posthoc independent-samples  $t$ -tests suggest that female perceivers tended to respond ‘observed’ significantly more than the male participants when targets were watching the neutral,  $t(41) = 2.30, p < .05$  and sadness,  $t(41) = 3.39, p < .005$  clips. Moreover, there was a large significant interaction effect between Conditions and the Gender of the Perceivers,  $F(1, 41) = 6.61, p < .05, \eta_p^2 = .14$  (Figure 8). Posthoc independent-samples  $t$ -tests revealed that overall, females had a higher tendency to judge targets as observed than the male perceivers,  $t(41) = 2.59, p < .05$ . Additionally, posthoc paired-samples  $t$ -tests suggest that there was a significant difference within the females judgments where they tended to respond ‘observed’ when that was true than when targets were alone,  $t(23) = 6.13, p < .001$ . Lastly, there was no significant interaction between Emotions, Conditions and the Gender of the Perceivers,  $F(6,246) = 2.05, p = .06$  suggesting there was no evidence of variation in the discrimination between the emotions and genders of the perceivers.



*Figure 8.* Mean number of times male and female perceivers responded ‘observed’ out of 10 for both social conditions in Experiment 2. Standard errors of the mean are represented by the error bars.

In summary, the findings suggest that the perceivers were able to distinguish when targets were being observed by another and when they were alone. Moreover, perceivers’ performance varied based on the emotional clips the targets watched and the social conditions they experienced: specifically when targets watched the irritation, fear and sadness video clips. Is it possible that the reactions to negative emotional videos are easier to discriminate? Did perceivers rely on the targets’ expressiveness when making these judgments?

Furthermore, could perceivers have used a low-level strategy to determine the social contexts targets experienced? For instance, did targets look away from the laptop screen (and thus the camera) and shift their gaze towards the experimenter more often in the observed than the alone condition? If so, perceivers might have inferred the social context based on the

frequency targets looked away from the screen. In order to investigate this possibility, we coded the number of times targets looked away from the screen but found no evidence to suggest that targets looked away from the screen more often in the observed than in the alone condition,  $t(58) = .63, p = .53$ . Therefore, there is no basis for suggesting that perceivers used this low-level cue to infer whether the targets were observed or alone.

#### **4.2 Experiment 3: Rate the Intensity of Targets' Expressiveness**

The purpose of Experiment 3 was to seek converging evidence in support of perceivers' sensitivity to the social context targets experienced. Past research has demonstrated that when people experience positive emotions (e.g. happiness, surprise) they tend to be more expressive when in the presence of others than when alone (Buck, 1984). On the other hand, when people experience negative emotions (e.g. disgust, fear) they tend to inhibit their expressions more when in the company of others than when alone (Spain, Eaton, & Funder, 2000). Is it possible that perceivers rely on the targets' expressiveness to discriminate between the social conditions?

In this experiment, perceivers were asked to rate the degree to which targets were controlling their expressions (inhibiting or exaggerating), with the prediction that they might interpret that targets tend to inhibit their expressions when observed by another and experiencing a negative emotion (i.e., irritation, disgust, fear, sadness) but exaggerate their expressions when being observed and experiencing a positive emotion (i.e., amusement, surprise). Lastly, we expect that perceivers might judge targets to be neither hiding nor exaggerating their expressions when observed by another or alone and experiencing a neutral emotion.

### **4.2.1 Participants**

Twenty-five male and twenty-four female university students aged between 17 and 29 ( $M = 18.7$ ,  $SD = 2.2$ ) were recruited. Perceivers were of different nationalities: 42 Malaysians, 2 Sri Lankans, 2 Pakistani, 1 Kazakhstani, 1 Indonesian, and 1 Indian. All perceivers gave their written informed consent to participate in the experiment.

### **4.2.2 Materials and Apparatus**

The 140 target stimuli used in Experiment 2 were also used in this experiment. Similarly, the stimuli were divided into two blocks (i.e., male and female faces) and were presented using PsychoPy (Version 1.74.01; Peirce, 2012). A 14-inch screen, HP Elite Book 8460p laptop was used.

### **4.2.3 Design**

A 7 (Emotion: irritation, disgust, fear, amusement, neutral, sadness, surprise)  $\times$  2 (Condition: observed, alone) repeated-measures design was used with the gender of the perceivers (male, female) as the between-subjects factor.

### **4.2.4 Procedure**

The procedure was similar to that in Experiment 2 with the exception that perceivers were not shown the videos of the two social conditions, and were not asked to detect whether targets were alone or observed. Indeed, perceivers were not given any information of the social contexts the targets experienced. After each target clip, perceivers were asked to decide the degree to which the target was controlling their expression on a rating scale of 1-7 (1 =

*inhibited... 4 = neither ... 7 = exaggerated*, Figure 9). The rest of the procedure was identical to that of Experiment 2.

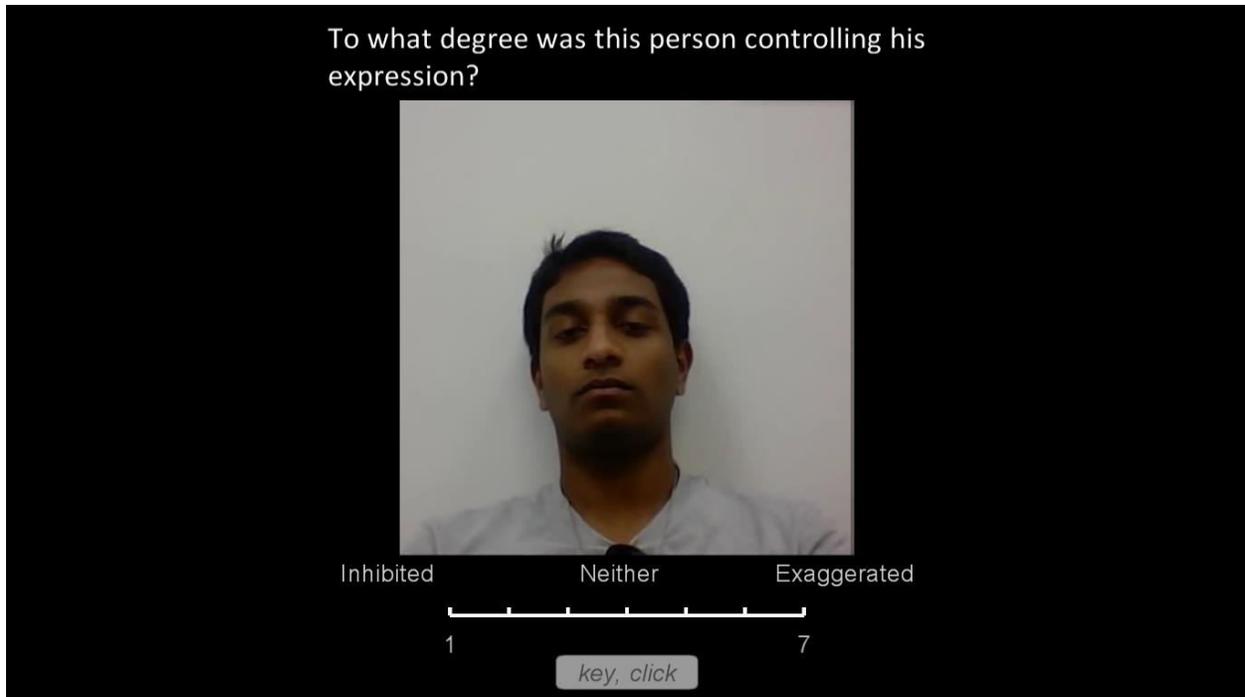


Figure 9. A screenshot of Experiment 3 where perceivers were asked to rate the intensity of the target's expressions on a rating scale of 1-7 (1 = *inhibited... 4 = neither... 7 = exaggerated*).

#### 4.2.5 Results and Discussion

Perceivers' ratings of the intensity of targets' expressions were averaged across the different emotions and conditions before conducting a 7 (Emotions: irritation, disgust, fear, amusement, neutral, sadness, surprise)  $\times$  2 (Conditions: observed, alone)  $\times$  2 (Gender of Perceivers: male, female) ANOVA. Effect sizes are reported as  $\eta_p^2$  for ANOVA results and are interpreted as follows;  $\geq 0.01$  is considered a small effect,  $\geq 0.06$  a medium effect, and  $\geq 0.14$  is a large effect (Cohen, 1992). There was a large significant main effect of Emotions,  $F(3.14, 147.70) = 85.18, p < .001, \eta_p^2 = .64$ , which resulted from perceivers judging that targets were

exaggerating their expressions more for amusement than other emotions ( $ps < .001$ ) except for disgust, and a similar pattern of judgment was shown with disgust when compared to the other emotions ( $ps < .001$ ) except for surprise. On the other hand, perceivers rated that targets tend to inhibit their expressions more when irritated than other emotions ( $ps < .001$ ) except for neutral and sadness. When targets were watching the fear clips, perceivers rated that targets tended to exaggerate their expressions more than irritation, neutral, and sadness ( $ps < .001$ ), but inhibiting when compared to disgust, amusement, and surprise. For targets who watched the sadness clips, perceivers rated them to be inhibiting their expressions more than others ( $ps < .001$ ) except when compared with irritation and neutral. Additionally, perceivers judged targets were exaggerating their expressions more in surprise than other emotions ( $ps < .001$ ) except for amusement and disgust.

There was no significant main effect of Conditions,  $F(1,47) = 2.91, p = .09$ , but there was a large significant interaction between Emotions and Conditions,  $F(6,282) = 10.10, p < .001, \eta_p^2 = .18$  (Figure 10). Posthoc paired-samples  $t$ -tests revealed a significant difference between disgust alone and observed,  $t(48) = 4.02, p < .001$ , which was due to perceivers' judgments that targets were inhibiting their expressions more in the observed than in the alone conditions. There was also a significant difference between surprise alone and observed,  $t(48) = -5.59, p < .001$ , which resulted from perceivers judging that targets were exaggerating their expressions more in the observed condition than in the alone condition. Therefore, perceivers were able to effectively discriminate whether targets were observed or alone by inferring the extent to which targets were controlling their expressions. However, these findings demonstrated that it was not always the case that perceivers judged targets were hiding their expressions more when observed than when alone; instead the direction of the effect also relied on the emotions the targets was experiencing.

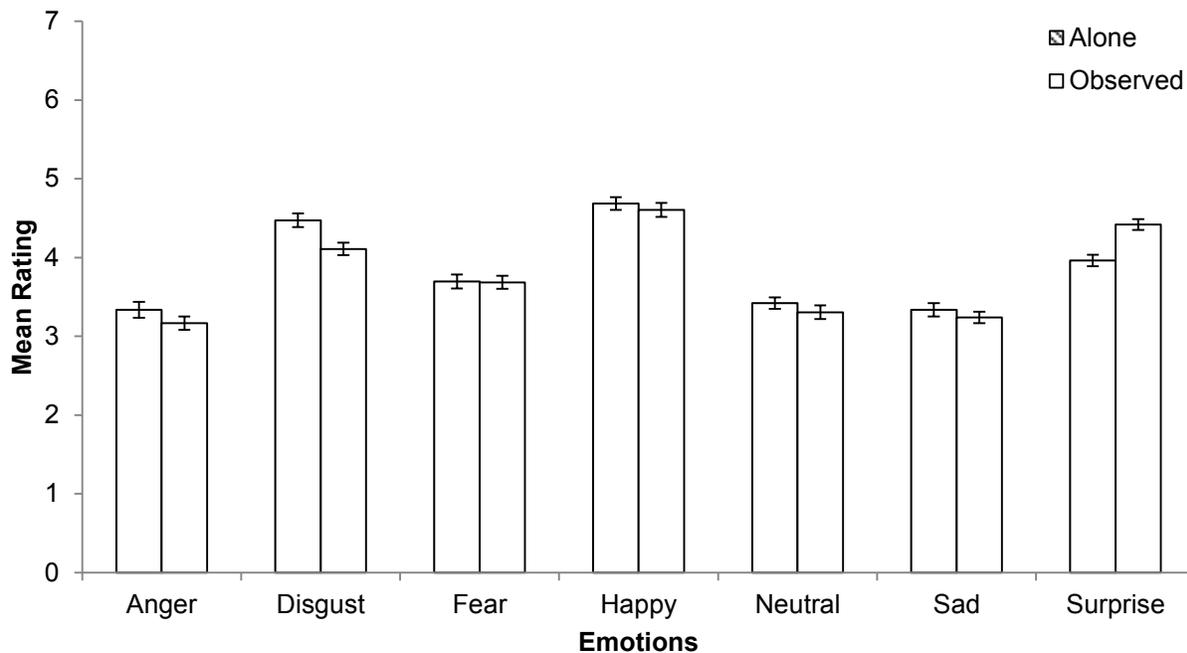


Figure 10. Mean ratings of how targets were controlling their expressions (1 = inhibited... 4 = neither... 7 = exaggerated) for the alone and observed condition in Experiment 3. The standard errors of the mean are represented by the error bars.

The gender of the perceivers did not significantly interact with Emotions,  $F(3.14, 147.70) < 1, p = .83$ , or with Conditions,  $F(1, 47) = 2.91, p = .09$ . There was also no significant three-way interaction between Emotions, Conditions and the Gender of the Perceivers,  $F(6, 282) = 1.54, p = .17$ . This suggests that there were no variation between the male and female perceivers in the way they rated the targets' expressiveness in regards to the emotions and the social conditions the targets were experiencing.

The results from this experiment were consistent with expectations. Generally, perceivers tended to judge that targets were exaggerating their expressions when experiencing a positive emotion (surprise) when observed by another than when alone. In contrast, they judged that

targets inhibited their expressions more often when experiencing a negative emotion (disgust) when observed than alone. These patterns of ratings are consistent with past research on the way individuals control their expressions in different social conditions (Buck, 1984; Spain et al., 2000), thus suggesting that perceivers were sensitive to this phenomenon and that their judgments effectively distinguished between the two social conditions targets experienced. However, these findings suggest that this effect is stronger when targets experienced certain emotions (disgust, surprise) than others. To further investigate perceivers' ability and sensitivity to detect the social conditions targets experienced based on their emotional reactions, we used stimuli where targets reacted to videos intended to evoke disgust, surprise and irritation. Even though, in the results reported above, there was no significant difference in perceivers' ratings when targets were alone and observed when watching the irritation clips, it was the only emotion approaching a significant difference,  $t(48) = 1.92, p = .06$ . Hence, in future experiments described in the next few chapters only 60 target stimuli were used. By narrowing the list of emotional expressions, this would aid in further understanding perceivers' ability in interpreting the behaviour of others in order to discriminate the social conditions others experienced.

### **4.3 General Discussion**

The purpose of the experiments described in this chapter was to investigate whether perceivers have the ability to infer social context from observing a brief sample of targets' behaviour. The results in Experiment 2 suggest that perceivers were able to distinguish when targets were alone or observed after watching targets' behaviour, especially with irritation, fear, and sadness. Therefore, implying that people are not only able to interpret the behaviour of others, but they are also able to determine the social context experienced by others.

Were perceivers using a low-level strategy to determine whether the target was observed or alone? For example, did targets look away from the screen and look up (at the experimenter) more often when the experimenter was present than absent? If so, this might have cued perceivers' judgements to the social context, without the need to interpret the target's reaction to the emotional video clips. There was no evidence to suggest that targets looked away from the screen more often in the observed than in the alone condition, suggesting that perceivers could not have used the targets' eye gaze as a clue to social context. Moreover, in Experiment 3 perceivers had no knowledge of the social context the targets experienced yet it was implicit in their ratings of targets' expressiveness that they were sensitive to the two social contexts of the targets.

In addition, perceivers' ratings of the targets' expressiveness did not reveal a similar pattern for a specific social context: for instance they did not always judge that targets tended to hide their expressions more when being observed than alone. Rather, perceivers' ratings were that targets tended to inhibit their expressions more when experiencing negative emotions (i.e., irritation, disgust) and exaggerate when experiencing positive emotions (i.e., surprise) when in the company of another. Hence, this shows that targets' reactions toward the emotional video clips were moderated by the presence or absence of the experimenter. These findings suggest that perceivers are attuned to this complex relationship between social contexts and targets' emotional expressivity. Perhaps perceivers' awareness of this link between social context and the expressiveness of an individual enabled them to discriminate between when the target was observed or alone. If so, this implies that people have a natural understanding of the relationship between social conditions and its effect on another person's expressiveness of positive and negative emotions. Granted, these findings are not sufficient to establish a direct link as to

whether perceivers' judgements of targets' social context is dependent on their judgments of the intensity of targets' emotional expressions.

In Experiment 2, we found a significant difference in performance between female and male perceivers where the females tended to judge the targets as observed when it is true more than the male perceivers. This lends its support to the debate on whether there is a female advantage in mentalising abilities (e.g. Baron-Cohen & Hammer, 1997; Bosacki & Astington, 1999) – our findings suggested that female perceivers were better at discriminating targets' social context. Does it mean that females are more sensitive to identifying subtler expressions as argued by Hall and Matsumoto (2004), thus enabling them to perform better when discriminating the target's social context? However, this possibility gained no support from Experiment 3's findings where there were no gender differences in the rating of the intensity of the target's expressions. This is similar to previous research which found no female advantage in mentalising tasks (e.g. Jarrold, Butler, Cottington, & Jimenez, 2000; Rahman, Wilson, & Abrahams, 2004). Therefore, it is difficult to conclude whether there are any gender differences in performance for our task.

In summary, Experiments 2 and 3 demonstrated that perceivers have the ability to discriminate when targets were alone and when they were observed, and that perceivers' judgments of targets' expressiveness were also moderated by the social context the targets experienced.

**CHAPTER FIVE:**  
**LINKING TARGETS' EXPRESSIVENESS WITH PERCEIVERS' ABILITY TO**  
**DISCRIMINATE SOCIAL CONTEXT**

**5.1 Introduction**

The findings reported in the previous chapter suggest that perceivers have the ability to discriminate between the different social contexts (i.e., alone, observed) from observing a target's behaviour. In other words, perceivers are able to use the clues from the target's behaviour and guess the social condition that the target was experiencing. This demonstrates people's ability to mentalise by accessing the minds (through observable behaviour) of others and indirectly learn about the social world. Moreover, from the previous chapter, we found that this ability to discriminate between social conditions might be based on an interpretation of the target's expressiveness. The findings revealed that perceivers judged targets to be inhibiting their expressions more when they were observed and experiencing a negative emotion (e.g. irritation, disgust) than when they were alone in the room. Conversely, perceivers rated that targets were more expressive when in the company of another when experiencing a positive emotion (e.g. surprise) as compared to when they were alone. These judgements of the intensity of targets' behaviour can be interpreted in the context of past research which examined the way people control their expressions in different social contexts.

For years research in the area of facial expressions has been examining how people behave and control their facial expressions in different social situations (e.g. Ansfield, 2007; Ekman & Friesen, 1982; Wagner & Lee, 1999). A series of studies found that social presence influences individuals to either inhibit or exaggerate their facial expressions depending on the

emotions they felt (e.g. Ekman, 1972, Killbride & Yarczower, 1989). For instance, people who are experiencing positive emotions (e.g. happiness, surprise) tend to exaggerate their expressions when in the presence of others than when left alone (e.g. Buck, 1984; Ekman & Friesen, 1975). Conversely, people tend to inhibit their expressions when experiencing negative emotions (e.g. anger, disgust) when in the company of others than when left alone (Spain, Eaton, & Funder, 2000). Furthermore, Ekman and Friesen (1969) claimed that our behaviour is governed by display rules (i.e., a set of rules on the types of behaviour deemed as appropriate by society for different social situations).

Therefore, we are interested in investigating the basis of perceivers' judgments on the intensity of the targets' expressiveness, and whether perceivers' ability to detect social presence or absence is based on targets' expressiveness. The two pilot studies described in this chapter were conducted to examine this.

In both pilot studies, perceivers were asked to rate the extent to which targets were controlling their expressions, followed by an open-ended question of what the perceivers thought caused the targets to control their expressions. Open-ended question was used to allow perceivers to respond in their own words (Brennan, 1997). The open-ended question was worded differently for Pilot Study 1 and 2 to investigate whether similar range of responses would be obtained from perceivers. Thus, if the range of responses from both pilot studies concurs with the suggestion that perceivers' judgment of target's social context is based on target's expressiveness, we are then able to link perceivers' ability to infer social context from targets' behaviour is based on the intensity of targets' behaviour.

These pilot studies used the same set of target stimuli as in the previous experiments, specifically for the stimuli in which the targets watched the movie clips intended to evoke

irritation, disgust and surprise. These stimuli were selected because the findings from Experiment 3 showed significant differences in perceivers' ratings of the targets' expressiveness for both disgust and surprise, with irritation approaching significance. By narrowing the number of emotional expressions to those that perceivers were more sensitive to would hopefully aid in furthering our investigation into understanding perceivers' ability to gauge social conditions from observing a brief sample of behaviour.

## **5.2 Pilot Study 1**

This pilot study was conducted to examine how perceivers make a judgment of the extent to which the target was inhibiting or exaggerating his/her expression. Perceivers were asked to rate the targets' expressiveness and what they thought caused the targets to control their expressions.

### **5.2.1 Participants**

Ten female and three male university students, all of whom were 18 years old and Malaysian, were recruited for this study. Written informed consent was obtained from all perceivers. No perceivers were excluded from the analysis of this study.

### **5.2.2 Materials and Apparatus**

Sixty of the 140 stimuli created in Experiment 1b as described in Chapter Three were used in this experiment. The stimuli consisted of ten male and ten female targets' reactions to the irritation, disgust and surprise movie clips when they were observed and when they were alone. All stimuli were presented using PsychoPy (Version 1.74.01; Peirce, 2012) on an 18.5-inch HP

Compax LE1902x monitor with a resolution of  $1366 \times 768$  pixels at a data sampling rate of 60 Hz.

### 5.2.3 Design

The pilot study was a within-subjects design where all perceivers were shown the same set of stimuli.

### 5.2.4 Procedure

Perceivers were tested individually. Before the start of the experiment, perceivers were given the response sheet and were asked to write down their answers after watching each stimulus. Perceivers were instructed to rate the extent to which the target was controlling his/her expression on a rating scale of 1-7 (1 = *inhibited*... 4 = *neither* ... 7 = *exaggerated*), and answer an open-ended question; '*What do you think caused this person to control their expression?*' after viewing each stimulus. There were no time limit for the perceivers to respond and they were able to complete the task at their own pace. Once they had responded to the questions for a stimulus, they pressed 'space bar' to proceed to the next stimulus. A fixation point (+) was presented in the centre of the screen for 1 second before each stimulus was presented.

After perceivers had completed the task, they were asked whether they knew any of the targets personally, and the data of the participants who stated that they knew one or more of the targets were excluded from the analysis.

### 5.2.5 Results and Discussion

Perceivers' ratings of the intensity of the targets' expressions were averaged across the different emotions and conditions, then analysed by conducting a 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone) repeated-measures ANOVA. Effect sizes are reported as  $\eta_p^2$  for ANOVA results and are interpreted as follows;  $\geq 0.01$  is considered a small effect,  $\geq 0.06$  a medium effect, and  $\geq 0.14$  is a large effect (Cohen, 1992). There was a large significant main effect of Emotions,  $F(2, 24) = 15.82, p < .001, \eta_p^2 = .57$ . Pairwise comparisons of the estimated marginal means with Bonferroni adjusted  $\alpha$  levels revealed that perceivers tended to rate that targets were inhibiting their expressions when viewing the irritation clip more than disgust ( $p < .005$ ), and surprise ( $p < .05$ ). There was no significant main effect of Conditions,  $F(1, 12) < 1, p = .66$ , but there was a large significant interaction between Emotions and Conditions,  $F(2, 24) = 8.70, p < .005, \eta_p^2 = .42$  (Figure 11). Posthoc paired-samples  $t$ -tests showed that perceivers tended to rate the targets to be significantly more expressive when they were alone than being observed while watching the irritation clips,  $t(12) = 2.65, p < .005$ . In addition, their ratings indicated that targets tended to exaggerate their expressions when observed by another than alone for surprise,  $t(12) = 3.29, p < .05$ .

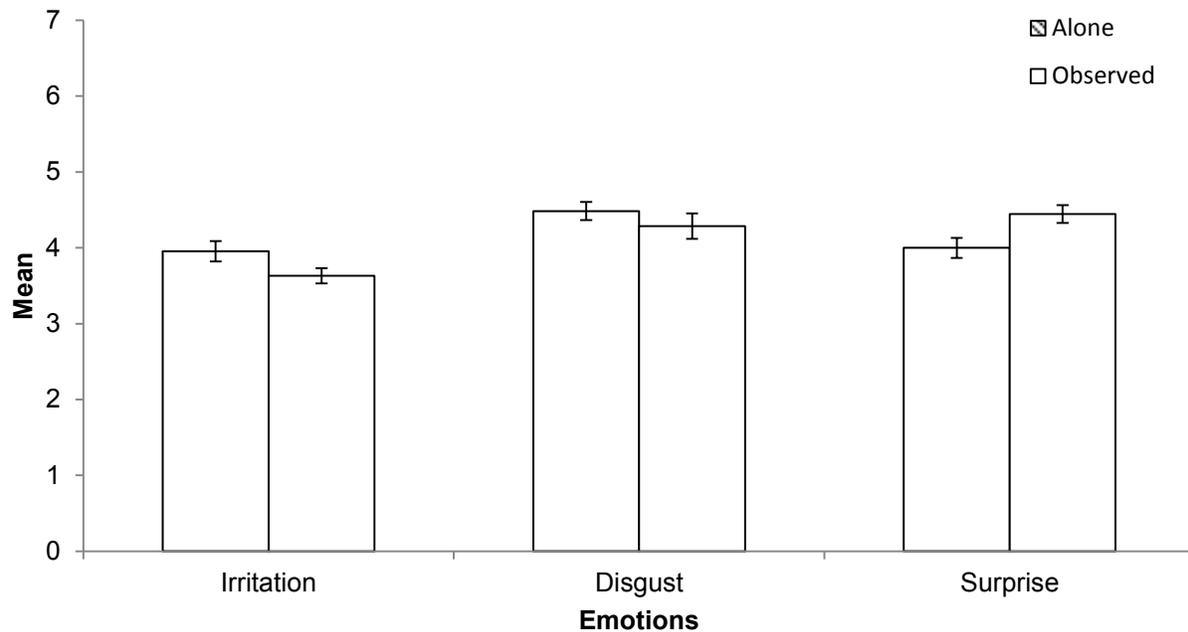


Figure 11. The mean ratings of the intensity of the targets’ expressions (1 = inhibited... 4 = neither... 7 = exaggerated) for the alone and observed condition in Pilot Study 1. The standard errors of the mean are represented by the error bars.

For the qualitative data, perceivers’ responses fell broadly into four main categories – internal, external, social condition, and event. ‘Internal’ responses referred to internal states such as mental states, emotions, etc. (e.g. ‘She’s in disbelief’, ‘She’s happy’). The ‘external’ category referred to responses involving the target’s observable behaviour such as facial expressions and body movements (e.g. ‘She is purposely doing some strange expression’, ‘Funny face’). The third category, ‘social condition’ referred to the social presence or absence (e.g. ‘Someone is watching her’, ‘Someone wants to slap her jokingly’). Lastly, ‘event’ included responses which involved other external situations or scenarios experienced by the target (e.g. ‘She is watching movie’, ‘She just hear shocking or bad news’).

Responses were coded into these four categories by two independent raters. Cohen's  $\kappa$  was run to examine if there was agreement between the two coders on the coding of the qualitative data. There was a moderate agreement between the coders for 'internal',  $\kappa = .59, p < .001$ , 'external',  $\kappa = .57, p < .001$ , 'event',  $\kappa = .60, p < .001$ , and an almost perfect agreement for 'social condition',  $\kappa = .92, p < .001$ .

Perceivers' coded responses were classified across the target stimuli for each category (internal, external, social condition, event), the conditions (observed, alone) and emotional video clips (irritation, disgust, surprise) the targets experienced. A preliminary one-way repeated measures ANOVA was conducted on the number of times perceivers referred to a particular category to investigate which category perceivers referred to more. It was found that there was a large significant main effect of Categories,  $F(2.14, 25.67) = 14.38, p < .001, \eta_p^2 = .55$ . Pairwise comparisons with Bonferroni correction revealed that perceivers tended to refer to targets' mental states than the social condition or external events ( $p < .005$ ). Furthermore, it was found that perceivers referred to the external events more than the social condition ( $p < .05$ ).

Separate 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone) repeated-measures ANOVA were conducted for the four Categories (i.e., internal, external, social condition, event) (Figure 12). Gender was not included in the analysis due to the unequal number of male and female perceivers.

For 'internal', there was no significant main effect of Emotions,  $F(2, 24) < 1, p = .45$ , and no significant main effect of Conditions,  $F(1, 12) = 1.16, p = .30$ . There was a large significant interaction between Emotions and Conditions,  $F(2, 24) = 6.43, p < .05, \eta_p^2 = .35$ . Posthoc paired-samples  $t$ -tests suggested that perceivers tended to refer to the mental states more often when targets were alone than observed when viewing the surprise video clips,  $t(12) = 3.42, p < .05$ .

For 'external', there was no significant main effect of Emotions,  $F(2, 24) < 1, p = .98$ , no significant main effect of Conditions,  $F(1, 12) < 1, p = .35$ , nor was there a significant interaction between the two factors,  $F(2, 24) = 2.05, p = .15$ .

For 'social condition', there was a large significant main effect of Emotions,  $F(2, 24) = 6.00, p < .05, \eta_p^2 = .33$ . Pairwise comparisons using Bonferroni correction revealed that perceivers tended to refer to the social conditions of the targets significantly more when targets were feeling irritated than disgust ( $p < .05$ ). Conversely, there was no significant main effect of Conditions,  $F(1, 12) < 1, p = .74$ , and no significant interaction between Emotions and Conditions,  $F(1.30, 15.59) < 1, p = .47$ .

Lastly, for 'event', there was no significant main effect of Emotions,  $F(2, 24) = 2.55, p = .10$ , Conditions,  $F(1, 12) < 1, p = .54$ , and no significant interaction between the two factors,  $F(2, 24) = 3.53, p = .05$ .

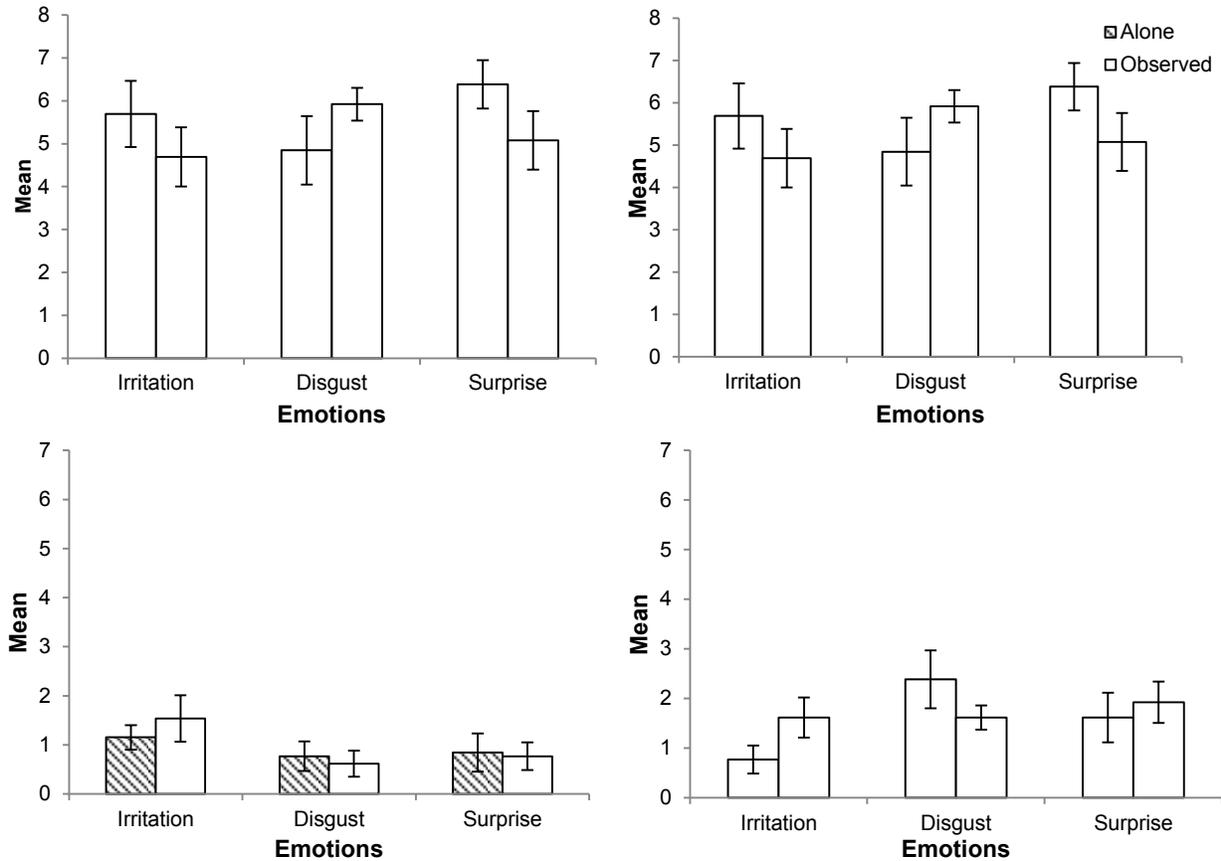


Figure 12. Mean frequency of perceivers' responses coded into the four Categories (internal, external, social condition, event) for alone and observed condition for the different emotions in Pilot Study 1. The standard errors of the mean are represented by the error bars. (Top left: Internal, Top right: External, Bottom left: Social Condition, Bottom right: Event).

In summary, perceivers' ratings of the intensity of targets' expressions were similar to that found in the previous experiment, where perceivers judged that targets tended to inhibit their expressions when viewing a disgusting clip while being observed than alone, and when viewing a surprise video alone than observed. However, perceivers' descriptive responses as to what they thought caused the targets to control their expressions suggest that perceivers' tended to refer to the internal mental states (e.g. emotions the targets felt) of the targets rather than referring to the

social conditions or any external events that the targets experienced. However, when perceivers' qualitative responses were examined more closely, no distinctive pattern was found within each category between the emotions and social context, indicating that perceivers did not lean on a particular explanation when asked what caused the targets to control their expressions.

### **5.3 Pilot Study 2**

This pilot study was conducted to investigate how perceivers judge the extent to which the target was inhibiting or exaggerating his/her expression, similar to that of Pilot Study 1 with the difference being the open-ended question. Perceivers were asked to rate the targets' expressiveness and why they thought the targets were controlling or not controlling their expressions.

#### **5.3.1 Participants**

Eleven university students (4 males, 7 females) were recruited for the study. All perceivers were Malaysian and aged 19 years old and all gave their written informed consent.

#### **5.3.2 Materials and Apparatus**

The study used sixty target stimuli similar to those used in Pilot Study 1. The video stimuli were presented randomly via PsychoPy (Version 1.74.01; Peirce, 2012) on an 18.5-inch HP Compax LE1902x monitor. The screen resolution was set to  $1366 \times 768$  pixels and stimuli were presented at a data sampling rate of 60 Hz.

### 5.3.3 Design

A repeated-measures design was used for this experiment where all perceivers were shown the same 60 target stimuli and then asked the same questions after each stimulus.

### 5.3.4 Procedure

The procedure was identical to that in Pilot Study 1 with the only difference being the open-ended question. After rating the extent to which the target was controlling his/her expression, perceivers were asked, *'Based on your answer above, why did you think the person was controlling or not controlling his/her expression?'*

### 5.3.5 Results and Discussion

Perceivers' ratings of the intensity of the targets' expressions were averaged across the three different emotions (i.e., irritation, disgust, surprise) and conditions (i.e., observed, alone). These were then subjected to a 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone) repeated-measures ANOVA (Figure 13). Effect sizes are reported as  $\eta_p^2$  for ANOVA results and are interpreted as follows;  $\geq 0.01$  is considered a small effect,  $\geq 0.06$  a medium effect, and  $\geq 0.14$  is a large effect (Cohen, 1992). The analysis revealed a large significant main effect of Emotions,  $F(2, 20) = 10.83, p < .005, \eta_p^2 = .52$ . Pairwise comparisons with Bonferroni correction showed that perceivers judged that targets inhibited their expressions significantly more for irritation than disgust ( $p < .05$ ) and surprise ( $p < .005$ ). However, there was no significant main effect of Conditions,  $F(1, 10) = .05, p = .83$ , and no significant interaction between the two factors,  $F(2, 20) = 3.61, p = .05$ .

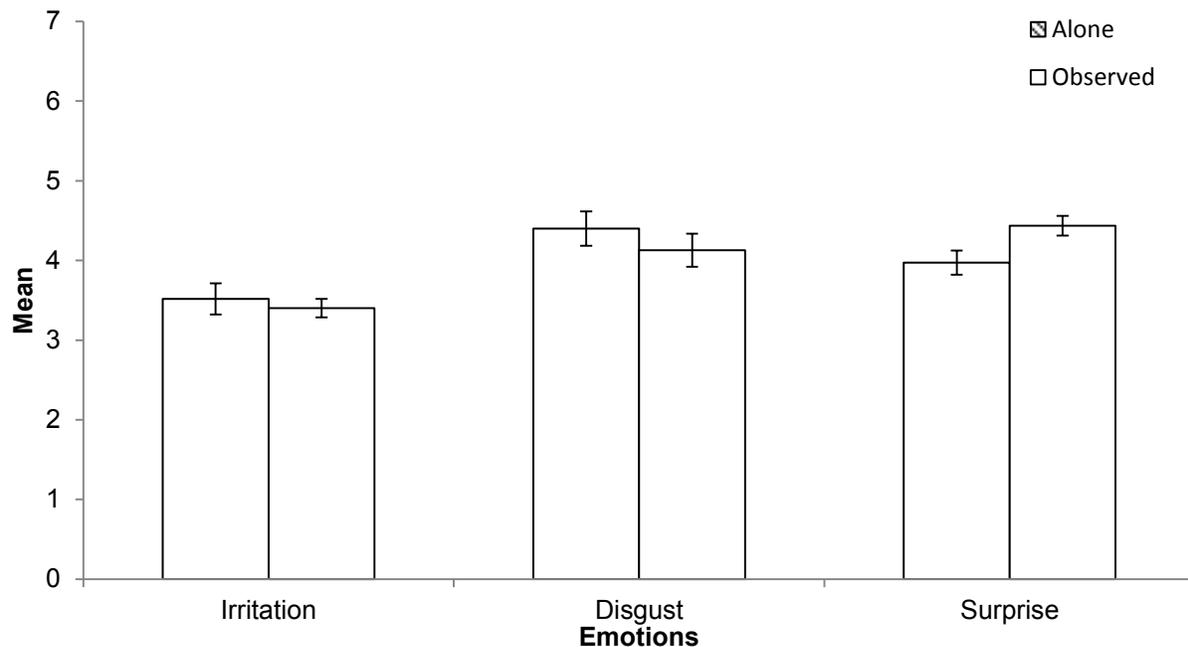


Figure 13. The mean ratings of the intensity of targets' expressions (1 = inhibited... 4 = neither... 7 = exaggerated) for the social conditions in Pilot Study 2. The standard errors of the mean are represented by the error bars.

Perceivers' descriptive responses were coded in a similar fashion by two independent raters to that described in Pilot Study 1. The responses were categorised into four groups – internal, external, social condition, and event. The first category, 'internal' referred to the target's mental states, emotions, etc. (e.g. 'She was unhappy', 'She was frightened'), while the 'external' category referred to target's observable behaviour such as facial expressions (e.g. 'Reacts too suddenly', 'Trying to laugh wholeheartedly'). 'Social condition' included responses referring to the social absence or presence of others (e.g. 'Being watched by others', 'Was alone'), and the 'event' category included responses involving any external scenarios experienced by the target

(e.g. 'Boyfriend made a joke', 'Being scolded'). Cohen's  $\kappa$  was conducted to determine if there was agreement between the two coders on the coding of the qualitative data. There was a substantial agreement between the coders for 'internal',  $\kappa = .73, p < .001$ , 'external',  $\kappa = .70, p < .001$ , a moderate agreement for 'event',  $\kappa = .60, p < .001$ , and an almost perfect agreement for 'social condition',  $\kappa = .88, p < .001$ .

A one-way repeated measures ANOVA was conducted on the number of times perceivers referred to a particular category to investigate which category perceivers referred to more. It was found that there was no significant main effect of Categories,  $F(3, 30) = 2.08, p = .12$ . Thus, indicating that perceivers did not have a specific preference to a category over the other three when asked why they thought the targets were controlling their expressions.

Separate 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone) repeated-measures ANOVA were carried out for the four different categories (i.e., internal, external, social condition, event) (Figure 14.)

For 'internal', there was no significant main effect of Emotions,  $F(2, 20) = 3.01, p = .07$ , Conditions,  $F(1, 10) < 1, p = .72$  and no interaction between Categories and Conditions,  $F(2, 20) = 1.02, p = .38$ . Similarly for 'external', there was no significant main effect of Emotions,  $F(1.23, 12.29) = 3.65, p = .07$ , no significant main effect of Conditions,  $F(1, 10) = 1.68, p = .22$ , and no interaction between the two factors,  $F(2, 20) < 1, p = .97$ .

For 'social condition', there was large significant main effect of Emotions,  $F(2, 20) = 4.96, p < .05, \eta_p^2 = .33$ . Pairwise comparisons with Bonferroni correction revealed that there was a near significant difference between irritation and surprise ( $p = .06$ ) where perceivers tended to refer to the social condition more when targets were irritated than disgusted. However, there was no main effect of Conditions,  $F(1, 10) = 1.12, p = .32$ , and no interaction between Emotions and

Conditions,  $F(2, 20) = 1.11, p = .35$ . Lastly, for the ‘event’ category, there was no significant main effect of Emotions,  $F(2, 20) < 1, p = .82$ , Conditions,  $F(1,10) < 1, p = .67$ , nor was there an interaction between the two factors,  $F(2,20) < 1, p = .69$ . Therefore, this suggests that there was no distinct pattern or preference in perceivers’ responses as to why they thought the targets were controlling their expressions.

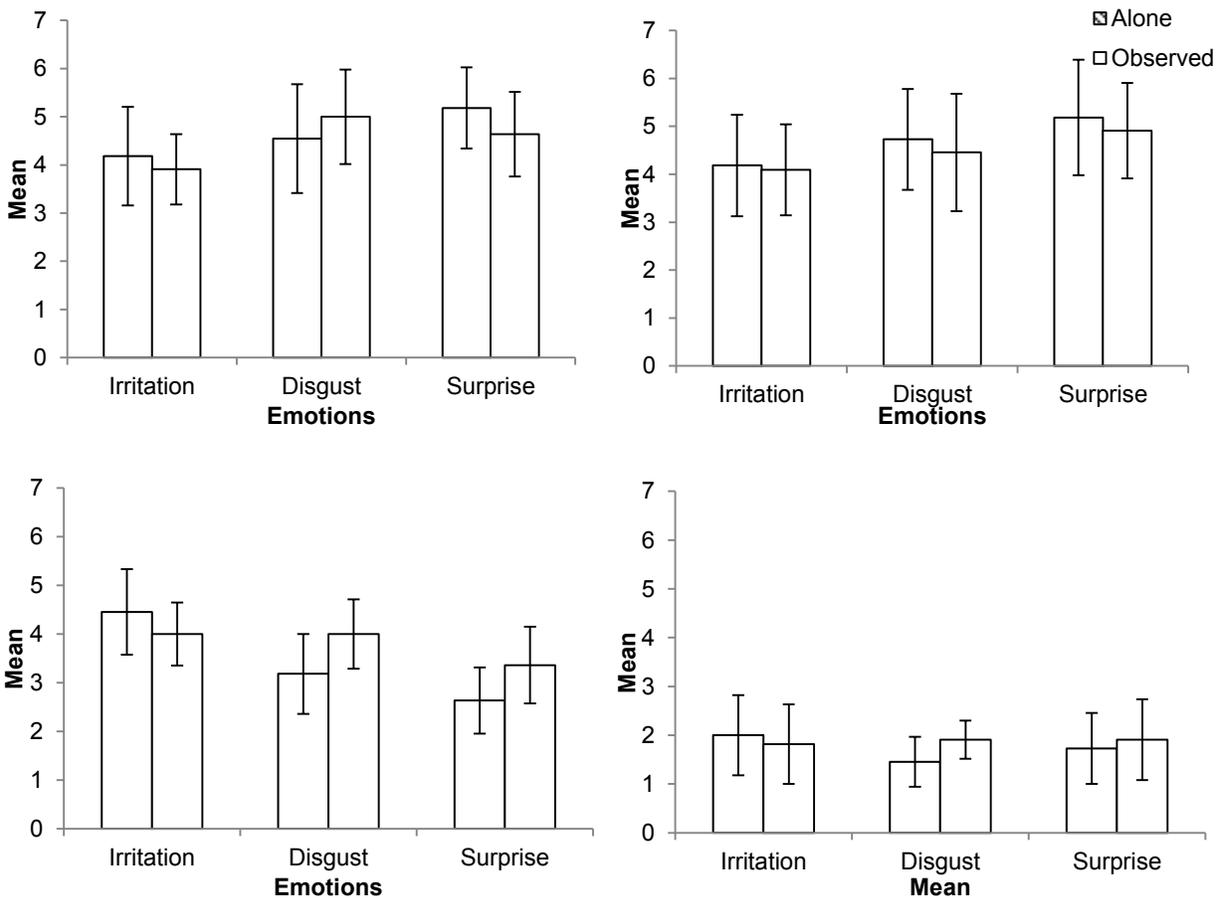


Figure 14. The mean frequency of perceivers’ responses coded into the four Categories (internal, external, social condition, event) for alone and observed condition for the different emotions in Pilot Study 2. The standard errors of the mean are represented by the error bars. (Top left: Internal, Top right: External, Bottom left: Social Condition, Bottom right: Event).

## 5.4 General Discussion

For both of the pilot studies described here, perceivers rated the extent to which the targets were controlling their expressions. The results showed a similar pattern to those obtained in Experiment 3 of Chapter Four where perceivers judged that targets tended to inhibit their expressions when viewing the irritation clips than disgust and surprise. In Pilot Study 1, it was also found that perceivers' ratings were influenced by the social conditions (i.e., alone, observed) the targets experienced, and the emotional video clips they were watching. For instance, perceivers rated that targets were more expressive when alone than observed for irritation and the opposite for surprise. These were consistent with past research on the way individuals control their expressions in different social contexts. However, in Pilot Study 2, there was no significant interaction between the Emotions and Conditions, and this could be largely due to the small number of perceivers tested, since the interaction effect was approaching significance. Nonetheless, the findings in Pilot Study 1 suggested that perceivers' ratings were moderated by the social conditions and emotional video clips that the targets experienced.

However, the main focus of these pilot studies was to gain a better understanding of how perceivers made a judgment of the expressiveness of the targets' behaviour. In particular, we are interested in discovering when perceivers judged the targets' social context is this judgment influenced by the targets' expressiveness?

From both pilot studies, perceivers' responses can be categorised into four main categories (i.e., internal mental states, external observable behaviour, social condition, external events). In Pilot Study 1, perceivers tended to refer to the internal mental states of the targets, such as the targets' emotions and intentions significantly more than the social conditions (e.g.

alone, with someone) or events (e.g. watching a movie, listening to a joke). However, this pattern of responses was not found in Pilot Study 2 where there was no distinct pattern in perceivers' descriptions of why they thought the targets were controlling their expressions.

When we examined each category's responses closely, no significant differences were found, suggesting that perceivers did not lean towards a particular category of responses when targets were experiencing a specific emotion or social context. Instead, the descriptive data suggest that perceivers' responses were largely influenced by the way the question was phrased. For instance, in Pilot Study 1, perceivers were asked what they thought caused the targets to control their expressions, and they tended to describe the emotions or intentions of the targets. Conversely, in Pilot Study 2, perceivers were asked why they thought the targets were either controlling or not controlling their expressions, and in majority of the responses, perceivers mostly referred to whether the targets were controlling or not controlling their expressions and/or describe what the targets' behaviour was, and the targets' mental states.

Furthermore, from perceivers' responses, it was clear that perceivers prefer to use the term '*hiding*' than '*inhibiting*'; hence for future experiments involving perceivers rating the targets' expressiveness, the term '*hiding*' would be used, to ensure that all perceivers grasp the concept of inhibiting an expression.

Moreover, these pilot studies suggest that asking perceivers to describe how they made a judgment of the intensity of the targets' behaviour may not be an ideal way of furthering our understanding of perceivers' ability to discriminate social conditions from observing the behaviour of others. In future studies, we should employ a more objective method of measurement, such as the eye-tracking technique which would be able to give insight to perceivers' eye movement patterns as they made these judgments. This would provide an

understanding of a more implicit nature of the way perceivers mentalise than the explicit method used in the pilot studies described here. In other words, by asking perceivers to describe or explain why they thought the targets were inhibiting or exaggerating their expressions might cue or disrupt the way perceivers would usually make such judgments. By using eye-tracking, perceivers would be able to rate the expressiveness of targets' without having to be cued to consider why exactly they have made this particular judgment, thus resembling a more realistic social situation.

**CHAPTER SIX:**  
**INFERRING SOCIAL CONTEXT AND EXPRESSIVENESS OF TARGETS’**  
**BEHAVIOUR WITH EYE-TRACKING<sup>1</sup>**

**6.1 Introduction**

Over the past century researchers have struggled to understand people’s ability to read others’ minds. This ability has variously been called *mentalising*, *mindreading*, *mind perception*, *empathic accuracy*, *mental simulation* and *theory of mind* amongst other things. Inspired by the work of Charles Darwin (1872), researchers have investigated the ability to interpret facial expressions to infer underlying psychological states and traits (e.g. Baron-Cohen, Jolliffe, Mortimore & Robertson, 1997; Wu, Sheppard & Mitchell, 2016). Such ability has great value in professional counselling as recognized by Carl Rogers (1957), who set the goal of finding people with a talent for ‘accurate empathy’, in other words the ability to infer what a client is thinking and feeling. This stimulated a research tradition extending far beyond its origins in counselling psychology to determine how accurately people can read other minds, but, according to Zaki and Ochsner (2011), the early work in the field of person perception devoted little attention to the process of *how* people read minds. Subsequently, researchers working in a different tradition investigated the development of a ‘theory of mind’ (Wimmer & Perner, 1983), and how that development might be adversely affected by autism (Baron-Cohen, Leslie & Frith, 1985). These researchers expended much effort in trying to understand the *processes* of mentalising but did not, until recently, give much attention to how accurately mature mentalisers perform (Zaki & Ochsner, 2011).

<sup>1</sup>This chapter is adapted from Teoh, Y., Wallis, E., Stephen, I. D., & Mitchell, P. *Seeing the World through Others’ Minds: Inferring Social Context from Behaviour*. Manuscript submitted for publication.

In determining how accurately a person (the perceiver) can mentalise, it is useful to know the true mental state of the person whose mind is being read (henceforth the target). West and Kenny (2011) recognize that knowing the true state of the target's mind presents a difficult problem and they champion the procedure devised by Ickes (e.g. 2001, 2009) as offering a solution. In the procedure, the target is videoed in conversation with another person. The video is then played back to the target who recalls and records what they were thinking and feeling during the conversation. Subsequently, perceivers watch the video of the target and are asked to infer what the target is thinking and feeling; they are adjudged to be correct if their responses correspond with what the target declared at any given moment.

The trouble with this procedure, though, is that it presumes that the target's mind is transparent to itself. In other words, it presumes that when the target declares that they are thinking and feeling X and Y then they are really thinking and feeling these things. Another possibility is that targets do not know or at least do not recall what they were thinking and instead merely guess at these things based on visible clues in the recordings of their own observable behaviour. If so, then investigating how well the perceiver's judgment corresponds with the target's declaration is formally the same as investigating judgments made by two independent perceivers about the behaviour of a target. Arguably, then, Ickes' procedure, although valuable in many ways, does not strictly satisfy West and Kenny's (2011) condition of knowing the target's true state against which we can then compare the perceiver's judgment.

A procedure which does satisfy West and Kenny's (2011) condition was developed by North, Todorov and Osherson (2010). In their procedure, targets were surreptitiously videoed while viewing two photographs presented one after the other. Perceivers subsequently watched the videos of the targets and were systematically able to infer which photo the target preferred

(the first or the second), presumably by recognising that the target had a more positive expression when viewing one of the photographs than the other. In this procedure, we know objectively which preference the target expressed (thus satisfying the ‘truth condition’ as defined by West and Kenny). Perhaps this raises a question about the functional purpose of mentalising as explained below.

In addition to inferring what others are thinking and feeling, how well can people use others’ minds as a lens onto an otherwise inaccessible view of the world? Such ability was fictionalised in Sherlock Holmes (Conan Doyle, 1902), who was able to observe and interpret fleeting clues in behaviour to infer what the person had been doing, where they had been and with whom. While ordinary people might not perform at the extraordinary level of Sherlock Holmes, based on findings described above, perhaps they can nevertheless achieve something similar by a matter of degree.

The mind is embodied in observable behaviour, especially in the facial expressions that are made in reaction to some event. Kraut (1982) claimed, moreover, that facial expressions potentially provide information about the environmental and social contexts that caused the reaction in the target. It is for this reason, presumably, that perceivers tested by North et al. (2010) were able to infer the preferences of targets who viewed pairs of photos. Facial expressions might also reveal other information about targets’ states and the aspects of the world they inhabit that caused those states. For example, Cassidy, Ropar, Mitchell, and Chapman (2013) reported that perceivers were correctly able to infer which gift had been offered to a target (chocolate, homemade novelty and monopoly money) by observing their reactions.

In another study, Pillai et al., (2012; 2014) examined perceivers’ ability to guess what the experimenter had said to the target after viewing the target’s reaction for a few seconds. Either

the experimenter told a joke, gave a compliment, related her difficult day or rudely used her mobile phone to speak with a friend instead of attending to the target. As with the study by Cassidy et al. (2013), perceivers were systematically able to guess what the experimenter had said to the target after observing the target's reaction for a few seconds. Perceivers were thus able to infer the antecedent event based on a small sample of the target's behaviour. This ability, known as retrodictive mindreading (Gallese & Goldman, 1998), is reputed to be a common form of mentalising that allows people to determine (a) the target's mental state and (b) what caused the mental state in question. Hence, among the various practical benefits of mentalising, one of the foremost is using another mind as a lens onto aspects of the world that are not apprehended directly. Such ability emerges very early in development in a basic form known as 'social referencing' (Sorce, Emde, Campos, & Klinnert, 1985): From about the age of 18 months it seems infants can interpret an adult's facial expression to determine their attitude on whether an aspect of the world is safe or dangerous which in turn has the effect of regulating the infant's approach and avoidance behaviour towards that particular aspect of the world.

The current study investigated a new phenomenon - people's ability to infer social context (was the target alone or accompanied by the experimenter?), along with perceivers' sensitivity to how this social context moderated target's reactions to positive or negative stimuli. The presence of the experimenter would surely have a subtle effect on the target's behaviour. A large body of research has demonstrated that individuals behave differently in different social contexts (e.g., Ekman, 1972; Fridlund, 1991; Zaalberg, Manstead, & Fischer, 2004) by inhibiting or intensifying their behaviour when in the presence of others depending on the emotions experienced (e.g., Kilbride & Yarczower, 1980; Kraut, 1982). Specifically, when individuals experience negative emotions (e.g., irritation, disgust), they tend to inhibit their behaviour

(Spain, Eaton, & Funder, 2000), but when experiencing positive emotions (e.g., happiness, surprise) they tend to be more expressive (Buck, 1984; Ekman & Friesen, 1975). We already know that social context influences people's behaviour, and re-confirming such a finding was not the purpose of the current research; rather we take it as given that social context will have an effect on the target's behaviour and we move beyond this basic assumption to explore *whether or not perceivers can determine social context from the target's behaviour*. If they could do so, then it would raise the possibility that perceivers have some understanding (implicitly or explicitly) of how social presence regulates behaviour, an understanding they might use to good effect in guessing whether the target is alone or accompanied. In so far as retrodictive mindreading is possible, it thus implicates a well-developed albeit informal understanding of social processes, such as how social presence impacts upon the way one behaves. Hence, a further aim was to shed light on the process by which perceivers made inferences of social context as elaborated below.

If perceivers understand (either implicitly or explicitly) that social presence suppresses the expression of negative emotions but intensifies the expression of positive emotions then this should be reflected not only in their judgments of whether the target is accompanied or alone; it should also be apparent in their explicit judgments of how expressive the target is. The latter was tested explicitly in Experiments 5, reported below, allowing us to test the possibility that perceivers infer social presence on the basis of sensing that targets were regulating their expressions of negative and positive emotions relative to whether they were alone or accompanied. In this respect, the current research forms a bridge between the tradition of investigating accuracy in person perception (which in the past has neglected the question of *process*) with the tradition of investigating process under the umbrella of research into 'theory of

mind' (which in the past has neglected to consider the findings of 'accuracy research' in the area of person perception).

In addition to asking perceivers to make judgments about the targets, Experiments 4 and 5 were replications of those described in Chapter Four with the addition of eye movement recordings and the use of fewer stimuli. We recorded the eye movements of the perceivers, principally to rule out any low-level strategies in judging the social context of targets. In addition to ruling out the use of low level strategies, we might also find that sensitivity to social context is implicit in more subtle features of the eye movements of perceivers. Both of Pillai et al.'s (2012, 2014) studies revealed that perceivers varied in their eye movements according to the scenarios the targets were experiencing. Pillai et al.'s (2012) study showed that perceivers tended to focus on the mouth more than the eyes for the joke, story and compliment scenarios, but for the waiting scenario, perceivers preferred to look at the eyes than the mouth. Meanwhile, Pillai et al. (2014), found similar patterns for the joke, story and compliment scenarios, but perceivers focused equally on the mouth and eyes in the waiting scenario. Cassidy et al.'s (2013) study suggested that perceivers' eye movements differed depending on the gift the targets received, where perceivers tended to look at the mouth more than the eyes when targets received homemade novelty and chocolate gifts, but focused more on the eyes than the mouth when targets received monopoly money. These studies collectively demonstrated that perceivers' sensitivity to what had happened to the target was apparent, albeit implicitly, in their eye movements.

In Experiments 4 and 5, we showed film clips to targets with the aim of evoking a range of emotions while targets experienced two different social contexts (observed, alone). Targets' reactions to the stimuli during the different social situations were video recorded and used as

stimuli. Since targets were filmed surreptitiously via the laptop's webcam, their natural and spontaneous reactions were captured unobtrusively and without awareness. This approach might have some benefits over methods in which targets were deliberately enacting emotional states (Klin, Jones, Schultz, Volkmar, & Cohen, 2002; Pillai et al., 2012). Experiment 4 investigated whether or not perceivers could correctly identify the social context based on targets' reactions. In Experiment 5, perceivers rated the degree to which targets were hiding or exaggerating their behaviour and we investigated whether the ratings varied according to the social contexts and emotions the targets experienced. Perceivers' eye movements were also recorded in both experiments.

## **6.2 Experiment 4: Inferring Social Context and Eye-Tracking**

### **6.2.1 Participants**

Seventeen male and sixteen female students aged between 18 and 23 ( $M = 19.8$ ,  $SD = 1.3$ ) were recruited from the University of Nottingham Malaysia Campus. Perceivers were of different nationalities: 28 Malaysians, 1 Hong Konger, 1 Indonesian, 2 Maldivians, and 1 Tanzanian. Perceivers gave written informed consent and were compensated RM5 for taking part. Three participants (2 males, 1 female) had less than 50 percent of their gaze sample collected by the eye-tracker and their data were excluded from the analysis.

### **6.2.2 Materials and Apparatus**

Two video clips of the experiment's behaviour during the stimuli development stage were used to demonstrate the two possible social contexts in which the targets were recorded. The details of these two clips were described in Experiment 2 of Chapter Four. Sixty of the 140 target

stimuli produced in the stimuli development stage (Experiment 1b, Chapter Three) were used. The chosen stimuli comprised of five male and five female targets watching videos that might elicit irritation, disgust and surprise as they were observed by the experimenter and when they were alone. These stimuli were presented randomly through Tobii Studio Software on a 17-inch TFT monitor integrated with the Tobii T60 eye tracking system. The participants' eye movements were recorded at a data sampling rate of 60Hz.

### **6.2.3 Design**

A repeated-measures design with 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone) was used, whereby the Gender of Perceivers (male, female) was the between-subjects factor.

### **6.2.4 Procedure**

Perceivers were tested individually in a quiet room. They sat approximately 60 cm from the monitor of a Tobii T60 eye tracker and a nine-point calibration was conducted to ensure accurate recording of the eye movements. After successfully calibrating, perceivers were shown two videos of the experimenter's behaviour in the alone and observed condition (counterbalanced across perceivers). The purpose was to give perceivers an idea of the social conditions the targets experienced. Perceivers were then instructed to rate whether the target was alone or observed in each of the 60 video clips, based on the target's behaviour. A fixation point (+) was presented for one second pseudorandomly in one of the four quadrants of the screen to prevent fixation bias before each stimulus. The video stimuli were then presented to the perceivers in random order. Each clip was viewed only once by each perceiver. After every clip,

perceivers were presented with a two-alternative forced choice question to decide whether the target was alone or observed, and were required to respond using the mouse. The responses were recorded automatically by Tobii Studio. Perceivers were allowed to answer each question at their own pace.

## 6.2.5 Results and Discussion

### 6.2.5.1 Behaviour Data

One-sample  $t$ -tests (test value = 5) were conducted to examine whether perceivers were able to detect the social conditions the targets experienced. Table 3 shows the mean accuracy rates for the different emotions and conditions. The results revealed that perceivers performed significantly above chance when targets were observed while watching the irritation clip,  $t(29) = 3.98, p < .001$ , and significantly below chance level when targets were alone while watching the disgust clip,  $t(29) = -4.54, p < .001$ , and when targets were watching the surprise video alone,  $t(29) = -4.75, p < .001$ , and when observed by another,  $t(29) = -2.22, p < .05$ .

Table 3

*Mean accuracy rates (and Standard Deviation) for the three Emotions for the Observed and Alone condition for Experiment 4.*

	Mean (SD)	
	Alone	Observed
Irritation	5.43 (2.25)	6.23 (1.70)
Disgust	3.80 (1.45)	4.70 (1.40)
Surprise	3.87 (1.31)	4.33 (1.65)

However, accuracy rate does not account for any biases in perceivers' responses (i.e., tendency to select one response over the other), thus, the responses were then coded based on the number of times perceivers responded 'observed' for the different emotions and conditions to examine whether perceivers were able to discriminate when targets were observed by another or alone.

A 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone)  $\times$  2 (Gender of Perceivers: male, female) ANOVA was performed. Effect sizes are reported as  $\eta_p^2$  for ANOVA results and are interpreted as follows;  $\geq 0.01$  is considered a small effect,  $\geq 0.06$  a medium effect, and  $\geq 0.14$  is a large effect (Cohen, 1992). There were large significant main effects of Emotions,  $F(1.49, 41.83) = 18.69, p < .001, \eta_p^2 = .40$ , and Conditions,  $F(1,28) = 8.22, p < .005, \eta_p^2 = .23$ . There was no significant interaction between Emotions and Conditions,  $F(2,56) = .29, p = .75$  (Figure 15). The main effect of Conditions resulted from perceivers judging that the target was observed significantly more often when that was true than when it was not true; the absence of an interaction effect suggests there is no reason to suppose that the ease of such discrimination varied between the three emotions. Pairwise comparisons with Bonferroni correction of the main effect associated with the factor Emotions revealed that perceivers tended to judge that the target was observed significantly more often when the target was viewing the irritation clip than the disgust and surprise clips ( $ps < .001$ ).

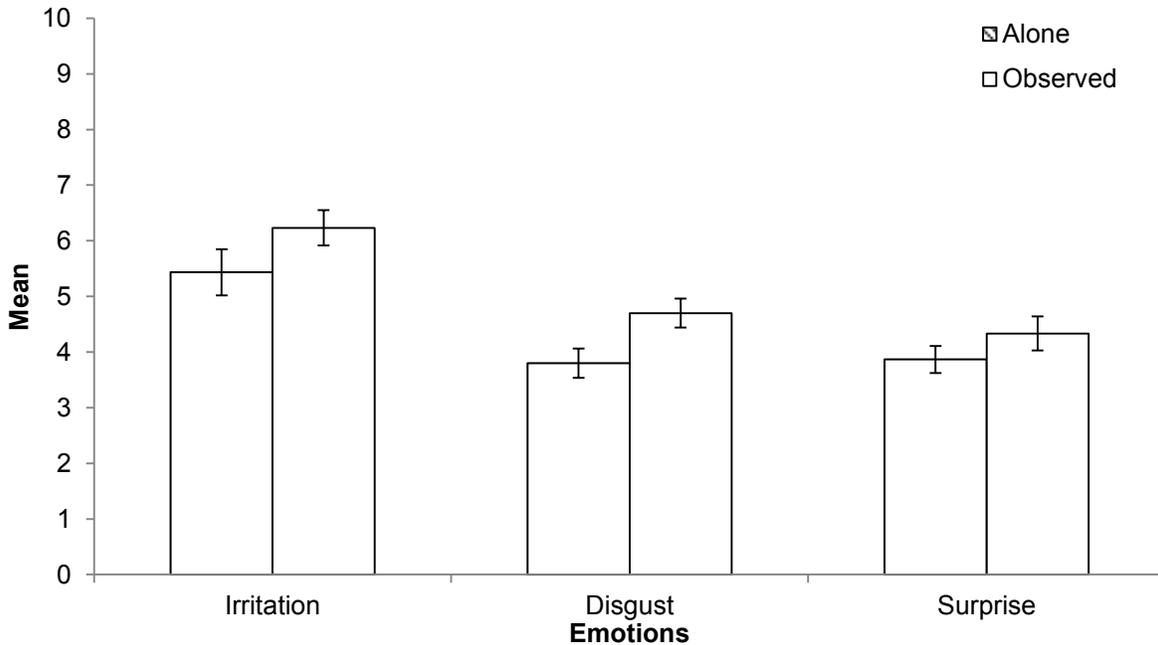


Figure 15. The number of times perceivers responded ‘observed’ out of 10 for alone and observed conditions in Experiment 4. Standard errors of the mean are represented by the error bars.

In addition, there was no significant between-subjects effect for the Gender of the Perceivers,  $F(1, 28) = .002, p = .96$ . There were also no significant interactions between the Gender of the Perceivers with Emotions,  $F(2,56) = .43, p = .65$ , and Conditions,  $F(1,28) = .16, p = .69$ . Moreover, there was no significant interaction between the three factors, Emotions, Conditions and the Gender of the Perceivers,  $F(2,56) = .73, p = .49$ . This indicates that there was no evidence of any difference between the male and female perceivers’ tendency to judge ‘observed’ for the three emotions and the two social conditions.

Did perceivers use a low-level strategy to determine whether targets were observed or alone? For example, did targets look away from the laptop screen (to shift their gaze towards the experimenter) more often in the observed than in the alone condition? If so, perhaps perceivers based their guess of social context on whether or not the target frequently looked away from the

screen (and thus the camera). To find out, we coded the number of times targets looked away from the screen but found no evidence to suggest that this was more common in the observed than in the alone condition,  $t(58) = 0.63$ ,  $p = 0.53$ . Apparently, then, this potentially low-level cue did not offer any basis for perceivers to guess whether the target was observed or alone.

### **6.2.5.2 Eye Movement Analyses**

Areas of interest (AOIs) were created using Tobii Studio 3.1.6. The AOIs were drawn onto each stimulus independently to delineate the eyes, nose and mouth, following Tan, Stephen, Whitehead, and Sheppard (2012), with the addition of an AOI for the Body (Figure 16). The Total Fixation Duration (seconds) for each AOI was obtained from Tobii Studio which calculates the total duration for all fixations within an AOI. Fixation is defined by the standard Tobii fixation filter as two or more consecutive samples falling within a 35 pixel radius. Only fixation duration was examined since the aim of the eye tracking analyses was to investigate whether perceivers' ability to discriminate the social context was associated with attending to specific parts of the target. Since each stimulus varied in duration, the percentage duration of fixations on each AOI were calculated  $[(\text{fixation duration of an AOI}/\text{total duration of the video}) \times 100]$ .



Figure 16. The predefined areas of interest (AOIs) used to analyse eye movement behaviour.

The main point of interest lies in whether or not the patterns of eye movements at the different regions vary depending on the social context. Because the variance differed considerably between the different areas of interest it was appropriate to conduct separate 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone)  $\times$  2 (Gender of Perceivers: male, female) ANOVA for the four different AOIs (Body, Mouth, Nose, Eyes) (Figure 17).

For the Body region, there were large significant main effect of Emotions,  $F(1.39, 38.98) = 147.89, p < .001, \eta_p^2 = .84$ , Conditions,  $F(1, 28) = 113.05, p < .001, \eta_p^2 = .80$ , and a large significant interaction between the factors Emotions and Conditions,  $F(2, 56) = 128.61, p < .001, \eta_p^2 = .82$ . Posthoc paired-samples  $t$ -tests indicated that perceivers looked longer at the Body region for disgust,  $t(29) = 12.60, p < .001$ , and irritation,  $t(29) = 7.31, p < .001$  when targets were alone than when observed, and surprise when targets were observed than alone,  $t(29) = -6.50, p < .001$ . Pairwise comparisons with Bonferroni correction revealed that perceivers attended

significantly less to the Body region when the targets were viewing the irritation clips than disgust and surprise clips ( $ps < .001$ ), and perceivers attended to the Body more when targets were viewing the disgust clips than surprise ( $p < .001$ ). Moreover, perceivers focused on the Body region significantly more when targets were left alone than when they were observed ( $p < .001$ ). For the between-subjects effect of the Gender of the Perceivers, there was no significant effect,  $F(1, 28) < 1, p = .99$ . There were no significant interactions between the Gender of the Perceivers with Emotions,  $F(2,56) < 1, p = .68$ , Conditions,  $F(1,28) < 1, p = .78$ , and between the three main factors,  $F(2, 56) < 1, p = .73$ . This suggests that there was no variation between the male and female perceivers in the way they attended to the Body region of the targets.

For the Mouth region, there was a large significant main effect of Emotions,  $F(2, 56) = 43.24, p < .001, \eta_p^2 = .61$ , and an interaction between Emotions and Conditions,  $F(2, 56) = 4.50, p < .05, \eta_p^2 = .14$ . Pairwise comparisons with Bonferroni correction showed that perceivers attended to the Mouth region significantly more for surprise than irritation and disgust ( $ps < .001$ ), and for disgust than irritation ( $p < .05$ ). Posthoc paired-samples  $t$ -tests revealed that perceivers looked longer at the Mouth for disgust alone than observed,  $t(29) = 3.61, p = .001$ . However, there was no significant main effect of Conditions,  $F(1,28) < 1, p = .54$ . As with the Body region, there was no significant main effect for the Gender of the Perceivers,  $F(1, 28) < 1, p = .77$ , no significant interaction between the Gender of the Perceivers with Emotions,  $F(2,56) < 1, p = .61$ , no interaction between Gender with Conditions,  $F(1, 28) = 1.31, p = .26$ , and no interaction between all three factors,  $F(2, 56) < 1, p = .46$ .

For the Nose region, there was a medium significant main effect of Emotions,  $F(2, 56) = 4.18, p < .05, \eta_p^2 = .13$ , and a large significant interaction associated with the factors, Emotions and Conditions,  $F(2, 56) = 16.64, p < .001, \eta_p^2 = .37$ . Posthoc  $t$ -tests showed that perceivers spent

more time looking at the Nose region for irritation alone than observed,  $t(29) = 4.34, p < .001$ , and disgust observed than alone,  $t(29) = -3.50, p = .002$ . Additionally, there was no significant main effect of Conditions,  $F(1, 28) < 1, p = .68$ , and no significant between-subjects effect of Gender of the Perceivers,  $F(1, 28) < 1, p = .65$ . Comparable with the Mouth region, there was no significant interactions between the Gender of the Perceivers and Emotions,  $F(2, 56) = 2.29, p = .11$ , no significant interaction between Gender and Conditions,  $F(1, 28) < 1, p = .68$ , and no significant interaction between the three factors,  $F(2, 56) = 1.71, p = .19$ .

For the Eyes region, there were large significant main effects of Emotions,  $F(2, 56) = 22.59, p < .001, \eta_p^2 = .45$ , Conditions,  $F(1, 28) = 55.62, p < .001, \eta_p^2 = .67$ , and a large significant interaction between Emotions and Conditions,  $F(1.67, 46.86) = 6.91, p < .005, \eta_p^2 = .20$ . Posthoc paired-samples  $t$ -tests showed that perceivers attended more to the Eyes for irritation observed than alone,  $t(29) = 5.08, p < .001$ , and disgust observed than alone,  $t(29) = 5.72, p < .001$ . Moreover, pairwise comparisons with Bonferroni correction revealed that perceivers attended to the Eyes significantly more for irritation than disgust and surprise ( $ps < .001$ ), and when the targets were observed than alone ( $p < .001$ ). As with the Nose region, there was no significant between-subjects effect for the Gender of the Perceivers,  $F(1, 28) = 2.50, p = .13$ . There were no significant interactions between the Gender of the Perceivers and Emotions,  $F(2, 56) < 1, p = .86$ , and no significant interaction between Gender and Conditions,  $F(1, 28) < 1, p = .84$ . However, there was a large three-way interaction between Emotions, Conditions and the Gender of the Perceivers,  $F(1.67, 46.86) = 5.23, p < .05, \eta_p^2 = .16$ . Posthoc paired samples  $t$ -tests revealed that male and female perceivers attended to the Eyes region significantly more when targets were observed than alone. ( $ps < .001$ ), and male perceivers attended to the Eyes significantly more when targets were watching the irritation than disgust,  $t(14) = 5.57, p < .001$ ,

and surprise clip,  $t(14) = 4.34, p < .005$ . On the other hand, the female perceivers attended to the Eyes significantly more for irritation than surprise,  $t(14) = 4.07, p < .005$ , and for disgust than surprise,  $t(14) = 4.16, p < .005$ .

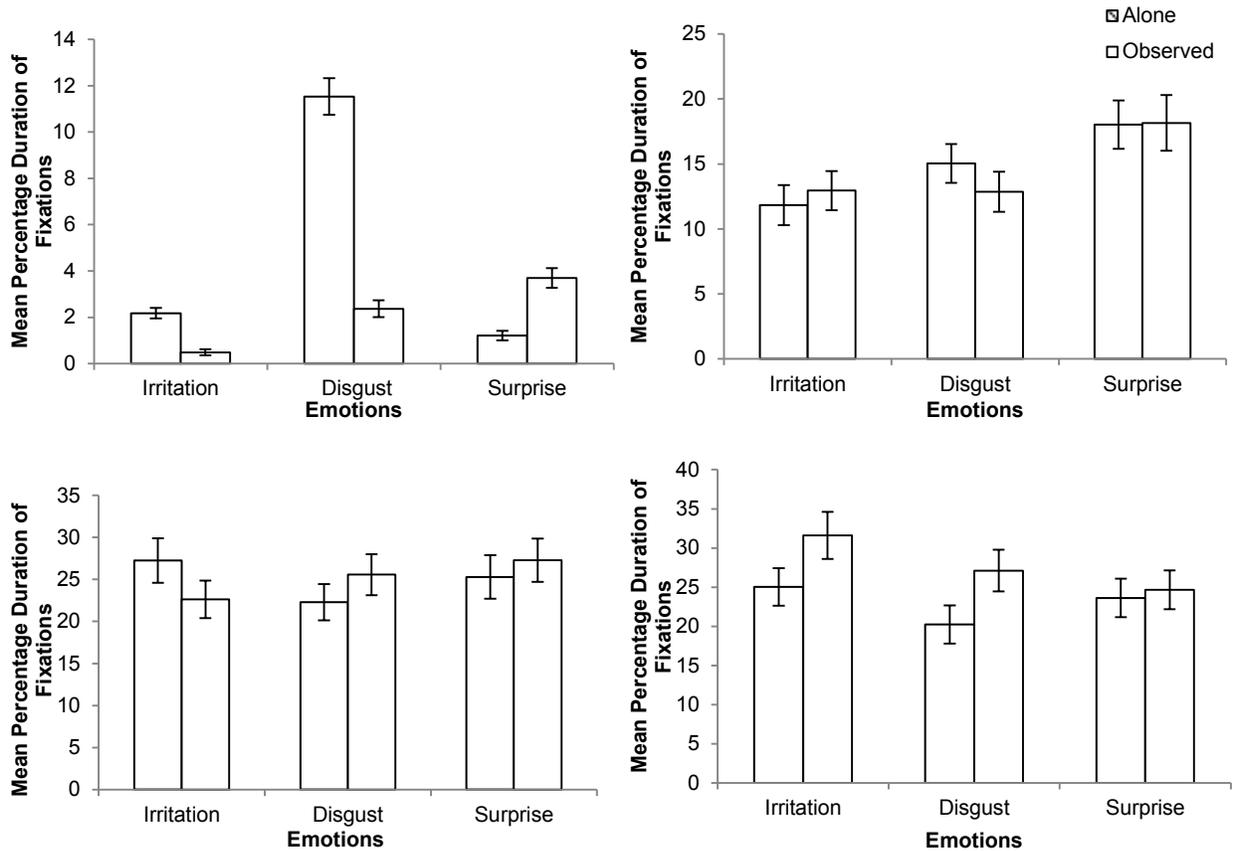


Figure 17. Mean percentage duration of perceivers' fixations for alone and observed conditions for the different AOIs in Experiment 4. The standard errors of the mean are represented by the error bars. (Top left: Body region, Top right: Mouth region, Bottom left: Nose region, Bottom right: Eyes region).

Another way to calculate the percentage of fixation duration in order to control for the varied stimuli duration is to divide the fixation duration of an AOI with the total fixation duration, instead of the total duration of each stimulus  $\times 100$ . The findings have similar patterns

to that reported above with the exception of the Nose region where there was no significant main effect of Emotions,  $F(2, 56) = F < 1, p = .52$ , but there was a large significant three-way interaction between Emotions, Conditions and the Gender of the Perceivers,  $F(2, 56) = 3.65, p < .05, \eta_p^2 = .12$ . Posthoc paired-samples  $t$ -tests revealed that male perceivers focused on the Nose region significantly more when targets were viewing the irritation than disgust clips,  $t(14) = 2.68, p < .05$ . Similarly, the female perceivers attended to the Nose significantly more when targets were watching the irritation than disgust clips,  $t(14) = 3.16, p < .05$ , and when they were viewing the surprise than disgust videos,  $t(14) = 5.06, p < .001$ . In addition to the difference in findings for the Nose region, there was a slight difference for the Eyes region. The posthoc paired-samples  $t$ -tests conducted to examine where the differences were in the three-way interaction, the female perceivers attended to the Eyes significantly more for irritation than disgust,  $t(14) = 4.34, p < .005$ .

In summary, the eye movement data showed that the time perceivers spent looking at the different regions varied systematically depending on whether targets were alone or observed. It was not that perceivers simply looked more at any particular region when the target was alone than observed, suggesting that perceivers were not influenced by any low-level clues in the behaviour of targets that might reveal their social context; rather, the relationship between the time perceivers spent looking at a region and whether the target was alone or observed depended on the particular kind of emotion the target was experiencing.

### **6.3 Experiment 5: Rating the Intensity of Targets' Expressiveness and Eye-Tracking**

One purpose in Experiment 5 was to begin to illuminate the process by which perceivers had inferred the social context of the target in Experiment 4. Previous research has established that when people experience positive emotions (such as surprise) they tend to be more expressive in the company of others than when alone (Buck, 1984); conversely, when people experience negative emotions (such as irritation and disgust) they tend to hide their expressions more in the company of others than when alone (Spain et al., 2000). In Experiment 5 we asked perceivers to judge the degree to which targets were controlling their expressions (hiding or exaggerating), with the expectation that they might judge that targets are hiding their expressions when they were observed and experiencing a negative emotion (irritation, disgust) but exaggerating their expression when observed and experiencing a positive emotion (surprise). They should judge in this way if their explicit judgments of whether the target is observed or alone, as measured in Experiment 4, were based on an understanding (either implicitly or explicitly) of how social presence differentially influences the expression of positive and negative emotions. At the very least, Experiment 5 has potential to demonstrate that sensitivity to the social context of the target is also implicit in perceivers' judgments of how targets are controlling their emotions.

#### **6.3.1 Participants**

Thirty-nine university students (20 males, 19 females) between 18 and 24 ( $M = 19.4$ ,  $SD = 1.1$ ) years were recruited. Perceivers were of different nationalities: 32 Malaysians, 3 Singaporeans, 2 Vietnamese, 1 Indian, and 1 Bangladeshi. Written informed consent was obtained from all perceivers who were compensated RM5 for taking part in the experiment. Less

than 50% of the gaze sample was collected by the eye-tracker for four male and two female perceivers, the data from these six perceivers were excluded from the analysis.

### **6.3.2 Materials and Apparatus**

The sixty video stimuli used in Experiment 4 were utilised. The target stimuli were presented in random order through Tobii Studio Software. A 17-inch TFT monitor that is equipped with the Tobii T60 eye tracking system was used to record eye movements at a data sampling rate of 60Hz.

### **6.3.3 Design**

This experiment used a mixed design with 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone) as the repeated measures factors and the Gender of Perceivers (male, female) as the between-subjects factor.

### **6.3.4 Procedure**

The procedure was similar to that used in Experiment 4, except perceivers were not presented with the videos of the experimenter demonstrating the observed and alone conditions, and were not asked to judge whether the target was alone or observed. Hence, unlike in the previous experiment, perceivers were not given any information about the two possible social contexts. A nine-point calibration was performed and then, for each stimulus clip, perceivers were instructed to decide the degree to which the target was controlling their expression on a rating scale of 1-7 (1 = *hiding*... 7 = *exaggerated*). The rest of the procedure was identical to that in Experiment 4.

## 6.3.5 Results and Discussion

### 6.3.5.1 Behaviour Data

Perceivers' ratings of how the targets were controlling their expressions were submitted to a 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone)  $\times$  2 (Gender of Perceivers: male, female) ANOVA. Effect sizes are reported as  $\eta_p^2$  for ANOVA results and are interpreted as follows;  $\geq 0.01$  is considered a small effect,  $\geq 0.06$  a medium effect, and  $\geq 0.14$  is a large effect (Cohen, 1992). There was a large main effect of Emotions,  $F(2, 62) = 30.86, p < .001, \eta_p^2 = .50$ , which resulted from perceivers judging that targets were hiding their expressions more in the irritation condition compared with the other two emotions ( $ps < .001$ ). There was no main effect of Conditions,  $F(1, 31) = 1.03, p = .32$ . However, there was a large significant interaction between Emotions and Conditions,  $F(2, 62) = 6.49, p < .005, \eta_p^2 = .17$  (Figure 18). Posthoc paired-samples  $t$ -tests revealed a significant difference between disgust alone and observed,  $t(32) = 2.81, p = .008$ , which resulted from perceivers judging that targets were hiding their expressions more in the observed than in the alone condition. Moreover, there was a significant difference between surprise alone and observed,  $t(32) = 2.54, p = .02$  where perceivers judged that targets were exaggerating their expressions more in the observed than alone condition. Hence, perceivers were effectively able to discriminate when targets were alone and observed by judging the extent to which targets were controlling their expressions. However, it was not the case that perceivers consistently judged that targets were hiding their expressions more when observed than when alone; rather, the direction of the effect also depended on the particular emotion the target was experiencing.

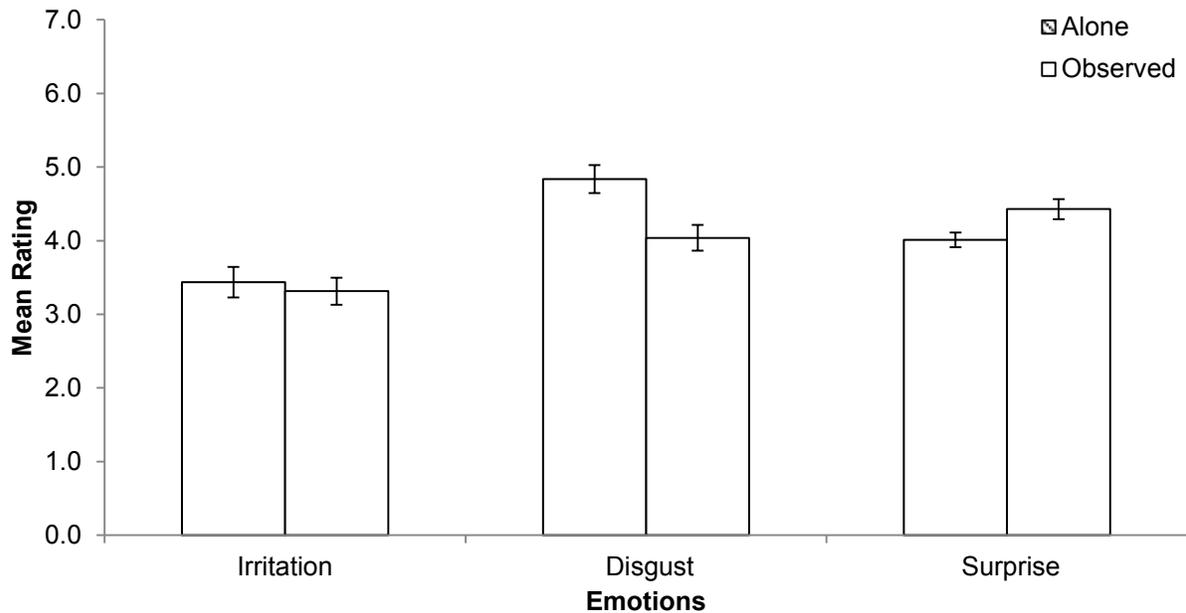


Figure 18. Mean ratings made by perceivers of how targets were controlling their expressions (1= *hiding...* 7= *exaggerated*) for the alone and observed condition in Experiment 5. The standard errors of the mean are represented by the error bars.

The findings were consistent with expectations. Generally, perceivers tended to judge that targets were exaggerating when the target was experiencing a positive emotion (surprise) and was observed rather than alone. Conversely, they tended to judge that targets were hiding their expressions when the target was experiencing a negative emotion (irritation or disgust) and was observed rather than alone. Such behaviour in the targets is consistent with what we might have expected from the literature (Buck, 1984; Spain et al., 2000) and the novel finding presented here suggests that perceivers were attuned to this phenomenon, for their judgments of how the targets were controlling their expressions effectively discriminated between the two social conditions experienced by the targets.

It was found that there was no significant between-subjects effect of Gender,  $F(1, 31) < 1$ ,  $p = .40$ . However, there was a medium-sized interaction between Emotions and the Gender of the Perceivers,  $F(2, 62) = 3.34$ ,  $p < .05$ ,  $\eta_p^2 = .10$ . Posthoc independent-samples  $t$ -tests revealed that there was a significant difference between male and female perceivers' ratings for irritation,  $t(31) = 2.19$ ,  $p < .05$ , which resulted from male perceivers rating higher than their female counterparts when targets felt irritated. However, there was no significant interaction between Conditions and Gender of the Perceivers,  $F(1, 31) < 1$ ,  $p = .86$ , nor was there a 3-way interaction between the factors, Emotions, Conditions and the Gender of the Perceivers,  $F(2, 62) = 1.01$ ,  $p = .37$ . This suggests that there was not much variation between the ratings of male and female perceivers on the intensity of targets' expressions.

#### **6.3.5.2 Eye Movement Analyses**

Areas of interest (AOIs) for the stimuli were created using Tobii Studio 3.1.6 to calculate perceivers' total fixation duration (seconds) on each target AOI (Eyes, Nose, Mouth, Body). The standard Tobii fixation filter defined a fixation as two or more consecutive samples falling within a 35 pixel radius. Since the aim of the eye tracking analyses was to investigate whether perceivers' judgment of the intensity of target's expression was associated with attending to specific areas of the target. In order to control for any differences in the stimulus duration, the percentage of fixation duration was calculated [(fixation duration of an AOI/total duration of the video)  $\times$  100].

Separate 3 (Emotions: irritation, disgust, surprise)  $\times$  2 (Conditions: observed, alone)  $\times$  2 (Gender of Perceivers) ANOVAs were conducted for the four different AOIs (Body, Mouth, Nose, Eyes, Figure 19). For the Body region, the ANOVA showed a large significant main effect

of Emotions,  $F(2, 62) = 87.07, p < .001, \eta_p^2 = .74$ , Conditions,  $F(1, 31) = 43.12, p < .001, \eta_p^2 = .58$ , and an interaction between Emotions and Conditions,  $F(1.48, 45.91) = 151.52, p < .001, \eta_p^2 = .83$ . Posthoc paired-samples  $t$ -tests revealed that perceivers fixated longer for irritation,  $t(32) = 8.47, p < .001$ , and disgust,  $t(32) = 11.96, p < .001$ , when targets were alone than observed, and surprise,  $t(32) = 9.55, p < .001$ , when targets were observed than alone. Pairwise comparisons with Bonferroni correction suggest that perceivers focused on the Body region significantly less for irritation than disgust and surprise ( $ps < .001$ ) and for surprise than disgust ( $p < .001$ ). Moreover, perceivers attended to targets that were alone significantly more than observed ( $p < .001$ ). There was no gender effect in perceivers' eye movements,  $F(1, 31) < 1, p = .93$ , and there were no significant interactions between Gender and Emotions,  $F(2, 62) < 1, p = 8.3$ , Gender with Conditions,  $F(1, 31) = 2.29, p = .14$ , and no interaction between the three factors,  $F(1.48, 45.91) = 2.16, p = .14$ .

For the Mouth region, there was a large significant main effect associated with the factor, Emotions,  $F(2, 62) = 43.26, p < .001, \eta_p^2 = .58$ , and a large-sized interaction between Emotions and Conditions,  $F(2, 62) = 21.03, p < .001, \eta_p^2 = .40$ . Posthoc paired-samples  $t$ -tests revealed that perceivers spent less time looking at the Mouth region when targets felt irritated when alone than observed,  $t(32) = -5.91, p < .001$ , and looked longer at the Mouth for surprise alone than observed,  $t(32) = 2.91, p = .007$ . Pairwise comparisons with Bonferroni correction indicated that perceivers attended to the Mouth significantly more when targets were watching the surprise clips than irritation and disgust clips ( $ps < .001$ ). However, there was no significant main effect of Conditions,  $F(1, 31) = 1.54, p = .23$ . As with the Body region, there were no gender differences in perceivers' eye gaze patterns,  $F(1, 31) < 1, p = .48$ . Furthermore, there were no significant interactions between the Gender of the Perceivers and Emotions,  $F(2, 62) < 1, p =$

.38, nor between Gender and Conditions,  $F(1, 31) = 2.80, p = .10$ , and there was no three-way interaction between the factors,  $F(2, 62) = 1.50, p = .23$ .

For the Nose region, there were large main effects of Emotions,  $F(1.66, 51.37) = 12.26, p < .001, \eta_p^2 = .28$ , Conditions,  $F(1,31) = 19.36, p < .001, \eta_p^2 = .38$ , and an interaction between Emotions and Conditions,  $F(2, 62) = 5.02, p < .05, \eta_p^2 = .14$ . Posthoc *t*-tests showed that perceivers spent less time focusing at the Nose for disgust alone than observed,  $t(32) = -3.47, p = .001$ , and surprise alone than observed,  $t(32) = -2.76, p = .01$ . Pairwise comparisons with Bonferroni correction also revealed that perceivers attended to the Nose significantly less for disgust than irritation and surprise ( $ps < .001$ ), and when the targets were alone than observed ( $p < .001$ ). Conversely, there were no gender effects on perceivers' eye movements,  $F(1, 31) = 3.21, p = .08$ . There were no significant interactions between Emotions and Gender of the Perceivers,  $F(1.66, 51.37) < 1, p = .58$ , nor between Conditions and the Gender,  $F(1,31) = 3.08, p = .09$ . Also, there was no significant interaction between the three main factors,  $F(2, 62) = 1.43, p = .25$ .

Lastly, the Eyes region revealed a large significant main effect associated with Conditions,  $F(1, 31) = 13.52, p < .005, \eta_p^2 = .30$ , which resulted from perceivers attending to the Eyes more when targets were observed than alone ( $p < .005$ ). However, there was no significant main effect of Emotions,  $F(2, 62) = 2.79, p = .07$ , and no significant interaction between Emotions and Conditions,  $F(2, 62) = 1.84, p = .17$ . As with the Nose region, there were no significant differences between male and female perceivers' eye gaze patterns when attending to the Eyes,  $F(1,31) < 1, p = .92$ . Furthermore, there was no significant interaction between Emotions and Gender,  $F(2, 62) < 1, p = .76$ , between Emotions and Conditions,  $F(2,62) = 1.84, p = .17$ , and between Emotions, Conditions and Gender,  $F(2, 62) = 1.04, p = .36$ .

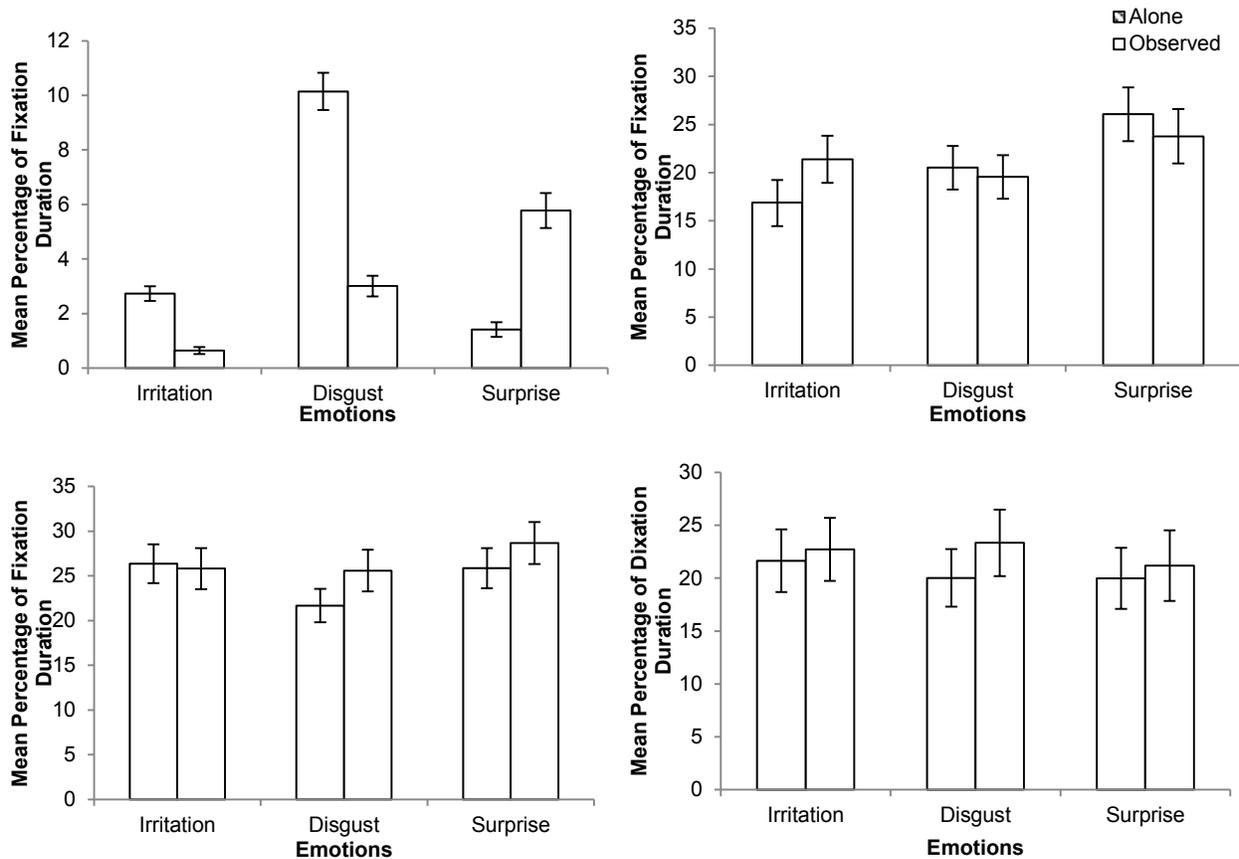


Figure 19. Mean percentage duration of perceivers' fixations for conditions in which targets were alone and observed for the different AOIs in Experiment 5. The standard errors of the mean are represented by the error bars. (Top left: Body region, Top right: Mouth region, Bottom left: Nose region, Bottom right: Eyes region).

As mentioned previously, the percentage fixation duration can be calculated by dividing the fixation duration of an AOI with the total fixation duration  $\times 100$  to control for the different durations of the stimuli. The results revealed similar patterns to those reported above with the exception of the Nose region where there was no significant main effect of Conditions,  $F(1, 31) = 2.92, p = .10$ . Moreover, perceivers only attended to the Nose significantly more when the targets were viewing the irritation clips than disgust ( $p < .001$ ), and the paired-samples  $t$ -tests

revealed only a significant difference for disgust alone than observed,  $t(32) = -3.67, p < .005$ . For the Eyes region, there was a large significant main effect of Emotions,  $F(2, 62) = 18.14, p < .001, \eta_p^2 = .37$  which was due to perceivers attending to the Eyes significantly less for surprise than irritation ( $p < .001$ ) and disgust ( $p < .005$ ). There was a large significant interaction between Emotions and Conditions,  $F(2, 62) = 9.16, p < .001, \eta_p^2 = .23$ . Posthoc paired-samples  $t$ -tests revealed that perceivers attended to the targets significantly more when they were observed than alone when viewing the disgust clips.

In summary, the eye-tracking results revealed that perceivers' gaze time differed between the different regions when targets were observed and alone for the various emotions. As with the first experiment, it was not the case that perceivers simply looked more at any particular region when the target was alone, suggesting that perceivers were not influenced by any low-level clues in the behaviour of targets that might reveal their social context; rather, the relationship between time perceivers spent looking at a region and whether the target was alone or observed depended on the particular kind of emotion that the target was experiencing.

## **6.4 General Discussion**

The purpose of this research was to explore the scope and process of human ability in knowing the world through other minds, a process known as 'retrodictive' mindreading (Gallese & Goldman, 1998). Previous research (e.g., Pillai et al., 2012, 2014) suggests that people are capable of making a sequence of two 'backwards' inferential steps from the behaviour of a target to their mental state and then from their mental state (as embodied in their behaviour) to the antecedent cause of that mental state. In that research, perceivers could make systematically accurate inferences about the content and manner of the experimenter's communication with the

target. The results presented here take us into new territory: From the manner of the target's emotional reaction to a video or photo, perceivers were able to distinguish whether the target was alone or accompanied. People can thus interpret another person's expression of a mental state to determine their social context. This is consistent with the findings reported in Chapter Four.

The results, particularly Experiment 5, speak to the process by which perceivers inferred the social context of targets from an embodiment of their mental states. When targets were viewing positive stimuli, perceivers judged that targets were more expressive (or 'exaggerating' their expressions) when it so happened the target was accompanied than when alone. When targets were viewing negative stimuli, in contrast, perceivers judged that targets were less expressive (or 'hiding' their expressions) when targets were accompanied than when alone. These results thus show that perceivers were sensitive to the social context of the targets in their judgments of how targets controlled their expressions. Furthermore, the results might also provide information about the basis on which perceivers explicitly judged that targets were observed or alone in Experiment 4, though the relationship between perceivers' judgments of target expressivity and judgments of target social context requires careful consideration, as explained below.

It could have been that perceivers linked target expressivity with target social context in a more sophisticated way. We know from classic research in social psychology that people are more expressive when accompanied than when alone if they are experiencing positive emotions (e.g. Buck, 1984); conversely, it seems people are less expressive when accompanied than when alone if experiencing negative emotions (Spain et al, 2000). Perceivers in our studies might have had sufficient insight into this social process to be able to determine target social context from their perception of how the target's emotional reaction seems to be moderated (or controlled)

depending on whether the target seemed to be having a positive or a negative emotion. However, the results of Experiment 5 merely suggest that perceivers might have utilised this relationship between target's expressivity and the social context the target was experiencing to infer the target's social context. A further study can be conducted to inspect the direct link between these two factors by asking the perceivers to rate the expressiveness of the target and the likelihood of the target being observed or alone.

Notwithstanding, we should consider whether perceivers were using a low-level strategy to determine whether the target was observed or alone. For example, did targets look away from the screen (and look instead at the experimenter) more often when the experimenter was present than absent? If so, perhaps perceivers were judging social context not based on the manner of the target's emotional reaction but on whether the target seemed to be distracted by the presence of another person in the room. There was no evidence to suggest that targets looked away from the screen more often in the accompanied than in the alone condition, meaning that perceivers could not use the apparent distractibility of the target as a clue to social context. Besides, in Experiment 5 perceivers were told nothing of the social context that sometimes the target was alone and sometimes observed; indeed, they were not even told anything about the videos being watched by the targets in any of the experiments. In Experiment 5 they merely had to judge whether the target was hiding or exaggerating their expression and they did so in a way that effectively showed they were sensitive to the two social contexts of the target.

Data from Experiments 4 and 5 are consistent in showing that eye movements of the perceivers were systematically different for several different areas of interest depending on the social context. It was not that the perceiver simply looked more at certain areas when the target was observed than alone (or the opposite); rather the patterns of eye movements revealed a

complicated relationship between the social context of the target and the particular emotion that he or she was experiencing. This suggests once again that the social context mediated the target's response to the video; and this in turn impacted upon the visual attention of the perceiver in a way that demonstrated sensitivity in the perceiver to the context (and the emotions experienced by the target) at the level of eye movements.

In Experiment 4, perceivers were explicitly asked about the target's social context. One might think that this instruction could have influenced the perceivers' eye movements. For example, they could have looked for clues as to whether the target was looking away from the screen and (by implication) at the observer. If so, one might expect the eye movement patterns to be quite different in Experiments 4 and 5 in that perceivers were not given any information about the targets' social context in the latter. While the patterns of data are not identical in the two experiments, nevertheless perceivers' eye movements suggested they were sensitive to the target's social context in both: This effect was not confined to Experiment 4. Notably, perceivers were demonstrably sensitive to conditions in which targets were alone and observed even in a circumstance where it is implausible to suppose that the perceiver was trying to detect if the target was looking away from the screen (Experiment 5). Moreover perceivers were not simply looking more at a particular region (such as the eye region) in the observed than in the alone condition; how much they looked at any particular region also depended upon the particular emotion the target was experiencing. This variation in perceivers' eye gaze behaviour supports Pillai et al.'s (2012, 2014) and Cassidy et al.'s (2013, 2015) findings that perceivers find different regions of the face informative based on the social situation targets were experiencing, in this case it was the social context and the nature of the movie clip watched by targets.

Having discussed how perceivers infer target social context by interpreting an embodiment of the target's mental state, we now turn to *why* they make such inferences. Assuming that any given ability develops because it is functional and adaptive (in most cases), it seems fair to consider the value of the particular ability that allows us to infer social context by interpreting clues in the target's behaviour (Tinbergen, 1963). Presumably, the ability in question broadly enables perceivers to know things about the world inhabited by the target; making inferences about social context is but a specific implementation of this broader ability. Other examples demonstrated in past research are guessing what another person said to the target (Pillai et al, 2012, 2014), guessing what gift had been offered to the target (Cassidy et al, 2013, in press) and guessing which stimulus a target selected as their preferred choice (North et al, 2010). The full scope of the ability to infer events in the world from a target's embodied mental state awaits further exploration: Perceivers might be able to guess the gender of a person interacting with the target, they might be able to guess the expression (positive or negative) of a person the target is interacting with and they might be able to guess which cue word a target is looking at (pride, embarrassment, happiness, shame) in a context where targets are instructed to think of a time they experienced the emotion indicated by the cue word.

In essence, the results presented here might speak to the broader ability of people knowing the world through the lens of another mind. Perhaps this basic process serves as the foundation for a more advanced ability to learn from other people. In its most highly developed form this could include the kind of explicit instruction from others that is formalised in education. Here, students learn things about the world that extends well beyond what they could reasonably expect to know from their own personal discovery. Accordingly, the expansive

knowledge and wisdom enjoyed by humans depends on a basic ability to apprehend aspects of the world through the lens of other minds (cf Vygotsky, 1978).

Such ability seemingly has its roots in early development. From the age of about 18 months, infants begin to show signs of ‘social referencing’ (Sorce et al., 1985), meaning that they look to their caregiver and are influenced by the mental state or attitude that is embodied in his or her facial expression. If the caregiver’s mental state is positive then the infant is likely to be more adventurous in an unfamiliar environment; if the mental state is negative they will be less adventurous. Apparently, then, the infant seems to learn something about the status of the environment (whether or not it is safe) by interpreting the caregiver’s attitude towards that particular aspect of the environment. Perhaps the basic capacity to learn about the world from other minds becomes refined during development, ultimately to determine such things as whether a target is alone or accompanied, what a third party said to a target or what a third party gave to a target.

In summary, the two experiments reported here yielded a variety of data which converge in showing that perceivers are sensitive to the social context of the target. This is apparent in their explicit judgments on whether the target is observed or alone and it is implicit in their judgments of how the target was controlling their expressions and in their eye movements. The explicit judgments might be made on the basis of knowledge (either explicit or implicit) that people display their emotions differently in the presence or absence of others depending on the particular emotion in question. Such an intuition, if it deserves to be called that, accords with research into the effect an audience has on the intensity of emotional displays (e.g. Ansfield, 2007; Spain et al., 2000). In consequence, the evidence testifies to the ability of our perceivers as natural psychologists.

**CHAPTER SEVEN:**  
**ALONE, ACCOMPANIED, OBSERVED –**  
**PERCEIVERS’ SENSITIVITY TO SOCIAL CONTEXT**

**7.1 Introduction**

The findings of the experiments described in previous chapters demonstrated that perceivers were able to discriminate the social contexts (i.e., observed, alone) the targets were experiencing from briefly observing targets’ behaviour. To what extent does the target need to be observed for the perceivers to be able to infer the social context the target experienced? During the stimuli development stage (Experiment 1b in Chapter Three), the experimenter scrutinised the targets while jotting down notes in the ‘observed’ condition. For the experiment described in this chapter, we investigated whether perceivers would still be able to distinguish when targets were alone or observed if they were merely accompanied without being scrutinised by the experimenter. Is it necessary for the targets to be overtly observed in order for perceivers to detect clues in targets’ behaviour that reveal social presence? Or perhaps the presence of another person would be sufficient even if this person is not scrutinizing the target. We created a new set of target stimuli for the experiment described in this chapter, which instead of only employing two social conditions (i.e., observed, alone), the targets experienced three different conditions – observed, accompanied, alone (Stimulus Development Phase).

There has been a longstanding debate among researchers investigating the audience effect on facial expressions - whether facial expressions are merely a “readout” (Buck, 1984) of a person’s internal state (i.e., emotions) or to express one’s social intentions (behavioural ecology view) (Fridlund, 1991). Fridlund (1991) tested the hypothesis that facial expressions are solely

used as communicative acts by inviting participants to watch a humorous video clip in one of the four social conditions: 1) alone, 2) alone but under the impression that a friend was in another room completing a different task, 3) alone but under the impression that a friend was watching a similar video clip, and 4) accompanied by a friend in the same room during the task). The findings indicated that the intensity of a participant's expression covary with the sociality of the social condition, but not with participant's self-reported emotion. Thus, this led to Fridlund (1991) to conclude that facial expressions serve as acts of communication, dependent on the social motives and the social conditions, without any reference to the expresser's internal state.

However, Hess, Banse, and Kappas (1995) argued that the function of facial expressions should not be exclusive to either one of the views; instead facial expressions are affected by various factors which include the person's internal state and social intentions. Hess et al. (1995) conducted an experiment where participants viewed film clips intended to elicit varying levels of happiness or amusement in one of three different social conditions: 1) alone and under the impression that another participant was in a nearby room performing a different task, 2) alone but believed that another participant was in nearby room performing a similar task, 3) accompanied by another participant while conducting a similar task. The results suggested that participants' facial expressions varied as a function of the intensity of the stimulus and the social conditions the participants were experiencing. Moreover, Jakobs, Manstead, and Fischer (1999) replicated Hess et al.'s (1995) results, thus supporting that both social condition and stimulus intensity influenced participants' facial expressions. Jakobs et al. (1999) found that the presence or absence of another person affected the intensity of participants' expression, where when participants were left alone, they smiled less than participants who were experiencing implicit or explicit presence of a friend. The greater social awareness (i.e., participant's awareness of others)

and stronger social motivation (i.e., participant's concern with other's evaluation of the stimulus and participant's motives to communicate) were linked with participants being more expressive in the explicit presence condition (i.e., a friend's physical presence), but not in the implicit presence (i.e., participant believed that a friend is in a nearby room) or alone condition. In addition, the study also found that the varying social conditions did not affect participants' intensity of emotional feelings. Therefore, Jakobs et al. (1999) concluded that facial expressions are influenced by the social condition the person is experiencing, as well as the emotional stimuli, and the extent of either factor on one's facial expression is dependent on the situation.

How about the effect of social context on the expression of negative facial expressions? Wagner and Smith (1991) stated that when participants are accompanied by strangers, participants can view as either co-acting participants or an evaluating audience, depending on the context and task set up by the researcher. For instance, some studies reported that participants tended to inhibit their facial behaviour when in the presence of a stranger (e.g. Kleck et al., 1976, Kraut, 1982) where the strangers are regarded as an evaluative audience. Meanwhile, Wagner and Smith (1991) reasoned that when the stranger shares an activity with the participant, this would elicit stronger expressions of negative facial behaviour because the stranger is considered as a co-actor, which evokes stronger social motives. Thus, Wagner and Smith (1991) conducted a study where pairs of strangers and pairs of friends (i.e., targets) were videoed as they watched emotional slides, and were asked to report the emotions experienced from the stimuli. These videoed reactions were shown to participants who were asked to identify the emotions experienced by the targets. Participants' ratings were compared with the ratings reported by the targets. The results suggested that pairs of strangers were less expressive (i.e., less recognised by participants) than pairs of friends, especially for expressions of amusement, sadness, and

tenderness, while expressions of anger, disgust, happiness, puzzlement and peacefulness showed no differences in expressions by either pairs of targets.

Conversely, Buck, Losow, Murphy, and Constanzo (1992) recruited targets to watch emotional (i.e., scenic, unpleasant, unusual, sexual) slides either alone, in the presence of a friend, or in the presence of a stranger. The targets' reactions were videoed, and participants had to rate what type of slide the targets were viewing. The findings contrasted from Wagner and Smith's (1991) where participants were more accurate when targets were alone than in the presence of a stranger. Furthermore, participants' judgements were more accurate when targets were viewing sexual slides in the presence of friends, and less accurate when targets were viewing unpleasant slides in the presence of friends. Hence, Buck et al.'s (1992) study suggested that when accompanied by friends, one would either enhance or inhibit one's facial expressions dependent on the type of stimuli presented.

Jakobs, Manstead, and Fischer (2001) expanded their investigation of the effect of social context on facial behaviour to include negative emotions. They found that participants inhibited their facial expressions of sadness more when in the presence of friends or strangers in either the same or different room as compared to when they were in the alone condition. The intensity of their expressions was also affected by the intensity of the stimulus. Moreover, the findings showed that participants tended to smile when in the presence of a friend (implicit/explicit) than a stranger or when left alone. Jakobs et al. (2001) stated that this was because the presence of a friend elicited stronger motivation within the participants to communicate and stronger awareness as compared to the presence of a stranger. Therefore, suggesting that the role and/or identity of the person present affects the way participants respond to negative stimuli. Parkinson (2005) summarised that the effects of a real or imagined presence on facial behaviour depended

on a varying factors such as the relationship between the participant and the person present, the stimuli used to evoke the reaction, and the strength of the social motives. Hence, in some social contexts, the presence of another person evokes a more exaggerated facial expression, while in other social contexts; it causes an inhibitory effect on the participant's facial expressions.

Other research investigating the effect of social context on emotional expressions mainly focused on the type and identity of the audience present, and it is now widely assumed that we have learned through socialisation, how to control our facial behaviour in various social situations (Zaalberg, Manstead, & Fischer, 2004). Thus, the research conducted on this chapter is not to examine how people control their facial behaviour in different social contexts, but to further our investigation of people's ability to judge social context from observing the behaviour of others. We utilised the concept of an evaluative observer, a co-acting (accompanying) stranger, and the alone condition as varying levels of social context, in order to further understand perceivers' sensitivity to gauge the social context the targets experienced. Are perceivers still able to detect the presence of another when targets were merely accompanied by the experimenter?

In Experiment 7 described in this chapter, perceivers were instructed to judge whether the targets were accompanied by another person or left alone. The perceivers' eye movements were also recorded during the experiment to examine whether perceivers' eye gaze was influenced by the social contexts the targets experienced (i.e., observed, accompanied, alone).

## **7.2 Stimulus Development Phase**

The aim of this experiment was to create a new set of stimuli for the next experiment. Targets were instructed to watch movie clips selected in Experiment 1a in Chapter Three as

targets were randomly assigned to one of the three conditions (i.e., observed , accompanied, left alone in the room). Targets' behaviour was recorded during the experiment.

### **7.2.1 Targets**

Sixty-four (31 males, 33 females) university students aged between 17 and 24 years ( $M = 19.2$ ,  $SD = 1.8$ ) participated in the experiment. Targets were recruited from the University of Nottingham Malaysia Campus and comprised of various nationalities: 59 Malaysians, 1 Sri Lankan, 1 Mauritian, 1 English, 1 Singaporean, and 1 American. Written informed consent was obtained from all targets, who were compensated RM5 for taking part in the experiment. Four of the targets' recorded behaviour was excluded due to technical difficulties encountered during the recordings.

### **7.2.2 Materials and Apparatus**

The highest rated movie clips intended to evoke irritation, disgust, and surprise which were selected in Experiment 1a in Chapter Three were used as stimuli in this study. These three video clips were presented randomly through PsychoPy (Version 1.74.01; Peirce, 2012) on a HP Elite Book 8460p laptop. Targets were positioned approximately 0.6 meters from the laptop's screen to ensure that their face, neck and shoulders were captured by the laptop's HD Webcam.

### **7.2.3 Design**

This experiment was a between-subjects design with targets randomly assigned to one of the three social conditions (observed, accompanied, alone) as they watched all three movie clips.

#### 7.2.4 Procedure

The experiment was conducted in a quiet room within the School of Psychology. Targets were tested individually and informed that the task involved watching three video clips while they rated what they felt and the intensity of the emotion felt after each clip. Upon arrival, targets were assigned randomly to one of the three conditions (observed, accompanied, alone). In the ‘observed’ condition, the experimenter sat adjacent the target and ostensibly observed the target as they watched the video clips. During the observation, the experimenter jotted down notes on a clipboard and made no communication with the target. In the ‘accompanied’ condition, the experimenter sat next to the target and watched the videos. After each video clip, the experimenter noted down the target’s response to the questions of what they felt from watching the clip and the intensity of the emotion felt. For the ‘alone’ condition, target was left alone in the room to watch the video clips.

The three video clips shown were intended to evoke certain emotions (irritation, disgust, surprise) and each clip was presented once in a randomised order using PsychoPy. After each clip, targets had to choose a response out of seven options (anger, disgust, fear, happy, neutral, sad, surprise) that best represented what they felt from watching the video, and then rate the intensity of the emotion on a 7-point scale, 1 = *least intense* and 7 = *most intense*. These responses were presented on the laptop’s screen in a rating scale, and targets responded by using the mouse. Since the purpose of the experiment was to capture targets’ spontaneous behaviour, the webcam was set to record before targets entered the room.

Once targets completed the task, they were debriefed of the true nature of the experiment. Targets were asked for their written consent to use the recordings of their behaviour for subsequent experiments.

### 7.2.5 Editing

The recordings of targets' behaviour were edited using VirtualDub (Version 1.9.11; Lee, 2010) and Sony Vegas Pro (Version 11.0) to capture the targets' reactions. The reactions to each clip were edited based on the descriptions made by participants in Experiment 1a in Chapter Three as the most emotionally intense section of the video clip to avoid any experimenter bias in editing the most reactive expressions. Once a target's reactions were edited according to each movie clip, the three reactions of the target were arranged to appear in a specific order - irritation, disgust, and surprise – and stitched as one stimulus. To help the participants in future experiments to identify what the targets were reacting to, a screenshot of each movie clip was placed on the top right corner of the stimulus (Figure 20). To ensure that the transition between each target reaction was smooth, a 'fade to black' effect was added between each reaction. In addition, all target stimuli were muted to prevent the audio revealing the social conditions the targets were experiencing. Each target stimulus was approximately 26 seconds long. The video frame was cropped to 500 pixels for both width and height with a rate of presentation of 29 frames per second, and only the target's head to the top of their shoulders was visible against a white wall. In total, there were 60 video stimuli; 20 for each of the three conditions, out of which ten were male targets, and ten were female targets.



*Figure 20.* An example of a target stimulus created. The screenshots of each of the movie clips targets watched were placed on the top right corner of the stimulus to help participants identify what targets were reacting to.

### **7.3 Experiment 7: Sensitivity to Social Context and Eye-Tracking**

The aims of this experiment were to investigate perceivers' sensitivity to the social context the targets experienced and whether perceivers' eye movements were influenced by the social contexts the targets were in as they made judgments. Perceivers were instructed to decide whether the targets were accompanied by another person or were alone in the room from observing a few seconds of targets' reactions to three emotional video clips intended to evoke irritation, disgust and surprise. If the mere presence of another person is sufficient for perceivers to distinguish between accompanied and alone, then this would further demonstrate perceivers' ability to infer social contexts from observing the behaviour of others.

From the body of research in the effects of social context on facial expressions, we used the observed and alone conditions as the anchor points in this experiment. The accompanied condition was added to investigate whether the judgments made by perceivers for this condition would be similar to that for the observed condition or the alone condition. If perceivers' judgments in the accompanied condition mirrored that of the observed condition, then this would

suggest that perceivers are sensitive enough to use the clues left by targets' behaviour to detect the presence of another person, even when this presence is merely a co-actor, not an observer. This would also corroborate with the body of research investigating the effect of social context on people's behaviour which found that the presence of another person, be it implicit or explicit, still have an effect on the way people behave as compared to when they are left alone. However, if perceivers' judgments reflect that of the alone condition, then it would suggest that perceivers were not able to detect the presence of another when targets were not observed directly by another person. In addition, this would reveal perceivers' limit in the ability to detect social context from observing targets' behaviour. In addition, perceivers' eye movements were recorded to give an insight to perceivers' visual processes when making their judgments on social context.

### **7.3.1 Participants**

Sixty-four (28 males, 36 females) students aged between 17 and 24 years ( $M = 20.5$ ,  $SD = 2.4$ ) were recruited to participate in the experiment. Perceivers were of varying nationalities: 49 Malaysians, 1 Sri Lankan, 1 Iranian, 1 Maldivian, 7 Vietnamese, 1 South Korean, 1 Tanzanian, 1 Singaporean, and 2 Chinese. Thirty-four of the perceivers were recruited from University of Nottingham Malaysia Campus and these perceivers had their eye-movement recorded during the experiment and were compensated RM5 for taking part. The remaining 30 perceivers were recruited from University of Nottingham, UK Campus and their eye movements were not recorded for the experiment due to technical reasons, and were compensated £5 for participating in the study. Four perceivers' data were excluded from the final analysis because less than 50 percent of their gaze sample was recorded by the eye-tracker.

### **7.3.2 Materials and Apparatus**

The three movie clips targets watched in the Stimulus Development Phase (described above) were shown to perceivers to give them a clearer idea of what the targets were reacting to since each of the target stimulus shown in this experiment comprised of all the target's reactions to all three movie clips. These movie clips were presented only once in the same order – irritation, disgust, surprise – to every perceiver using Windows Media Player. The order of the presentation was similar to the arrangement of the target's reactions for each stimulus. The 60 target stimuli created in the Stimulus Development Phase which comprised of 20 targets for each of the three conditions (observed, accompanied, and alone) with 10 male and 10 female targets for each condition. For the Malaysian Campus perceivers, these target stimuli were presented randomly through Tobii Studio Software on a 17-inch TFT monitor that was integrated with the Tobii T60 eye-tracking system. The perceivers' eye movements were recorded at a data sampling rate of 60Hz. The UK Campus perceivers were presented with the stimuli in a random order via PsychoPy (Version 1.74.01; Peirce, 2012) on a 14-inch screen, HP Elite Book 8460p laptop.

### **7.3.3 Design**

This experiment used a 3 (Conditions: observed, accompanied, alone)  $\times$  2 (Gender of Perceivers: male, female) design where all perceivers were tested with the same set of stimuli.

### **7.3.4 Procedure**

Perceivers were tested individually in a quiet environment. Perceivers who were tested with the eye-tracker sat approximately 60 cm from the monitor. All perceivers were shown the three movie clips in the same order – irritation, disgust, and surprise. Then, for the perceivers

who had their eye movements recorded, a nine-point calibration was conducted to ensure accurate recording of their eye gaze. All perceivers were instructed to infer whether the target was accompanied by another person or alone for each of the 60 stimuli based on the target's behaviour. In the eye-tracking condition, a fixation point (+) was presented for one second pseudorandomly in one of the four quadrants of the screen to prevent fixation bias before each stimulus. For the non-eye-tracking condition, a fixation point (+) was also presented before each stimulus but was positioned in the centre of the screen. The target stimuli were shown only once and in a random order to all perceivers. After each stimulus, perceivers were asked a forced choice question of whether the target was alone or accompanied by another person, and they responded by using the mouse; perceivers were given as much time as they needed to respond to each question. These responses were recorded automatically by Tobii Studio (in the eye-tracking condition) or PsychoPy (in the non-eye-tracking condition).

### **7.3.5 Results and Discussion**

#### **7.3.5.1 Behaviour Data**

To examine whether perceivers were able to distinguish between the social conditions above the level of chance, perceivers' correct responses were tested with one-sample *t*-tests with a test value of 30. The test value was 30 because there were a total of 60 target stimuli, and if perceivers performed at a chance level, on average, they would be correct 30 out of 60. It was found that perceivers were able to correctly distinguish when the targets were accompanied by another person and when they were alone above the level of chance,  $t(59) = 2.71, p < .05$ .

To take into account the possibility of response bias in perceivers' answers, responses were coded based on the number of times perceivers responded 'accompanied by another

person.’ A 3 (Conditions: observed, accompanied, alone)  $\times$  2 (Gender of Perceivers: male, female) ANOVA was conducted. Effect sizes are reported as  $\eta_p^2$  for ANOVA results and are interpreted as follows;  $\geq 0.01$  is considered a small effect,  $\geq 0.06$  a medium effect, and  $\geq 0.14$  is a large effect (Cohen, 1992). There was a large significant main effect of Conditions,  $F(2, 116) = 19.69, p < .001, \eta_p^2 = .25$  (Figure 21). Pairwise comparison with Bonferroni correction revealed that perceivers tended to respond ‘accompanied’ more often when targets were observed and accompanied than alone ( $ps < .001$ ). However, there was no significant difference in perceivers’ tendency to respond ‘accompanied’ when targets were observed than accompanied ( $p = .75$ ). This suggests that the mere presence of another individual was enough for perceivers to detect that targets were accompanied.

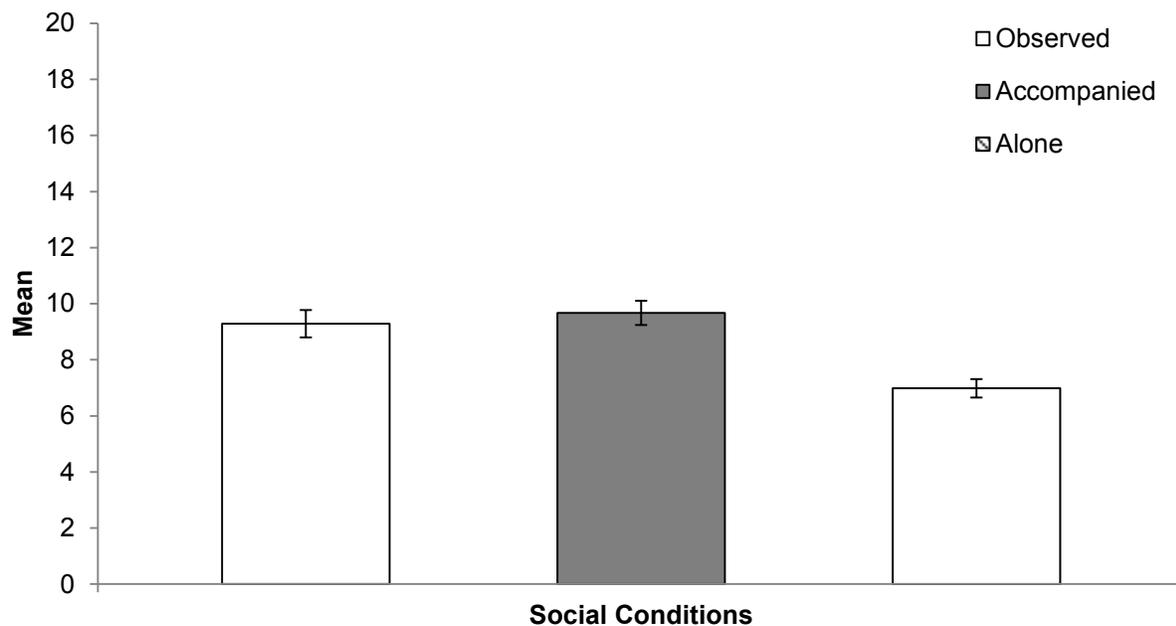


Figure 21. The mean number of times perceivers responded ‘accompanied by another’ out of 20 for the three social conditions (i.e., observed, accompanied, alone) in Experiment 7. Standard errors of the mean are represented by the error bars.

There was no significant between-subjects effects for the Gender of the Perceivers,  $F(1, 58) < 1, p = .73$ . Also, there was no significant interaction between the Conditions and the Gender of the Perceivers,  $F(2, 116) = 1.69, p = .19$ . This suggests that there was no variation between male and female perceivers in their rating of social context.

A 3 (Conditions: observed, accompanied, alone)  $\times$  2 (Venue: Malaysia Campus, UK Campus) ANOVA was performed to examine any difference in performance between perceivers from the two campuses. There was no significant difference in performance between perceivers from UK and Malaysia Campus,  $F(1, 58) < 1, p = .43$  and neither was there a significant interaction between the factors, Conditions and Venue,  $F(2, 116) = 2.71, p = .07$ . It seems perceivers from both campuses performed in a similar pattern when discriminating whether targets were alone or accompanied by another.

Overall, perceivers demonstrated that they were able to distinguish between the social conditions the targets experienced above the level chance. Moreover, perceivers' judgments systematically discriminated when targets were in the presence of another, and when they were alone in the room. This suggests that perceivers were able to discriminate when someone was in the presence or absence of another from the targets' behaviour, and the mere presence of a person who did not overtly observe the targets was sufficient for perceivers to detect that the target was accompanied. This demonstrates perceivers' sensitivity and ability to use the behaviour of others to infer an aspect of the social world that perceivers were not able to directly experience themselves.

### 7.3.5.2 Eye Movement Analyses

Areas of interest (AOIs) were created on Tobii Studio 3.1.6. The AOIs were drawn on each stimulus independently to delineate the eyes, nose, mouth and body, similar to that in Experiment 4 and 5 described in Chapter Six. The Total Fixation Duration (seconds) for each AOI was obtained from Tobii Studio which measures the total duration for all fixations within an AOI. Fixation is defined by the standard Tobii fixation filter as two or more consecutive samples falling within a 35 pixel radius. Only fixation duration was examined in this study since the aim of the eye tracking analyses was to investigate whether or not the patterns of eye movements at the different regions vary depending on the social context. The Total Fixation Duration (seconds) for each AOI was calculated as the percentage fixation duration for each AOI [(fixation duration of an AOI / total duration of the video)  $\times$  100] to take into account the varying duration of the stimuli.

Four separate 3 (Conditions: observed, accompanied, alone)  $\times$  2 (Gender of Perceivers: male, female) ANOVAs were conducted for the four different AOIs (Body, Mouth, Nose, Eyes) (Figure 22), as detailed below.

For the Body region, there was a large significant main effect of Conditions,  $F(2, 56) = 40.35, p < .001, \eta_p^2 = .59$ . Pairwise comparison with Bonferroni correction revealed differences in perceivers' eye gaze between observed, accompanied and the alone conditions ( $ps < .001$ ), where perceivers attended to the Body region significantly more when the targets were alone. Moreover there was a large significant interaction between Conditions and Gender of Perceivers,  $F(2, 56) = 7.33, p < .005, \eta_p^2 = .21$ . Paired-samples  $t$ -tests revealed that male perceivers attended to the Body region significantly more when targets were alone than observed and accompanied ( $ps < .005$ ). Female perceivers attended significantly more to the Body for alone than observed

and accompanied ( $p < .001$ ), and for observed than accompanied ( $p < .05$ ). However, there was no significant main effect for the Gender of the Perceivers,  $F(1, 28) < 1, p = .53$ .

For the Mouth region, there was a large significant main effect of Conditions,  $F(2, 56) = 17.88, p < .001, \eta_p^2 = .39$  and pairwise comparisons with Bonferroni correction revealed that perceivers attended to the Mouth the least when targets were alone than accompanied ( $p < .001$ ) and observed ( $p < .005$ ). However, there was no significant interaction between the Conditions and the Gender of the Perceivers,  $F(2, 56) < 1, p = .72$ , and there was no significant between-subjects effect of the Gender of Perceivers,  $F(1, 28) < 1, p = .87$ , suggesting there were no significant variations in the way male and female perceivers attended to the Mouth region of the targets.

As for the Nose region, there was a large significant main effect of Conditions,  $F(2, 56) = 9.37, p < .001, \eta_p^2 = .25$ . Pairwise comparison with Bonferroni correction showed that perceivers tended to focus on the Nose region more when the targets were observed and accompanied by the experimenter than when alone ( $p < .005$ ). There was also a large significant effect associated with the Gender of the Perceivers,  $F(1, 28) = 5.10, p < .05, \eta_p^2 = .15$ , where the female perceivers attended to the nose region significantly more than the male perceivers ( $p < .05$ ). However, there was no significant interaction between the Conditions and the Gender of the Perceivers,  $F(2, 56) = .97, p = .39$ .

Lastly, for the Eyes region, there was a large significant main effect of Conditions,  $F(2, 56) = 12.33, p < .001, \eta_p^2 = .31$ . This was due to perceivers attending to the Eyes significantly less when the targets were observed than when alone ( $p < .001$ ), and accompanied ( $p < .005$ ). There was no significant interaction between the Conditions and Gender of the Perceivers,  $F(2,$

56)  $< 1$ ,  $p = .46$ , and no significant main effect for the Gender of the Perceivers,  $F(1, 28) < 1$ ,  $p = 57$ .

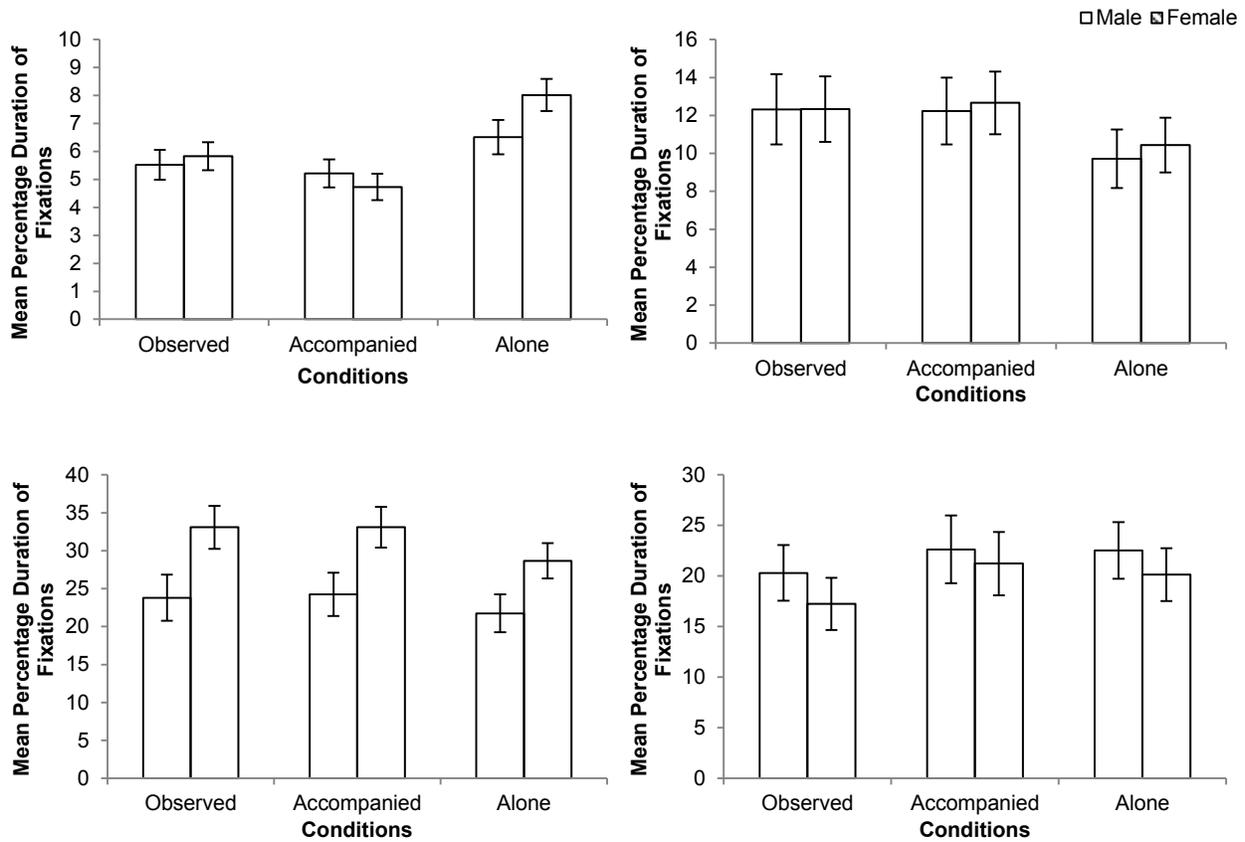


Figure 22. The male and female perceivers' mean percentage duration of fixations for observed, accompanied and alone conditions for the different AOIs in Experiment 7. The standard errors of the mean are represented by the error bars. (Top left: Body region, Top right: Mouth region, Bottom left: Nose region, Bottom right: Eyes region).

An alternative method to calculate the percentage of fixation duration in order to control for the varying duration of the target stimuli is where the fixation duration of an AOI is divided by the total fixation duration  $\times 100$ . The findings showed a similar pattern of results, with several minor exceptions. The separate  $3(\text{Conditions: observed, accompanied, alone}) \times 2(\text{Gender of$

Perceivers: male, female) ANOVAs for the four different AOIs revealed similar results to those reported above with a few differences. For the Body region, the pairwise comparisons with Bonferroni correction for the main effect of Conditions showed that perceivers attended to this region significantly more when the targets were alone than when accompanied by another or observed ( $p < .001$ ), and when they were observed than accompanied by the experimenter ( $p < .001$ ). Furthermore, there was no significant interaction between the Conditions and the Gender of the Perceivers,  $F(1.64, 46.04) = 2.19, p = .13$ . For the Nose region, the pairwise comparisons with Bonferroni correction for Conditions revealed that perceivers attended to the region significantly less when the targets were alone than accompanied ( $p < .05$ ), and there was no significant between-subjects effect,  $F(1, 28) = 3.69, p = .07$ . Lastly, for the Eyes region, the pairwise comparisons with Bonferroni correction suggest that perceivers attended significantly more to the Eyes when the targets were observed than alone ( $p < .05$ ).

In summary, the eye movement data revealed that the duration perceivers fixated on the different regions of the targets' body and face varied according to the social conditions and the emotional video clips the targets experienced. In other words, there was no evidence of a particular pattern when looking at the targets' behaviour and making a judgment of whether they were alone or accompanied by another person. Rather, the relationship between the fixation duration on a region and the social condition the targets experienced was also influenced by the emotional video clip the targets were reacting to.

#### **7.4 General Discussion**

The aim of the experiment in this chapter was to further explore the scope of perceivers' ability to mentalise, specifically the ability to discriminate between social contexts (i.e.,

observed, alone). Previous experiments have shown that perceivers were able to infer when targets were alone in the room or observed by an experimenter after observing a brief sample of targets' behaviour. How sensitive are perceivers to the social contexts targets experienced? To investigate this, we developed a new set of stimuli in which targets were left alone in the room, observed ostensibly by the experimenter, and where targets were merely accompanied by the experimenter to watch the video clips together. With the additional social condition, perceivers were asked to judge whether targets were alone or accompanied by another person.

The results of Experiment 7 show that perceivers can detect the mere presence of another person by observing the target's behaviour. The results for the accompanied condition yield a similar effect to the observed condition. This suggests that perceivers were sensitive enough not only to interpret the behaviour of others, but they are also able to learn about the social presence or absence of others. Perceivers' judgments matched that of the research conducted in the area of social psychology that focused on the effects of social context on facial expressions which found that people acted differently in the presence of others; regardless it was implicit or explicit presence, as compared to when they were alone. These studies indicated that people either facilitated or inhibited their facial behaviour when in the presence of another person, depending on the emotions experienced and the role played by the accompanying presence. This suggests that perceivers might have used targets' behavioural cues and perceivers' own knowledge of how people behave in various social situations when experiencing different emotions to help mentalise whether the target was accompanied by another person or left alone.

In addition, the perceivers' results were similar across campuses. This could be due to the use of Asian perceivers from both campuses, reducing any possible cross-cultural differences in judgments. Therefore, for future studies, perceivers and targets from the Western population

could be examined to investigate whether it would yield similar results. If yes, it could suggest that perceivers from different cultures use similar techniques to infer social context from observing target's behaviour. Moreover, it could imply that targets use similar display rules when expressing themselves in various social situations. To further test perceivers' ability to mentalise, it would be useful to use a mix of Western and Asian perceivers and targets in a similar experiment to investigate whether there are any cultural differences in mentalising by incorporating in-group (targets and perceivers from similar cultures) and out-group (targets and perceivers from different cultures) factors. This would shed some light on perceivers' ability to infer social context, and the underlying processes involved during mentalising.

Furthermore, perceivers' sensitivity to the presence of another person is implicit in their eye movements. However, participants did not simply attend to a particular region for a specific social context. As with the pattern of results found in Chapter Six, the eye movements were systematically different for the different areas of interest depending on the social context the targets experienced and depending on the particular emotion the target was experiencing.

It is possible that in the accompanied condition, the experimenter's presence with the targets viewing the video clips created a similar effect or social motivation for the targets to when the targets were observed directly. As demonstrated by many of the studies investigating the effects of social context on facial expressions, the role and identity of the person being present with the target, as well as the implicit or explicit nature of the presence, also affect the way the targets behave (Parkinson, 2005). Hence, it would be useful in future studies to create various social conditions with the person accompanying the target, and varying the role and identity of the person, as well as the implicit or explicit nature of the presence, to examine

whether perceivers are still able to detect social context from target's behaviour. This would inform us of the scope of perceivers' ability in mentalising social context.

In summary, this study further supports previous findings that perceivers are sensitive to the social context of the targets. This is not only apparent in their judgements of the social context itself, but also in perceivers' visual attention. Furthermore, this experiment demonstrated that by having the experimenter accompany the target was sufficient for perceivers to discriminate when targets were alone or accompanied. This demonstrates perceivers' ability to 'know' the social world through the minds of others without having to directly experience it themselves.

## **CHAPTER EIGHT:**

### **GENERAL DISCUSSION AND CONCLUSION**

#### **8.1 Background Overview**

Humans can obtain a rich amount of information when interacting with others. This helps them to make sense of the interaction and in turn respond accordingly. Some of this information is directly observable, such as facial expressions, and some can only be accessed indirectly through the mind of others (Achim, Guitton, Jackson, Boutin, & Monetta, 2013). Mentalising refers to the ability to infer and interpret the mental states (i.e., beliefs, intentions, and emotions) of others. A central tenet of this thesis is that the process of mentalising is deployed in order to access information about the world, indirectly through the lens of other minds.

A large body of research in the area of theory of mind has focused on the processes involved in mentalising by investigating the factors involved in making these inferences. Research in the tradition of ‘person perception’ is somewhat different, focusing less on the process and more efforts to determine how accurately people make interpersonal judgments. Recently, some studies have begun to combine both approaches with the aim of establishing a more comprehensive understanding of people’s ability to mentalise.

Kraut (1982) stated that we can learn about the social contexts and the environment from the facial expressions of others; and there has been lots of research examining how people behave differently in different social contexts. However there is little evidence on how well people can infer the social context of a target (e.g. absence or presence of the experimenter in the company of the target). Social presence is likely to modify the target’s expression of emotions (Wagner & Lee, 1999) and so long as perceivers can sense that the target’s expression is being

modified then this might be sufficient for the perceiver to judge correctly when the target is accompanied and when the target is alone. The research described in this thesis thus aimed to investigate people's (perceivers') ability to detect the social context of the target. We employed the retrodictive mindreading procedure in which perceivers observed the reaction of targets to provocative stimuli and then had to infer whether the target was observed or alone. The provocative stimuli were film clips that we assumed caused an emotional reaction in targets, a reaction that could have been affected by the presence or absence of the experimenter. We assume that the facial expression of the target is effectively an embodiment of their mental state. Hence, in so far as the perceiver can interpret the facial expression, they can effectively interpret the underlying mental state. We also assume that perceivers might be able to detect whether this embodied mental state is being constrained in some way (by the presence of a third party observing the target). If so, it follows that perceivers are making the secondary inferential step of inferring something about the social context through the mind of the target.

Chapter Three describes the development of target stimuli in which perceivers were asked to infer the emotion the target was expressing to investigate whether this judgment is influenced by social context. Experiments in Chapter Four examined whether perceivers were able to effectively discriminate social contexts and whether the level of targets' expressiveness influences the perceivers' inference of social context. Chapter Five investigated how perceivers rated the intensity of targets' expressions to find whether there is any relationship between perceivers' inference of social context and their ratings of targets' expressiveness. Chapter Six replicated the experiments described in Chapter Four with the incorporation of eye-tracking and a reduced number of target stimuli to further our understanding of the scope of perceivers' ability to discriminate social context from observing the behaviour of others. Lastly, in Chapter Seven, a

new set of target stimuli was created to determine whether the mere presence of an experimenter is sufficient for perceivers to detect social context.

This chapter begins with a summary of the findings reported in Chapters Three to Seven, followed by a discussion of the implication of these findings, the limitations of this research, the future direction of this research, and a conclusion from the experiments described in this thesis.

## **8.2 Summary of Results**

### **8.2.1 Chapter Three: Stimulus Development**

Studies described in Chapter Three focused on the development of the target stimuli. We considered Ekman's six basic emotions as a point of reference when creating the target stimuli which allows us to investigate whether perceivers are able to detect the social contexts from observing target's emotional reactions to movie clips.

Experiment 1a was a validation of the movie clips where perceivers rated what they felt, the intensity of the emotion, and briefly described the scene that evoked the emotion for 34 different movie clips. The data obtained from this experiment helped select 14 movie clips to be used as stimuli when creating the target stimuli, and the description provided by the perceivers were used to aid the editing of the target stimuli. Meanwhile, Experiment 1b described the procedure involved when developing the target stimuli. This generated a total 140 stimuli which consisted of 10 targets reacting to seven different emotions (irritation, disgust, fear, amusement, neutral, sadness, surprise) in two different social contexts (alone, observed).

Experiment 1c investigated the effectiveness of the target stimuli created and perceivers' sensitivity to social contexts by asking them to infer the emotions expressed by the target. Perceivers were able to discriminate between the seven emotions for the two social contexts.

Furthermore, the findings indicated that perceivers were significantly more accurate when targets were alone than observed for irritation, disgust, fear and sadness. Meanwhile, for amusement, neutral and surprise, perceivers performed significantly better when targets were observed than when alone. In addition, female perceivers were significantly more accurate than male perceivers when judging that targets were expressing fear. Therefore, the variation in perceivers' accuracy of the emotions expressed by targets suggests that perceivers were sensitive to the social contexts targets experienced.

### **Interpretation**

The experiments described in Chapter Three not only showcased how the target stimuli were developed, but also perceivers' sensitivity to the social contexts targets experienced from judging the emotions expressed by targets. Is it possible that the perceivers' judgments of emotions expressed were affected by the social contexts targets experienced? The findings from Experiment 1c seem to have demonstrated this effect since perceivers' accuracy in the judgments of the emotions expressed by targets varied according to the social contexts targets experienced. For instance, perceivers were more accurate when targets were observed than alone for positive emotions (amusement, surprise) and the opposite effect was found for negative emotions (irritation, disgust, fear, sadness). This pattern of results corroborate with studies conducted to investigate the effects of social contexts on behaviour. Specifically, these studies have demonstrated that when in the presence of others, individuals tend to exaggerate their behaviour for positive emotions (e.g. Ekman & Friesen, 1975) and inhibit their expressions of negative emotions (e.g. Spain et al., 2000). From our findings, it seems that perceivers have some sort of insight into this phenomenon; hence their accuracy in rating the emotions expressed by targets

was also dependent on the social contexts targets experienced. Thus, is it possible that perceivers relied on targets' expressiveness to infer the emotions targets experienced? This will be addressed when reviewing further studies reported in this thesis.

In addition, it was found that female perceivers were more accurate than males when targets were watching fearful movie clips. This gender difference in accuracy rates supports research which suggests that females are more sensitive and accurate in recognising less intense emotional expressions (Hall & Matsumoto, 2004). However, there have been inconsistent results reported in various studies in the area of gender differences in emotional facial perception (Coleman, 1949). This seems to be the case for the performance for the other emotions involved in our study. Therefore, it might be premature to conclude that there are differences in performance between male and female perceivers. This effect is further explored in the remaining studies described in this thesis.

### **8.2.2 Chapter Four: Inferring Social Context and Expressiveness of Targets' Behaviour**

The experiments described in Chapter Four examined perceivers' ability to identify the two different social contexts (observed and alone) from observing the targets' emotional reactions and whether their judgments are dependent on the targets' expressiveness. Findings from Experiment 2 suggested that perceivers were able to distinguish when targets were alone and when they were observed. Their performance varied depending on targets' emotional reactions and the social context they were experiencing, especially when targets were watching movie clips depicting irritation, fear and sadness. In addition, the results showed that female perceivers were more likely to respond 'observed' when it was true compared with the male

perceivers, and this was mainly due to conditions in which targets were experiencing neutral or sad emotions.

Since perceivers' inferences of social context varied based on the emotional reaction of targets, Experiment 3 was conducted to investigate whether the expressiveness of targets' reactions influenced the perceivers' judgments of social context. Perceivers' ratings of the intensity of targets' expressions revealed that perceivers were effectively discriminating between conditions in which targets were alone and observed. Perceivers tended to judge that targets were inhibiting their expression of disgust when observed than when alone, but when targets experienced positive stimuli, perceivers judged that targets exaggerated their expression more when observed than when alone.

### **Interpretation**

The experiments described in Chapter Four suggested that perceivers were able to distinguish the social contexts targets experienced from observing targets' emotional reactions. Perceivers' performance varied based on the emotion and the social contexts the targets were experiencing in both experiments. This led us to question whether it was possible that certain emotions were easier to discriminate than others, and whether perceivers relied on targets' expressiveness when making inferences of the social contexts targets experienced. Findings from Experiment 3 revealed that perceivers were sensitive to targets' expressiveness in a way that effectively discriminated between social contexts. This effect was stronger for certain emotions (disgust, surprise) than others. The judgments made by perceivers thus mirrors findings reported in social psychology research on how a target's emotional expressions are moderated by the presence of an audience (e.g. Ekman, 1972; Kraut, 1982; Kilbride & Yarczower, 1980). In turn,

this raises the possibility that perceivers in Experiment 2 made inferences about the target's social context based on an implicit understanding of how an audience affects the emotional expression of the target depending on whether the emotion is positive or negative.

An alternative explanation is that perceivers used low-level cues such as targets' eye gaze to infer social context – for example, perhaps the target looked away from the screen (and towards the observer) more often when an observer was present than when absent. However, it was demonstrated in Experiment 2 that the number of times targets looked away from the monitor did not lead to easier discrimination of the social context they were in, suggesting that perceivers were using other cues when making such judgments. Nevertheless, eye-tracking was incorporated into later experiments to further investigate and understand the implicit processes involved when identifying the social contexts targets experienced.

Moreover, findings from Experiment 2 indicated that female perceivers may be better at identifying social contexts than the male perceivers; however data from Experiment 3 did not reveal any gender differences in identifying the social contexts. This is consistent with previous studies in the area of facial expressions recognition, which have failed to identify any differences in performance between male and female perceivers (e.g. Hoffman et al., 2010; Kessler et al., 2005).

### **8.2.3 Chapter Five: Linking Targets' Expressiveness with Perceivers' Ability to Discriminate Social Context**

Two pilot studies were conducted to gain a better understanding of how perceivers rate targets' expressiveness. In addition, we narrowed the number of stimuli used to irritation, disgust and surprise because the findings in Experiment 3 showed that these emotions yielded stronger

results. In both pilot studies, perceivers were asked to rate the intensity of targets' expressions, and write down why they thought the target was controlling his/her expressions. The intensity ratings from both studies revealed similar pattern of results to what was found in Experiment 3. In addition, the results from the open-ended questions from both pilot studies suggested that perceivers' responses were largely influenced by the way the question was phrased, instead of reflecting how the perceivers made such judgments. Thus, this method of measurement was abandoned in future experiments for a more objective measurement that gives an insight on the processes involved in making such inferences – eye-tracking.

#### **8.2.4 Chapter Six: Inferring Social Context and Expressiveness of Targets' Behaviour with Eye -Tracking**

Experiments described in Chapter Six were similar to those reported in Chapter Four but with the addition of eye-tracking. As with the pilot studies described in Chapter Five, we only used target reactions to stimuli that provoked irritation, disgust and surprise

The behavioural data for both experiments described in Chapter Six replicated that of previous experiments where perceivers were able to distinguish when targets were alone and when they were observed, and their ratings of targets' expressiveness varied according to the social contexts and the emotions experienced by the targets; there were no gender differences in perceivers' judgments.

Eye-tracking data for both experiments revealed that perceivers' eye gaze at the different regions varied depending on the social context. For the Body region, it was found that perceivers tended to attend to the region longer for irritation and disgust when targets were alone than when observed, and longer for surprise when targets were observed than alone. Meanwhile for the

remaining three regions, there were slightly different results between the two experiments. In Experiment 4, it was found that perceivers attended to the Mouth and Nose regions more when targets were alone than observed for disgust. Meanwhile, perceivers spent more time looking at the Eyes region when targets were observed than when alone for irritation and disgust. In Experiment 5, it was revealed that perceivers looked longer at the Mouth region when targets were alone than observed for surprise, and the reverse effect was obtained for irritation. For the Nose region, perceivers spent more time on the region when targets were alone than when observed for both disgust and surprise. Lastly, for the Eyes region, perceivers attended to it more when targets were observed than when alone. There was no gender difference in the time spent on the different regions. Therefore, the relationship between the time spent on a region for a particular social context is a complex one since the amount of time perceivers spent looking at a region depended not only on the social context but also on the valence of the emotion experienced by targets (positive or negative).

### **Interpretation**

Both experiments presented in Chapter Six demonstrated that perceivers were able to discriminate between the two social contexts from targets' emotional reactions. For instance, perceivers judged that targets were inhibiting their negative (disgust, irritation) expressions to a greater degree when observed than when alone. Conversely, perceivers rated that targets tended to exaggerate their positive (surprise) expression to a greater degree when observed than when alone. It seems therefore, that perceivers were sensitive to the social contexts targets were experiencing in their ratings of targets' expressiveness. Furthermore, perceivers' judgments of whether targets were alone or observed indicated that they were explicitly discriminating the two

social contexts. These findings suggest that perceivers seem to have an understanding of the effect of social context on targets' emotional expression. Therefore, it is plausible to suppose that perceivers used targets' expressiveness as a basis to infer the social context.

The eye-tracking data from both experiments revealed that perceivers' eye gaze patterns were systematically different for the various regions depending on the social context of the targets. Perceivers did not simply look at specific regions more when targets were alone than observed (or the opposite); instead the eye gaze pattern showed a complex relationship between the social context of the targets and the particular emotion the targets were experiencing. For instance, for both experiments described in the chapter, the body region was attended to more when the target was alone than observed for irritation and disgust and the opposite effect was observed for surprise. This looking behaviour could be due to the increased movement among the targets in the alone condition for the negative emotions and observe condition for the positive emotion. This matches the perceivers' judgment of the intensity of target's emotional reactions. Furthermore, in Experiment 4, perceivers attended to the mouth and nose regions more for disgust when the target was alone than observed. This could be explained by the facial movements involved when expressing disgust which mostly involve the central region of the face. Meanwhile, in Experiment 5, perceivers attended to the eyes region more when targets were observed than alone, suggesting the possibility that perceivers relied on the region to judge the intensity of the targets' expressions which in turn was influenced by the targets' social contexts. In addition, regardless of the question posed to the perceivers (whether they were asked about social context or whether they were asked about the target's expressiveness); their eye gaze pattern suggested that perceivers were influenced by the targets' social contexts, as well as the emotion the targets were experiencing. Hence, it seems that the social context influenced

the targets' emotional reactions, which in turn affected the perceivers' eye movement behaviour in a way that further demonstrated their sensitivity to when targets were alone or observed.

### **8.2.5 Chapter Seven: Alone, Accompanied, Observed – Perceivers' Sensitivity to Social Context**

The experiment conducted in this chapter investigated perceivers' sensitivity to the social context the targets experienced on both an implicit (eye-tracking) and an explicit level, with an additional condition (accompanied). The 'accompanied' condition consisted of the experimenter seated next to the target, facing the laptop's screen to watch the movie clips together, which was different from the 'observed' condition where the experimenter was seated next to the target but facing them instead of the screen while simultaneously jotting down notes of the target's behaviour. The results revealed that perceivers were able to discriminate when targets were alone or accompanied by another. Furthermore, there was no significant difference in the judgments of targets being observed and accompanied.

The eye-tracking data yielded a similar pattern of results to that reported in Chapter Six where perceivers' eye movements systematically varied for the different regions depending on the social context and emotion targets were experiencing. The Body region was focused on more when targets were alone than when they were accompanied or observed and this could be due to targets inhibiting less of their movements within this region when left alone. For the Mouth and Nose regions perceivers spent less time on these areas when targets were alone than accompanied and observed. Meanwhile the Eyes region was least attended in the observed condition compared with the alone and accompanied conditions.

A gender difference was found in the eye-tracking data where female perceivers attended to the Nose region longer than the male perceivers. Additionally, female perceivers attended to the Mouth more than males when targets were observed than accompanied.

## **Interpretation**

The findings in Chapter Seven suggest that the mere presence of another individual is sufficient for perceivers to detect that targets were accompanied. This was demonstrated on both an implicit and an explicit level. Perceivers were able to discriminate when asked explicitly if the target was accompanied or alone. Moreover, the eye-tracking data showed perceivers' dwell time for any particular region was affected by the valence of the emotion experienced by the target and by the social context. This was similar to the findings reported in Chapter Six. Moreover, the results for the 'accompanied' condition yielded similar results to the 'observed' condition, suggesting that the mere presence of another person in the room is sufficient for perceivers to detect a modulated reaction in the targets depending on whether they were reacting to something positive or negative. Therefore, perceivers are able to know something about the social world by interpreting how others express their emotions without needing to have any direct experience of the world inhabited by the target.

## **8.3 Implications**

### **8.3.1 Retrodictive Mindreading**

The aim of this thesis was to investigate and further understand people's ability in learning about the world through the minds of other people. The findings demonstrated that perceivers are able to make correct inferences about the target's social context (observed or

alone). Past research by Pillai et al. (2012, 2014) and Cassidy et al. (2013, 2015) suggested that people have the ability to make backwards inferences from observing the target's behaviour, to their mental state, and from the mental state embodied in behaviour to the antecedent cause of that mental state. In these studies, perceivers were able to make systematic inferences about the experimenter's behaviour or the type of gift the experimenter gave to the target. The findings reported in this thesis thus extend the scope of research into people's ability to make retrodictive inferences: Perceivers can guess what was said to the target, what was given to the target and we now know they can also interpret the target's emotional reaction to infer the target's social context. Hence, it seems that retrodictive mindreading has a broader scope than suggested by research conducted by Pillai et al. and Cassidy et al. The limit of this scope remains unknown but at least we have established that it is broader than previously thought.

The suggestion that people can interpret the behaviour of others by attributing mental states is supported by many (e.g. Baron-Cohen et al., 1997; Dennett, 1978). For example, Baron-Cohen and Cross (1992) found that people are able to infer what someone is thinking by observing the direction of their eye gaze. In addition, Ekman and Friesen's (1971, 1975) studies demonstrated that people's ability to recognise basic emotions indicates that mental states are embodied and indeed observable in behaviour, in this case, the face. Baron-Cohen et al. (1997) went on to claim that mentalising involves a mix of 'top-down' (using prior knowledge or context about how one mental state relates to the other), and 'bottom-up' process (e.g. mental states are expressed in behaviour). In other words he was proposing that our mental states are expressed through our behaviour and our behaviour is driven by our mental states.

Perceivers' ratings of the target's expressiveness seem to support the notion that people are able to correctly judge target's social context from observing target's behaviour which is an

embodiment of their mental states. Instead of finding a straightforward effect such as people judging that targets tend to inhibit their expression more when observed than alone (or the opposite) across all the emotional reactions, our studies showed that perceivers tend to rate that targets were inhibiting their expressions of negative emotions (e.g. disgust, irritation) when in the presence of others than when alone. Conversely, perceivers judged that targets tend to exaggerate their expressions of positive emotions (e.g. surprise) when in the presence of others than when alone. This complex relationship between the target's expressiveness and the social context that modified the expression is also dependent on the emotional movie clips the targets watched. The variation in perceivers' ratings demonstrated that people are sensitive to the effects of social context on targets' expressiveness which raises the possibility that perceivers' ability to judge social context may be based on their understanding of the effects of social context on targets' expressiveness of their emotional reactions.

The possibility that perceivers may have relied on the target's expressiveness of their emotional reactions to infer social context is plausible because when a perceiver observes a target, not only the emotion of the target needs to be identified, but the intensity of the expression and its cause are usually identified together (Hess & Hareli, 2015). Hess and Hareli (2015) continued by stating that there is a lack of research on the influence of social norm knowledge on the perception of emotions. Even though this thesis is not focused on perceivers' ability to decode social norms or recognise emotions, the investigation of perceivers' ability to identify the social context from observing targets' emotional reaction can help to address Hess and Hareli's statement.

Research investigating the effect of social context on behaviour has found that individuals tend to exaggerate or inhibit their behaviour when in the presence of others

depending on the emotions felt (Kraut, 1982). Some studies have found that individuals tend to inhibit their expression of negative emotions (e.g. disgust, fear) when in the company of others (Spain et al., 2000), but exaggerate their expression of positive emotions (e.g. happiness, surprise) when in the presence of others (Buck, 1984; Ekman & Friesen, 1975). These findings are what Ekman (1972) referred to as display rules which are social and cultural rules that guide one's behaviour and expression of emotions in a particular social context as deemed appropriate. A large body of research has since been developed to further understand the impact of social context, especially display rules on the behaviour of targets, particularly their facial expressions (Hess & Hareli, 2015).

The pattern of behaviour found by studies investigating the effects of social context on the expression of emotions mirrors that of our perceivers' judgments of targets' expressiveness for the different social contexts and emotions experienced by the target. Hence, is it possible that perceivers use this insight that a target's expressiveness is moderated by the social context as the basis for making a correct inference of the social context? If so, it is not a surprising discovery that targets' expressions vary depending on the social context, since perceivers seem to have this knowledge all along. Therefore, it seems plausible that perceivers have acquired the knowledge of social norms and display rules through socialisation over the years and applied this knowledge when inferring the target's social context.

As mentioned earlier in Chapters One and Two, research in the area of mentalising has tended to focus on how people infer the mental states of others without taking into account how accurate people are at making these inferences. Zaki and Ochsner (2011) suggested that the most effective method of investigating people's ability to mentalise involves not only measuring how perceivers mentalise, but also how capable they are at it. Ickes' (1997, 2003) empathic accuracy

comes close to achieving this by relying on targets' self-report of their own mental state as a point of comparison to measure perceivers' accuracy. By using the retrodictive mindreading paradigm (Cassidy et al., 2013; Pillai et al., 2012, 2014), we are able to measure perceivers' ability to infer targets' social context from observing their spontaneous reactions by comparing perceivers' responses to an objective criterion (observed or alone), as well as gain an insight into how perceivers achieved this inference by asking perceivers to rate the expressiveness of targets' behaviour and the use of eye-tracking. This demonstrated the advantage that the retrodictive mindreading paradigm has over methodologies used in previous research.

Additionally, our findings provide further support that individuals are able to learn about the target's world by observing the target's behaviour. In other words, we are able to learn about the world through the lens of other minds (Pillai et al., 2012). It is useful to be able to infer the social context from a brief observation of another since it allows us to learn about the social world through the experiences of others without the need to have a first-hand experience (Frith & Frith, 2007). In turn, we are able to use this information to guide our own response to the novel situation (also known as social referencing). For instance, we are able to gauge whether the context is approachable or threatening from observing the behaviour of others. Additionally, by being able to detect a target's social context from observing their behaviour, it seems that perceivers are aware that people are able to manipulate their own behaviour in various social situations (e.g. inhibiting or exaggerating their expressions when in the presence of others) which in response, perceivers are then able to manage their own reactions and behaviour which is vital when interacting with others.

Overall, the findings described in this thesis demonstrate how sensitive and able perceivers are in making retrodictive inferences. Apart from being able to detect the

experimenter's behaviour (e.g. Pillai et al., 2012, 2014) and the cause of the target's reaction (e.g. Cassidy et al., 2013, 2015), our findings provided evidence that perceivers were able to infer the presence or absence of an experimenter which modified targets' emotional reactions. The results thus testify to the versatility of our ability to mentalise.

### **8.3.2 Eye-tracking**

From our studies, it is evident that perceivers do not look more at a particular region when targets were alone (or when targets were observed); instead perceivers' eye movement pattern differed depending not only on whether the target was observed or alone but also on the valence of the target's emotional reaction. For instance, perceivers tended to look at the Body region more when targets were alone than observed for irritation and disgust, but for surprise the opposite effect was found where perceivers attended to the Body more when targets were observed than alone. This could be due to targets inhibiting their expressions of disgust and irritation less when left alone as compared to when they were being observed. Based on Pillai et al.'s (2012, 2014) studies which demonstrated that perceivers' eye movements varied according to the scenarios experienced by the target, this variation in eye movements suggest that perceivers are able to discriminate between the scenarios on an implicit level. In addition, Cassidy et al.'s (2013) study also revealed that perceiver's eye gaze patterns varied according to the gift the target received, instead of a simple effect between the time spent on a region and the type of gift received. Hence, the different time spent looking at the various regions for the social contexts suggests that the effect of social context on the target's behaviour impacted on perceivers' eye movements which demonstrate their sensitivity to the target's social context and emotional reaction at an implicit level.

It has become common in social cognition research as well as mentalising research to examine the evidence for implicit and explicit understanding. For example, Piaget (1968) found that infants aged eight months demonstrated object permanence through reaching behaviours, while Baillargeon (1987) discovered that infants as young as four months demonstrated similar understanding via looking times. This type of discovery led some researchers to suppose that these two types of measures index different types of knowledge (Ruffman, Garnham, Import, & Connolly, 2001). Frith and Frith (2008) defined implicit as a lower level of cognition which occurs rapidly, automatically, and without awareness. Explicit process, on the other hand, is a higher level cognition that requires mental effort. To illustrate the difference between these two processes in a false belief task, it is commonly found that children around the age of five years are able respond correctly, thus revealing an explicit knowledge of false belief (Wimmer & Perner, 1983). However, Clements and Perner (1994) then found that children around age three will search at the correct location but give an incorrect response when asked directly, hence demonstrating an implicit understanding of false belief. The implicit understanding of false belief was further shown in Onishi and Baillargeon's (2005) study with the eye movements in infants aged between 12 and 15 months. In addition, Schneider et al. (2012) tested adults with a false belief task and incorporated the use of eye-tracking technology. The participants' eye movement patterns and responses from the post-experimental debriefing procedure indicate false belief processing without the awareness of such behaviour. In other words, people have the ability to implicitly monitor the mental states of others (Schneider, Slaughter, & Dux, 2015). However, recent research suggests that explicit and implicit mentalising processes overlap, and should not be viewed as distinct processes from one another since they both share certain functional features (e.g. the demand on working memory) (Schneider et al., 2015).

The studies presented in this thesis are enlightened by Cheesman and Merikle's (1984) definition of objective and subjective threshold of consciousness in connection with the implicit-explicit distinction. The objective threshold is related to whether individuals perform above chance on a task, and the subjective threshold is whether individuals believe they are guessing, indicating a lack of awareness of their knowledge (Ruffman et al., 2001). For instance, Clements and Perner's (1994) study on false belief suggests that children have an implicit knowledge of false belief via their eye gaze data; however, there is no evidence on whether the children were aware of the knowledge implied by their eye gaze. Therefore, although, the study showed that the children have an implicit understanding of false belief at the level of their eye movements, it is undetermined whether this understanding is actually implicit (i.e., without awareness). Hence, for the eye-tracking studies described in this thesis, when we use the term 'implicit' we meant on the eye movement level, not that the perceivers have an implicit understanding since we are not able to evaluate perceivers' awareness of the knowledge indicated by their eye movements. Therefore, by connecting perceivers' varied eye gaze pattern at the different regions of the target to perceivers' responses, it is evident that they are able to discriminate between the target's social context on both explicit and implicit levels.

### **8.3.3 Gender Differences**

An incidental aspect this thesis investigated whether there were any gender differences in performance. In folk psychology, female perceivers are viewed to be more emotional, sensitive and better mind readers than male perceivers (Krach et al., 2009). Some research has demonstrated that girls perform better than boys in mental state talk (Hughes & Dunn, 1998) and emotion understanding (Dunn, Brown, & Beardsall, 1991). In addition, various studies have

found a female advantage in mentalising abilities among children (e.g. Bosacki & Astington, 1999) and adults (e.g. Baron-Cohen & Hammer, 1997). However, other studies did not find such gender difference in performance (Jarrold, Butler, Cottington, & Jimenez, 2000).

In the research on emotion recognition, findings are inconsistent as to whether female perceivers are more accurate at recognising emotional expressions than male perceivers (Coleman, 1949), with some studies indicating no differences in performance between male and female perceivers (e.g. Rahman et al., 2004), and others suggesting female perceivers are more sensitive in observing subtle emotional expressions (Hall & Matsumoto, 2004).

The studies presented in this thesis only found gender differences in performance for Experiment 1c (for fearful stimuli only) and Experiment 2 (for neutral and sadness stimuli, where females tended to respond ‘observed’ more than males when it was true) when all seven of the target’s emotional reactions were used but not in other experiments when the number of emotional reactions was limited. With the exception of the eye-tracking data in Experiment 7 where female perceivers attended to the Nose region longer than the male perceivers, female perceivers also attended to the Mouth more than males when targets were observed than accompanied. Due to lack of evidence, we are inclined to suppose that gender differences are not an important factor in performance when perceivers were asked to infer targets’ social context and the intensity of their expressions. It seems that male and female perceivers performed similarly in detecting targets’ social context on an explicit and implicit level.

This contrasts with Baron-Cohen et al.’s (1997) finding of a female advantage in the ‘Reading of the Mind from the Eyes’ task where perceivers were shown photographs of the eye region to infer what the target might be thinking or feeling. Moreover, the lack of gender differences in performance reported in this thesis supports the many studies on mentalising that

found no gender differences or a female advantage (Nash & Grossi, 2007). Thus, the robustness of such a gender effect is questionable.

#### **8.4 Limitations and Future Research**

One of the limitations of the studies reported here is that it is confined to Asian targets and perceivers only. As suggested by various studies, there is an in-group advantage when it comes to recognising emotions, whereby members of the same nationality and/or ethnicity find it easier to recognise the emotions expressed by targets from the same group (Elfenbein & Ambady, 2002). Wallis (2015) investigated similar effects we examined in this thesis with other nationalities and ethnicities, predominantly British targets and perceivers, and found similar results where perceivers were able to distinguish targets' social context. Hence, this suggests the possibility of generalisability across cultures in perceivers' ability to infer social context from brief observations of targets.

In addition, cross-cultural studies examining mentalising abilities among children did not find any differences in performance (e.g. Avis & Harris, 1991); however, Lillard (1998) suggests that cultural differences could play a larger role in adult mentalising (Frith & Frith, 2003). Thus, it will be interesting to further investigate whether there are any differences in performance cross-culturally, especially when research in display rules has indicated differences between cultures in the way people behave and express themselves in various social situations (Ekman, 1972, Hochschild, 1979). Furthermore, Fischer et al. (2003) suggested that individuals from a more collectivistic culture often relied on the judgments and behaviour of others in social interactions, while individuals from a more individualistic culture tend to refer to their own concerns and self-esteem when interacting with others. In addition, recent studies in face

perception found cultural differences in the strategies employed when attending to faces (e.g. Blais et al., 2008, Kelly et al., 2010, Tan et al., 2012). Therefore, by including targets and perceivers from different cultures (i.e., collectivistic vs individualistic), it might provide further insight as to whether there are any cross-cultural differences in retrodictive mindreading on both implicit and explicit level, and whether perceivers attend to display rules when making such inferences.

Another limitation of the research presented here is the lack of concrete evidence of a direct association suggesting that perceivers rely on the target's expressiveness to discriminate the social context. Wallis (2015) asked perceivers to rate the targets' expressiveness (1 = Non-expressive... 6 = Very expressive) and the probability that the targets were accompanied (1 = Not likely... 6 = Very likely). The results indicated that perceivers made a connection between targets' expressivity and their social context. This supports the suggestion that perceivers rely on both low-level cues (i.e., target's facial expressions) and higher-level clues (i.e., knowledge of display rules) to infer the social context. However, Wallis' (2015) study revealed that perceivers who are better at inferring social context did not base their judgments solely on the target's expressiveness: Other factors may also contribute in making such an inference.

In addition, it will be interesting to extend current research by involving different types of observers (e.g. friends, higher or lower status observer, different genders) to expand on the influence it has on the target's behaviour to investigate whether perceivers are more able to detect the social context for one type of observer than another. In short, different types of observer affect the way targets behave (e.g. Devereux & Ginsburg, 2001), and it will be informative to investigate perceivers' scope of inferring social context, and specifically whether

perceivers are more able to determine targets' social context depending on who is observing the targets.

There has been an increasing interest in recent years in the neural basis of mentalising (Frith & Frith, 2006). Results have implicated a set of regions that include the superior temporal sulcus (pSTS) and temporoparietal junction (TPJ); generally, the medial prefrontal cortex and the temporal poles are activated when perceivers think about the mental states of others (Frith & Frith, 2003, 2006). For example, Funnell (2001) found that damage to temporal lobes can hinder one's ability to use the knowledge we have about the world from how feelings affect behaviour to knowing the types of situations we should avoid because they are dangerous. This knowledge is crucial for the process of mentalising.

However, there is a lack of research into the neural basis of retrodictive inferences; thus, incorporating neuroimaging techniques into the investigation allows further insight into the processes involved when making these kinds of judgment. It also enables us to further investigate the implicit level of understanding perceivers have on making such inferences.

Lastly, Ickes' (1997, 2003) empathic accuracy research prides in its naturalistic approach where the target's behaviour occurs in a natural social environment with at least one other individual as their interaction is recorded. The video stimuli created for the studies reported in this thesis were similar whereby targets' behaviour was video recorded covertly as the targets were observed by the experimenter or alone in the room. Even though the targets' behaviour was spontaneous, the setting in which the targets were recorded was still somewhat controlled. Therefore, in future research, it would be beneficial to create an even more naturalistic setting for the targets and the observers in order to construct more ecologically valid stimuli.

## 8.5 Conclusion

In summary, the studies presented in this thesis suggest that perceivers were able to know about the social world through observing the behaviour of others. Specifically, perceivers were able to distinguish targets' social context from a brief sample of target reactions to emotional movie clips on both an explicit (response) and an implicit (eye movements) level. Moreover, the mere presence of another person, who did not overtly observe the target, is sufficient for perceivers to detect that the target was accompanied rather than alone. It seems plausible to suppose that perceivers rely on the target's expressiveness to infer the target's social context. This is evident from perceivers' ratings of the intensity of target expressions – perceivers rated that targets tended to inhibit their expressions of negative emotions when being observed than when alone and they rated that targets tended to exaggerate their expressions of positive emotions when observed than when alone. This accords with previous studies which examined the effect of social context on behaviour, especially facial expressions. However, past studies conducted in the field of social context and facial expressions mainly focused on the targets, and how their behaviour is influenced by different situations, but there is a lack of research which directly examines perceivers' ability to gauge social context from observing the behaviour of others. It is nevertheless important to investigate what perceivers can infer from observations of target behaviour since it draws upon an ability that not only allows perceivers to learn something about the world indirectly through observing others, but it also demonstrates the power of an inference that can be drawn from a tiny amount of information contained in a brief sample of behaviour when interacting with others.

This research offers a further demonstration of the value of Pillai et al.'s (2012, 2014) and Cassidy et al.'s (2013, 2015) retrodictive mindreading paradigm. It extends Pillai et al.'s and

Cassidy et al's research which demonstrated that perceivers have the ability to infer an aspect of a social interaction with the experimenter (e.g. the experimenter's behaviour, the gift received from experimenter), to now indicating that people are sensitive enough to also infer the presence or absence of an experimenter. With this design, we are able to gauge perceivers' mentalising ability (accuracy), and shed some light on the processes involved in making such retrodictive inferences. This is a major strength since it incorporates the aims of person perception research and mentalising research which tended to focus on investigating either perceiver's accuracy in making a social judgment or how they made such decisions (but not both). This enables us to understand the scope and activity involved in reading others' minds.

Since early in development we are able to learn about the nature of an environment (whether it is safe or not) from observing our caregiver; it is possible that this ability to learn about the world from others develops over the years to enable individuals to infer the presence or absence of another individual from a brief observation of the behaviour of a third party. In turn, we are able to use this knowledge to guide our own behaviour to ensure smooth interactions with others.

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## Appendix 1

List of video clips used in Experiment 1a and its sources:

1. **Anger Clip 1: YouTube: “The Most Annoying Video on YouTube”**  
Source: [http://www.youtube.com/watch?v=O6D2g\\_txXZ4](http://www.youtube.com/watch?v=O6D2g_txXZ4)
2. **Anger Clip 2: YouTube: “The Most Irritating 9:36.47 Minutes of Your Life”**  
Source: <http://www.youtube.com/watch?v=z-TykljBz-E&feature=share&list=PLEC5EABF55CD6EDF6>
3. **Anger Clip 3: YouTube: “Baby Crying”**  
Source: <http://www.youtube.com/watch?v=qS7nqwGt4-I>
4. **Anger Clip 4: YouTube: “NyanCat: Trollololol Edition”**  
Source: <http://www.youtube.com/watch?v=hvj8b1Ia1hw&feature=share&list=PLEC5EABF55CD6EDF6>
5. **Anger Clip 5: YouTube: “I Will Respect Anyone Who Can Watch the Whole Thing”**  
Source: [http://www.youtube.com/watch?v=vxOuECN03RQ&list=PLEC5EABF55CD6EDF6&index=43&feature=plpp\\_video](http://www.youtube.com/watch?v=vxOuECN03RQ&list=PLEC5EABF55CD6EDF6&index=43&feature=plpp_video)
6. **Disgust Clip 1: “127 Hours” by Danny Boyle**
7. **Disgust Clip 2: YouTube: “Pituitary Surgery”**
8. **Disgust Clip 3: “Requiem for a Dream” by Darren Arnofsky**
9. **Disgust Clip 4: “V/H/S” by Joe Swanberg**
10. **Disgust Clip 5: “Excision” by Richard Bates Jr.**
11. **Fear Clip 1 & 2: “Insidious” by James Wan**
12. **Fear Clip 3: “The Woman in Black” by James Watkins**
13. **Fear Clip 4: “American Horror Story, Pilot” by Ryan Murphy**
14. **Fear Clip 5: “American Horror Story, Piggy Piggy” by Michael Uppendahl**
15. **Happy Clip 1: “FRIENDS, The One Where Joey Speaks French” by Gary Halvorson**
16. **Happy Clip 2: “FRIENDS, The One with the Cop” by Andrew Tsao**
17. **Happy Clip 3: “FRIENDS, The One with Unagi” by Gary Halvorson**
18. **Happy Clip 4: “FRIENDS, The One Where Emma Cries” by Sheldon Epps**
19. **Happy Clip 5: “FRIENDS, The One with Ross’s Tan” by Gary Halvorson**

20. **Neutral Clip 1: “The Love We Make”** by Bradley Kaplan & Albert Maysles
21. **Neutral Clip 2-4: “Secrets of Middle-Earth: Inside Tolkien’s ‘Lord of the Rings’** by Chris Gormlie
22. **Sad Clip 1: YouTube: “Very Sad Thai Insurance Commercial”**  
*Source: <http://www.youtube.com/watch?v=hyVfKDrAAJg>*
23. **Sad Clip 2: “The Champ”** by Franco Zeffirelli
24. **Sad Clip 3: “Marley & Me”** by David Frankel
25. **Sad Clip 4: YouTube: “TC Bank, The Courage of Mother”**  
*Source: <http://www.youtube.com/watch?v=ngHfyUIH6hM>*
26. **Sad Clip 5: “Up”** by Pete Docter & Bob Peterson
27. **Surprise Clip 1: YouTube: “Mike Henderson – Britain’s Got Talent 2009”**  
*Source: <http://www.youtube.com/watch?v=0TfsHBLuZkE>*
28. **Surprise Clip 2: YouTube: “A Giant Dead Snake”**  
*Source: <http://www.youtube.com/watch?v=z2i-C10vxbI>*
29. **Surprise Clip 3: YouTube: “Relaxing Car Drive”**  
*Source: <http://www.youtube.com/watch?v=GMgsFZ4rkEI>*
30. **Surprise Clip 4: “Grave Encounters”** by The Vicious Brothers
31. **Surprise Clip 5: “Mulholland Dr”** by David Lynch