Individual Differences in Contextual

Effects on Interpreting Facial Expressions

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Abstract

Classification of facial expressions involves interpreting both the face and the context in which the face appears. Generally, it is believed that cues from the context influence the classification of facial expressions because the context shifts viewers' *perception* of the face. However, we questioned the validity of this conclusion due to methodological limitations of past studies leading to it. Therefore, the first aim of this thesis was to examine whether contextual cues indeed shifted viewers' perception of facial expressions. We carefully examined this using a recently developed psychophysical method that aims to isolate the contribution of perceptual processes to viewers' behavioural responses about facial expressions. Second, we highlight that there is a considerable amount of variability in the extent to which different individuals experience the effect of context on classification of facial expressions. Accordingly, in this thesis, we also conducted a series of experiments to identify the source of such individual differences.

In Chapters 2 and 3, we show that changes in classification of facial expressions that result from contextual cues (body gestures in our case) is not due to changes in the perception of the face. Accordingly, we claim that contextual effects on classification are the product of changes in post-perceptual (e.g., decisional) processes contributing to classification. In Chapter 3, we also demonstrate that both perception and classification of facial expressions shift in the direction of the emotion conveyed by the context, although the two effects appear to be independent of each other. The size of these shifts increased with greater disparity in emotion between how viewers perceive/classify isolated facial expressions and the emotion signalled by the context. We replicated this relationship for the classification of facial expressions in Chapters 4 and 5 as well, with large effect sizes. Based on this recurring effect, we claim that individual differences in how facial expressions (alone) are interpreted is a crucial determinant of individuals' susceptibility to the influence of contextual cues.

In Chapters 2 to 5, we also explored various other individual differences. We find that individual differences in the severity of clinical traits (autism, depression, alexithymia and anxiety), thinking styles (holistic and analytical), self-construals (independent and interdependent) and the deployment of overt attention between the face and context, do not account for the variability in the level of contextual effects experienced by our participants. Although we found in Chapter 4 that culture seems to play a role, with Western British participants experiencing larger contextual effects than Asians. We believe this was a result of Western participants' greater familiarity with Caucasian faces and body gestures that we used as stimuli.

Drawing on our findings, we propose a novel "seeds and conflict theory", wherein the degree of *conflict* between an individuals' subjective evaluation of the target facial expression and the representation of an expression activated by a context (i.e., primed) drives the strength of contextual influence. Accordingly, while existing theories of contextual effects (e.g., emotion seeds hypothesis) cannot explain some of our findings, in Chapter 6, we provide a critical evaluation of theories and show that our *seeds and conflict theory* can account for our findings across all empirical Chapters (2-5), as well as findings from previous studies in the literature.

Keywords: Facial Expressions, Contextual Effects, Individual differences

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Matthew 9:29 "Because of your faith, it will happen"

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Declaration

I declare that this thesis is the result of my own work completed under the normal terms of supervision.

Chapter 1. Literature Review

1.1. Defining "emotions", historical perspectives and functions of emotions

1.1.1. What are emotions?

Emotion pervades every aspect of our daily lives, yet there has been considerable controversy on what constitutes as an emotion. To this day, there is much debate regarding what parameters can be used to reliably operationalise emotions. Historical accounts on "emotions" can be dated back to great philosophers, such as Plato (ca. 428 - 347 B.C.) and Aristotle (384 - 322 B.C.). Plato introduced his evaluation of emotions in his book The Republic on the "tripartite soul" composed of reason, spirit and appetite (Knuuttila, 2014; Solomon, 1993). According to Plato's account, emotion was differently related to each of the three parts, where the "appetitive" part was pleasure seeking and the "spirit" related to self-affirmation and aggression. Finally, "reason" governed these emotional parts by assessing them against internal knowledge and ethical values (i.e., appraisal). Similarly, Aristotle also regarded emotions in relation to the soul, but his account would be the closest historical perspective that aligns with the contemporary theories of emotion. He operationalised emotions based on four elements (Knuuttila, 2014), namely, cognition (i.e., evaluate a stimulus as positive / negative), affect (i.e., pleasant or unpleasant), dynamic (i.e., readiness to take action) and physiological changes (i.e., bodily responses). Between these two philosophers, an emotional experience was characterised by components, such as cognitive appraisals, behavioural tendencies and physiological arousal.

Clearly, from these historical accounts, we can see the early emergence of structural components that contemporary theories have used when defining emotions. Nevertheless, given that we do not delve into the exact nature of emotions, the scope of this thesis considers an emotion as “a complex reaction pattern, involving experiential, behavioural, and physiological elements, by which an individual attempts to deal with a personally significant matter or event”, in accordance with the American Psychological Association (APA Dictionary of Psychology, 2018). Based on this definition, an emotional experience is characterised by three main components, namely, subjective “feelings” of emotion, physiological reactions and behavioural responses. First, the “feeling” component refers to the subjective conscious experience of emotion that can be unique from one individual to another. For example, at a football game, the fans on the winning side experience vastly different feelings (e.g., happiness, pride) to those on the losing side (e.g., sadness, anger). Furthermore, this “feeling” component is thought to be related to cognitive appraisals regarding a stimulus / event and therefore is involved in monitoring whether a triggering event leads to the same responses at different time points (Moors, 2005). Second, physiological changes in the body (e.g., changes in temperature, hormone levels, heart rate, sweating) in response to a stimulus is important in preparing the individual to take action. For example, fear includes physiological changes such as increased heart-rate and blood flowing into the skeletal muscles, preparing the individual to flee if needed. Finally, behavioural or motor responses consist of expressive behaviour which communicates to the outside world that an individual is going through an emotional experience. The most important of which being facial expressions, followed by body language, vocal cues, flight-or-fight responses, to name a few.

On the whole, we discussed the three key components most commonly recognized (in a theoretical perspective) to be part of an emotional experience. However, it is important to recognize that in everyday circumstances, the term “emotion” is primarily used in relation to the subjective feeling. Accordingly, it is generally assumed that these feelings would affect and influence the physiological and behavioural responses, rather than these responses operating as independent components of an emotion. This divergence between theoretical definitions and intuitive understanding of emotions underscores the ongoing lack of consensus that exists regarding the precise nature and, especially, the temporal sequence of these components functioning during an emotional experience (see Moors, 2009 for review).

Early theories, such as the James-Lange's (James, 1884, 1890), Cannon-Bard's (Cannon, 1927) and Schacter-Singer's two-factor (Schachter & Singer, 1962) theories of emotion, have been influential in driving the discourse on the timeline of an emotional experience. According to James and Lange, a triggering stimulus would elicit a set of physiological responses, which in turn would evoke an emotion. Using the infamous example of encountering a bear, physiological responses, such as elevated heart rate and increased blood flow, would lead to the experience of "fear". This interpretation of the emotional experience by James and Lange, would suggest that each emotion has a unique set of corresponding physiological responses. However, Cannon (1927) highlighted that the same stimulus could evoke different emotions (e.g., fans of winners / losers at a game) and that some emotions (e.g., pride) may not have characteristic physiological responses. Such criticisms led to the development of the Cannon-Bard theory (Bard, 1928; Cannon, 1927), which suggests that the experience of emotion occurs alongside physiological responses. For instance, here, the bear would evoke elevated heart rate and fear. Both these theories, although considered pioneering, can be criticised for their reductionist approach, as they *reduce* the experience of emotions to bodily responses (Moors, 2009). In other words, this narrow perspective oversimplifies the complex nature of emotions by prioritising physiological arousal, while overlooking other psychological and cognitive components.

Thus, the Schachter-Singer (two-factor) theory (Schachter & Singer, 1962) was put forward to reconcile much of the criticisms directed to the two theories that preceded it. Here, the first step involves a stimulus (e.g., bear) triggering physiological arousal (e.g., elevated heart rate). Following which, this physiological arousal would be evaluated (i.e., cognitive processing) in terms of the characteristics of the stimulus (e.g., bear as a wild animal that can attack any time). Consequently, this cognitive evaluation would be the deciding factor in eliciting varied emotions (e.g., fear with the bear). However, some theorists criticise the emphasis put on cognitive processes and even go so far as to claim cognition is not even necessary to experience emotion (Kunst-Wilson & Zajonc, 1980; Zajonc, 1980). Thereby, leading to appraisal theories of emotions (see Sections 1.3.3 and 1.7.3) which we will discuss within the context of facial expressions.

Although each of these theories deviate in their definition of emotions, one commonality exists. They all agree that an emotional experience begins with an external stimulus or event that holds some significance to the individual. On the whole, however, there appears a clear lack of consensus regarding the question “What is an emotion?” (see Moors, 2005, for review). The current work will not attempt to explore this question any further than introducing the prevalent theories in the field. Many theories discussed above explain emotions within a broad perspective, without consideration of the specific cues that communicate emotions. Therefore, in subsequent sections (1.7), we will discuss theories relevant to the current research, specifically focusing on our overarching aim of identifying factors that influence the use of contextual cues (e.g., body gestures), when interpreting emotions from facial expressions.

1.1.2. Functions of emotions

Another question within the field of emotion that has attracted much conversation is why we have emotions. For the purpose of being concise, we shall only discuss the relevance of emotions within an evolutionary and social context. Evolutionary significance of emotions dates back to Darwin (1872) who emphasized the adaptive nature of emotions. He believed emotions could not only protect the organism in specific situations but also had communicative relevance within a social context. For example, the emotion of disgust that accompanies bad smells or yellow / green foods helps us avoid getting sick or fear that is felt upon encountering snakes or thunder ensures our survival. Avoidance of poisonous foods or being wary of dangerous animals or harmful weather conditions held greater significance to early humans who had to forage, hunt and seek shelter in the wilderness than for humans today. However, the fact that we still experience identical emotions in relation to these stimuli suggests that the experience of such emotions over time has increased the chances of an individual's survival (Tooby & Cosmides, 2010). Nevertheless, although from a broad perspective we can say that emotions have evolved to facilitate survival, more specifically, they function to ensure the reproductive success of oneself and one's kin. Therefore, within this perspective, emotions help address a wide array of adaptive challenges beyond immediate survival—such as attracting and keeping mates, managing competition within one's sex, raising offspring, and investing in kin (Al-Shawaf & Lewis, 2020).

Emotions are also connected to "social survival", for instance, success within a society is directly linked to our ability to communicate, cultivate relationships and compete. Only through effective communication of emotions can we sustain stable relationships and maintain our place in society relative to others. Therefore, according to Fischer and Manstead (2008), "social survival" at its core requires individuals to set goals that promote acceptance (i.e., affiliation function) and allow individuals to stand apart from others (i.e., distancing function). Emotions can play a significant role in how we achieve these two types of goals. For example, emotions, such as happiness or love experienced when interacting within a group of people, would serve to promote deeper bonds between members (i.e., serving affiliation function). Conversely, anger directed toward another individual may function as a mechanism for renegotiating the value of a social relationship in situations where individuals don't feel valued—either by 1) asserting aggression or 2) by distancing / withdrawing expected benefits (Sell et al., 2009).

1.2. Emotional expressions and their importance in social interactions

As discussed above, emotions are of great importance to a human living within society and facial expressions tend to be the popularly studied cue when communicating these emotions. Within the scope of this thesis, the terms "facial expressions" and "expressions" will be used interchangeably, in reference to how emotions are conveyed through facial signals. By accurately interpreting facial expressions, not only can an observer infer an expresser's emotions but also anticipate their next course of action (Seidel et al., 2010). Therefore, the diagnostic value of facial expressions cannot be overestimated with regard to survival and their ability to communicate behavioural intentions (Brosch et al., 2010; Fridlund, 1992).

When explaining this relationship, Gray's theory on behavioural approach system (BAS) and behavioural inhibition system (BIS; Gray, 1982) has been extensively cited linking the interpretation of facial expressions to social behaviour. According to this perspective, observers evaluate an expresser's facial expression and consequently, would either approach or avoid the expresser based on the observer's interpretation of the expressed emotion (Elliot & Covington, 2001). There is good empirical evidence to support Gray's theory, and the findings by Horstmann (2003) is one among those. In their study, participants were asked to rate facial expressions based on how they communicated emotional feelings, behavioural intentions and requests to take action (by the observer). Their findings reported that participants found happy faces to communicate an invitation to reciprocate smiles (i.e., approach behaviour), whereas facial expressions of anger and disgust signalled requests to move away from the expresser (i.e., avoidance behaviour).

In addition to rating measures, similar relationships have been observed with behavioural measures too. For example, Marsh and colleagues (2005) inferred behavioural intentions that participants had towards angry and fearful expressions by the movement of a joystick. Across different conditions, their participants classified angry or fearful faces by either pushing the lever away (i.e., approach behaviour) or pulling it towards them (i.e., avoidance behaviour). Implicit behavioural intentions (i.e., approach / avoidance) were quantified by comparing the time taken to push and pull the lever in response to a specific expression (e.g., anger or disgust). Here, the term *implicit* refers to the fact that behavioural intentions were measured indirectly, rather than through self-report, and does not necessarily imply that these intentions were unconscious—a meaning the term *implicit* can sometimes carry. Marsh and colleagues reported how angry expressions facilitated joystick movements characteristic of avoidance behaviour (i.e., pull lever backwards), whereas fearful faces facilitated approach-related behaviours (i.e., push lever forwards). Similarly, Seidel et al. (2010) reported how happy facial expressions facilitated approach behaviour, as indicated by their participants being more prone to make faster forward movements (i.e., approach) on a joystick. Taken together, above studies support a general understanding that facial expressions differentially activated either the BAS or BIS and, therefore, are capable of driving social interactions. Furthermore, this approach and avoidance behaviour remains in line with evolutionary theories where humans exhibit an innate tendency to avoid dangerous or threatening stimuli thereby engaging in safer situations (Langeslag & van Strien, 2018; Tooby & Cosmides, 2000).

1.3. Theories of emotions and classification of facial expressions

In Section 1.1, we broadly discussed historical and traditional theories on emotion, with an emphasis on the components contributing to emotion elicitation in response to an environmental stimulus. Here, we discuss additional theories of emotion, aligning with the scope of the current research, to understand how they define and differentiate between emotions communicated through facial expressions.

1.3.1. Basic-emotions approach

First, the basic-emotions approach proposed by Ekman (1992) has been a long-standing theory within the field of emotion perception. Ekman originally proposed six discrete classes of basic emotions (i.e., happy, angry, disgust, sad, surprise and fear), although contempt was later recognised as an emotional category too. Figure 1.1 depicts examples for each of the six original emotional categories. Notably, this theory is predicated on the assumption whereby perceivers have supposedly genetic predispositions that map specific emotion labels to unique configurations of facial features, conventionally known as "action units" (e.g., wrinkled nose; downward angled brow; Ekman, 1992; Izard, 1994; Matsumoto & Sung Hwang, 2010). Additionally, it was postulated that subjective experiences of emotions co-varied with facial expressions. For example, only happiness would be characterized by a "Duchenne or true smile" where the lip angles upwards towards the cheekbones (Ekman et al., 1990).

Figure 1.1

Examples of Ekman's original six basic emotions

Note. Facial expressions obtained from the Karolinska Directed Emotional Faces database (Lundqvist et al., 1998).

Much of the evidence supporting this theory comes from studies that have tested whether different human populations can universally recognise this subset of emotions dubbed as “basic”. A series of influential studies established this supposed “universality” by providing evidence that for individuals in both Western and non-Western populations being able to categorise facial expressions belonging to several basic emotions with above chance level accuracy (Ducci et al., 1982; Ekman, 1972, 1992; Ekman & Friesen, 1976; McAndrew, 1986). However, the validity of these studies supporting universality in emotion recognition has been criticized due to the methodologies used and populations tested and will be discussed below (see Section 1.3.2 for variability in emotion recognition). Nevertheless, this early evidence has been partly corroborated by Elfenbein and Ambady (2002), who calculated an overall recognition accuracy of 58% in their meta-analysis based on 97 studies that included different cultures from 42 countries.

Whilst Ekman’s (1992) criteria for categorising expressions as “basic” were based on facial or biological features, let us refer to these criteria as the “biological criteria”. There have been other such criteria theorists have used in an attempt to define an emotion as “basic”. For example, Ortony (2022) describes two criteria, which we refer to as the “elemental” and “conceptual” criteria. The former considered any emotion that is not a compound or combination of other emotions as “basic” (Ortony, 2022). For example, if hate is recognised as being comprised of anger, fear and disgust, according to this view, we cannot define “hate” as a basic emotion. Ekman’s biological criteria and elemental criteria are not necessarily incompatible. They both subsume that basic emotions are discrete categories and that basic emotions can serve as fundamental building blocks (i.e., irreducible) to describe more complex emotional states (Tracy & Randles, 2011).

Finally, we have the conceptual criteria for being “basic”, which pertains to how an individual’s language constrains concepts regarding emotions that are internally represented (Scarantino & Griffiths, 2011). Although not wholly popular, some experimental evidence lends credence to this viewpoint. When participants were asked to sort English words according to the perceived similarity between these words, a cluster analysis revealed that participants’ attributions all fell within six basic categories, namely, love, joy, anger, sadness, fear and surprise (Shaver et al., 1987). Lastly, some theorists also believe emotions can be considered “basic” if they lead to affective processes that originate from dedicated neural structures that allowed humans to deal with specific ecological challenges (Izard, 2009; Tracy & Randles, 2011). Whilst we have discussed only three different criteria that have been used when defining basic emotions, there have been others too. In any case, the evidence cited above clearly show a general lack of consensus regarding which criteria should be used when defining an emotion as “basic”.

Moreover, there have been numerous subsets of emotions identified as “basic” since the establishment of Ekman’s (1992) six categories (see Ortony, 2022, for review). To quote an example, Izard (2009) identified ten basic emotions (i.e., anger, disgust, distress, contempt, fear, guilt, interest, joy, shame, surprise), whereas Panksepp and Watt (2011) proposed seven (i.e., fear, rage, lust, play, care, seeking, panic/grief). Both these subsets were derived on the general premise that these emotions have unique facial configurations and fixed neural circuits, which have been selected by evolution to consistently help overcome specific ecological challenges (Tracy & Randles, 2011).

Furthermore, well-known evidence on basic emotions comes from studies using isolated faces as stimuli, and they were easily recognizable given that these faces stereotypically posed by actors to depict highly intense expressions (Aviezer et al., 2017). However, these posed expressions may not be valid. First, in real life, expressions are not as intense as they might be depicted in posed images. Second, expressions are not static like with posed expressions; rather they unfold over time, and this unfolding does not necessarily start from low levels of expressiveness (e.g., neutral expression). Third, given the complexity of human emotions, categorizing them into a fixed set of discrete categories may oversimplify their nuanced nature. Moreover, even if there exists a finite number of core emotional categories, the ways in which emotions are experienced and expressed can vary considerably across individuals and contexts.

From the evidence discussed above, we can see several problems emerge that challenges the validity of this "basic" emotions approach; 1) there is a general lack of agreement between the criteria used to classify an emotion as "basic" (Ortony, 2022), 2) a lack of consensus on which proposed subset of "basic" emotions can be universally accepted, and 3) whether distinct boundaries even exist between each of these basic emotions (Wenzler et al., 2016; Aviezer et al., 2012). Given such criticisms, the basic-emotions approach has declined in popularity to a certain extent over the years.

1.3.2. Discrete theories of emotions

The basic emotions approach serves as a prime example of how emotions can be classified into discrete and inflexible categories (e.g., Ekman, 1992; Izard, 2009; Panksepp & Watt, 2011). The core of discrete emotions is intrinsically linked to the perspective of basic emotions whereby each emotion triggers distinct neurological and physiological responses that are supposedly consistent across different cultures (Ekman & Friesen, 1971; Thanapattheerakul et al., 2018). Supporting this view, neuroimaging studies have identified specific brain regions that may be associated with specific emotions (see Lindquist et al.

2012). For instance, fear has been consistently linked to activity in the amygdala (Colombetti, 2009), disgust to the anterior insula (e.g., Jabbi et al., 2008; Wicker et al., 2003), and anger to the orbitofrontal cortex (Murphy et al., 2003; Vytal & Hamann, 2010). However, a meta-analysis of neuroimaging studies (published between 1990 & 2007) by Lindquist et al. (2012) found no consistent evidence of localised brain regions associated with specific emotions for categories such as fear, anger, disgust and sadness. In fact, Lundquist and colleagues (2012) provide more support for a "psychological constructionist" view which posits that our brains actively construct emotional experiences by integrating various sources of information (e.g., prior knowledge, sensory input). From this perspective, the amygdala is not exclusively linked to fear; rather, it is thought to be involved in processing motivationally salient or novel stimuli in a broader sense (Wright et al., 2003). Accordingly, in contexts characterized by ambiguity or unpredictability, the amygdala plays a critical role in directing attention and facilitating the interpretation of sensory information (Lindquist et al., 2012). Taken together, the studies cited above illustrate how challenging it can be to attribute specific brain structures or neuronal activation patterns to distinguish distinct emotions.

In addition, discrete categories cannot account for the immense variability in how individuals interpret emotional expressions across different populations (Barrett et al., 2009). To exemplify, Gedron and colleagues (2014) compared recognition patterns between individuals from United States and the indigenous Himba ethnic group who lived in remote regions of Namibia. In one of their "free-sorting" conditions, participants from both populations sorted expressions into piles, where within each pile the faces were meant to express the same emotion (according to the participants' judgements). Following this, participants labelled each pile based on what they thought the individuals in these piles were "feeling". Interestingly, American participants were more likely to label expressions based on the "universally" accepted discrete categories (e.g., anger, fear, disgust), whereas the Himba participants labelled expressions more based on action descriptors (e.g., laughing). More importantly, a cluster analysis of their labelling patterns revealed that only Americans (not the Himba) followed typically accepted discrete categories. For instance, Americans matched actions, such as smiling (for happy), scowling (for angry) and wide-eyes (for fearful), into distinct categories. Conversely, the Himba people categorized scowls and wide-eyes into a single category. The findings clearly suggest that the judgement and/or categorisation of emotional expressions themselves vary across different cultures and does not necessarily align with the mapping of distinct facial features to specific emotions. That being said, the significance of Gedron et al.'s (2014) findings may be limited by the likelihood that the Western and Himba populations interpreted the sorting task differently, Himba's conceptualisation of emotions may be distinct from traditionally accepted discrete categories.

In any case, Gendron et al. (2014) went on to emphasize that emotions are not "recognized" in the conventional sense, rather emotion recognition involves processes beyond semantic categorisation and takes into account action tendencies (like with the Himba population). Nevertheless, experimental paradigms continue to use discrete categories when collecting responses in emotion studies (e.g., through forced-choice tasks) due to the convenience with which these categories align with linguistic labels (Harmon-Jones et al., 2017, Study 1).

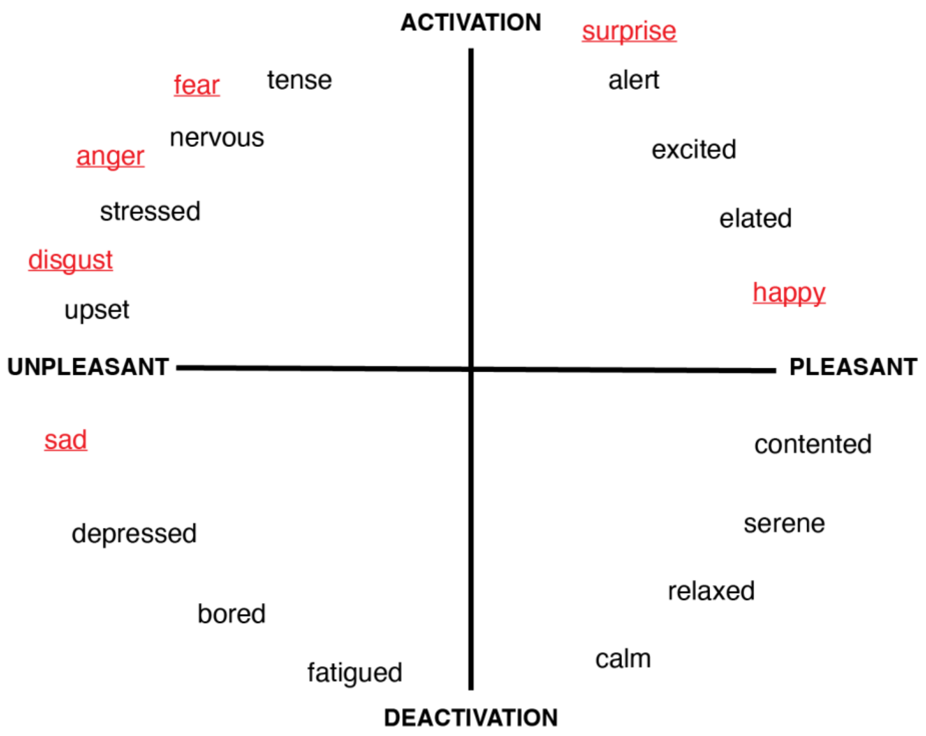
1.3.3. Dimensional theories of emotions

In contrast to discrete categories, dimensional theories attempt to capture a broader range of emotions by conceptualizing them in multidimensional emotion spaces. These theories typically apply not only to emotions in general but also to the characterisation of facial expressions (discussed further below). Some examples of multidimensional spaces (2-dimensional to be specific) include defining emotions in terms of valence-arousal (Russell, 1980, 2003), valence-dominance (Katsikitis, 1997) and valence-attention (Schlosberg, 1952). Common to all three of these spaces is the dimension of "valence" which refers to a continuum between positive and negative affect. The other dimensions are often paired with valence and not with each other. These include "arousal", which refers to the level of activation or alertness elicited, "dominance" which refers to the sense of control an individual feels in a given situation, and "attention" which refers to the degree to which an emotion engages an individual, that is, whether the emotion draws attention (e.g., surprise) or if it involves withdrawal (e.g., disgust). That being said, a drawback of dimensional theories is that they do not take into account the subjective experience of the emotion rather focusing instead on characterising emotions along measurable dimensions.

Nevertheless, the valence-arousal space has been frequently studied within the context of emotion perception. One reason being identifying emotions along these two dimensions have thought to be intrinsically linked to motivation and, consequently, behavioural tendencies (Höfling et al., 2020; Lang & Davis, 2006). Broadly, it has been proposed that identifying the affect of emotions would allow us to determine whether approach (e.g., for happy, surprise) or avoidance (e.g., for disgust, fear) actions were necessary. Then, arousal works in tandem to determine the intensity of the action needed, "fear" would evoke fleeing a dangerous situation, whereas anger could trigger attacking your competition. These examples elucidate how emotions characterised by valence-arousal not only have relevance to ecological survival but also allow distinct motor and physiological responses, in reaction to the emotion experienced (see Lang & Davis, 2006, for detailed description). Figure 1.2 highlights how valence-arousal models capture emotion, including those considered "basic" by Ekman (1992).

Figure 1.2

Schematic diagram of valence-arousal model with basic emotions superimposed



Note. Reproduced with permission from "Independence and bipolarity in the structure of current affect," by L. Feldman Barrett and J.A. Russell, 1998, Journal of Personality and Social Psychology, 74(4), p. 970 (Independence and bipolarity in the structure of current affect.). Copyright 1998 by the American Psychological Association. ACTIVATION / DEACTIVATION refers to arousal and PLEASANT / UNPLEASANT refers to valence i.e., positive / negative, respectively. The emotional labels in red and underlined denote Ekman's (1992) basic emotions.

When relating this dimensional approach to facial expressions as single emotional cues, behavioural experiments support the fact that individuals do evaluate expressions along these two dimensions, both for subtle (Fiorentini & Viviani, 2009; Takehara & Suzuki, 2001) and prototypical (Sutton et al., 2019) expressions, most popularly using Likert-type rating scales (Adolph & Alpers, 2010; Vesker et al., 2018). Other measures based on this theory include the self-report Positive and Negative Affect Schedule (PANAS; Watson et al. 1988, Study 2) and the Affective Grid that defines emotions along the axes of pleasure-displeasure and arousal-sleepiness (Russell et al., 1989). Such measures highlight how the valence-arousal space is not limited to evaluating perceived emotions but also other emotion-related cues like mood.

Although we highlighted differences between discrete and dimensional models, a growing body of research advocates for a hybrid approach where elements from both these theories are incorporated (Harmon-Jones et al., 2017). In fact, some studies have already discovered that individuals classify expressions based on both discrete and dimensional representations of emotions (Fujimura et al., 2012; Mendolia, 2007).

1.3.4. Appraisal theories of emotions

Next, we discuss appraisal theories that consider cognitive factors and adopt a componential approach. Here, emotions are both triggered and differentiated based on a subjective evaluation or "appraisal" (coined by Magda Arnold in 1960) in response to a change in the environment (e.g., stimulus, event). However, there are two popular perspectives on how an "appraisal" relates to emotion: 1) appraisal as a cause, thereby leading to changes in the components involved in an emotional experience, and 2) appraisal as another component of emotional experience. The former being a straightforward perspective whereby theorists believe that an appraisal is part of all or some emotions (Frijda, 2008). Furthermore, according to the first perspective, appraisals come *first* in the causal chain of events. Consequently, these appraisals would result in changes to other components involved in an emotional experience, such as "motivational" (i.e., readiness to take action), "somatic" (i.e., physiological reactions), "motor" (i.e., executable actions), and finally the subjective experience of feelings to name a few (Lazarus, 1991; Moors et al., 2013). Furthermore, this perspective draws a clear boundary between cognition (i.e., appraisals) and the experience of emotion (Ellsworth & Scherer, 2003). That being said, it remains undecided whether an appraisal is a necessary preceding aspect for all components (Lazarus, 1991). Alternately, according to the second perspective, “appraisals” may be a part of the emotional experience (i.e., as another component). That is to say, for example, the subjective experience of fear involves negative valence and high arousal (among other motor / physiological changes elicited by appraisals), however, once all the appraisals occur, ultimately, all individuals experience is “fear” and not separate identifiable components (Ellsworth & Scherer, 2003).

This perspective aligns with the view of emotions as continuous processes, in which revisiting and revising appraisals can elicit synchronous changes in multiple components (e.g., motivational, physiological) in an emotional experience. For instance, when walking alone at night, an individual may feel initially safe, however, upon hearing footsteps, they might reassess the situations as being potentially threatening. Accordingly, they would exhibit heightened arousal (i.e., motivational component), increased heart rate (i.e., physiological component) and the experience of fear (i.e., subjective experience). In other words, a single revision of the appraisal (i.e., reassessing the situation as threatening) synchronously affected multiple components–all aligning with the revised appraisal of threat.

Therefore, the premise of appraisal theories suggests that experience and recognition of emotions remain greatly flexible. For a given emotional situation (i.e., an environmental change), individuals can experience an infinite number of transitional, nuanced and varied levels of intensity (e.g., less angry, somewhat angry, more angry) between recognized boundaries of emotions (Ellsworth & Scherer, 2003). Interestingly, this account of emotions remains compatible with discrete-emotions by recognising that emotions often manifest along a spectrum of intensities, rather than as absolute states (i.e., present or absent). Furthermore, appraisal theories can account for both universal and specific interpretations of emotions across different populations. Here, universality implies that identical appraisals of a particular event result in eliciting the same emotions, unique / individual-specific interpretations of a single event would lead to the experience of different emotions (Moors et al., 2013).

1.4. The influence of context when judging emotions from facial expressions

Thus far, we have discussed the early theories of emotion by focusing on defining and differentiating between emotions based on the evaluation of a single cue (e.g., facial expression), without sufficiently considering other factors that can influence this process of interpreting the emotion from the face. Discrete categories more so than dimensional theories of emotions (see Section 1.3.2) remain highly resistant to considering contextual influences on how people interpret the emotion conveyed by a face. Whether we are interpreting a facial expression by assigning a category to it or rating it along one or more dimensions, in many cases, we are accurate if we rely just on the face. However, this may not always be the case, especially given the highly contextualised nature of emotion perception.

To elaborate, Aviezer et al. (2008) argued that faces in real life are rarely seen in isolation and they always appear within a perceptually rich, informative situational context. For example, the surrounding visual environment, such as a classroom or a funeral home, or (what is the focus of the thesis) the posture of a body that the face is attached to. In fact, a large body of research (discussed below: Sections 1.5 and 1.6) attest to how these contextual cues are clearly capable of altering the interpretation of facial expressions. First, context can serve to disambiguate those expressions that remain inherently difficult to classify. For example, past research highlight expressions of high intensity (e.g., positive / negative; (Aviezer et al., 2012; Wenzler et al., 2016, Study 1), expressions sharing overlapping physical features (e.g., anger-disgust; Aviezer et al., 2008; Lecker et al., 2020) or subtle (low intensity) expressions (Van den Stock et al., 2007) can all be ambiguous in nature. Therefore, in such cases, the face alone conveys no clear signals for a reliable interpretation of the emotion underlying the expression. Consequently, contextual cues clearly play a crucial role in disambiguating these expressions. Second, even those expressions that can be accurately classified in isolation remain vulnerable to contextual influence (Aviezer et al., 2008; Kret et al., 2013, Study 1; Meeren et al., 2005). These studies imply that even in circumstances where contextual reliance might not be necessary, information from the context appears to be integrated into the judgement of facial expressions. These two distinct effects of contexts will be explored in greater depth under the section on body gestures (see Section 1.6.2), as the current thesis exclusively investigates the factors influencing the contextual effects from body gestures in relationship to the interpretation of facial expressions.

1.5. The effect of contextual cues originating outside the expresser and perceiver

Now that we have established that context can play an important role in how people interpret facial expressions, at this juncture, it is important to distinguish broadly between various types of contextual cues. Some of the cues arise outside of the expresser (and outside of the perceiver too), whereas others arise from the expresser itself. These two types will be discussed in detail below. First, the former refers to cues such as visual scenes (Hietanen & Astikainen, 2013; Righart & de Gelder, 2008), short vignettes (i.e., situational information; Carroll & Russell, 1996; Kayyal et al., 2015), and emotional labels presented on a screen (i.e., visual; Nook et al., 2015) to manipulate background knowledge as contexts. Furthermore, Aviezer et al. (2017) noted in their review that background knowledge about a situation can drastically impact individuals’ responses to facial expressions.

1.5.1. Visual Scenes

In Righart and de Gelder (2008), participants classified faces of disgust faster and more accurately when they were embedded on spatial contexts of static scenes that invoked the same emotion (e.g., a picture of garbage). Conversely, when the scene and facial expression depicted incongruent emotions (e.g., disgust face on a picture of flowers), participants' accuracy decreased whilst also needing longer durations to make the classification. Similar observations were made by Heitanen and Astikainen (2013) when a positive (e.g., cute animals) or negative (e.g., sick people) static scene preceded (i.e., temporal context) the facial expression. Their participants made faster classifications on happy and sad facial expressions when the contextual cues provided congruent information. Both studies indicate how congruency between the emotions expressed in a visual scene and a facial expression can influence the judgement of the latter.

One noteworthy study by Barrett and Kensinger (2010) highlighted how context was routinely encoded when we judge facial expressions even when they do not communicate any affect (i.e., neutral scene). In their study, participants viewed facial expressions of fear, disgust, and neutral emotions that were embedded on neutral visual scenes (e.g., lake, patio). While viewing these images in the study phase, participants either: 1) indicated whether they would approach / avoid the presented face identity or, 2) labelled the emotion expressed by the face embedded on a scene. Subsequently, participants were subjected to a recognition test where they were presented with individual images of the scenes and faces which had been previously presented during the study phase. Their task was to indicate whether they recognised these images of a scene or face identity from the study phase earlier. Participants remembered the contextual information from a visual scene better when they had previously labelled the emotion expressed on a face rather than if they had indicated their intent to approach or avoid.

Based on the findings above, for approach/avoidance judgements, facial configurations appear sufficient, which remains in line with the findings discussed above (see Section 1.2) by Seidel et al. (2010) and Marsh et al. (2005). On the other hand, judgements of emotion appear to integrate both information from a spatial context and facial cues (Barrett & Kensinger, 2010; Wieser & Brosch, 2012). That being said, better memory for visual scenes can also be attributed to greater attention being accorded to contextual cues when processing facial expressions; after all, the greater deployment of attention during memory encoding can lead to better recall (Chun & Turk-Browne, 2007).

1.5.2. Situational information

Classification can also be influenced by descriptions of a situation provided as a story or vignette. Carroll and Russell (1996) presented context in the form of short stories that temporally preceded facial expressions which participants judged. Their findings revealed context dominance across all experimental conditions, whereby participants consistently chose the emotion expressed in the story when classifying a specific facial expression (i.e., bias towards the context). Moreover, they replicated this bias when the emotions of the context stories conveyed both emotions regarded as “basic” (Carroll & Russell, 1996, Study 1; anger, fear and disgust) and “non-basic” (Carroll & Russell, 1996, Study 2; puzzlement, determination, hope and pain). The influence exerted by the context was stronger for the latter group of emotions. Nevertheless, in both the studies above, participants were still able to classify the face accurately when presented alone.

Carroll and Russell’s (1996) findings have been corroborated with not only the use of real-life spontaneous expressions but also when the task was to rate the facial expression.

Kayyal and colleagues (2015) presented expressions of athletes from the London Olympics who either won or lost at their respective games. Participants were first presented with either correct, incorrect or no information regarding the athletes' losses or wins. Participants subsequently rated an athlete's facial expression on the degree to which it conveyed anger, sadness, fear, disgust, happiness, pride and excitement, using a scale from 0 (not at all) to 6 (extremely). Facial expressions were rated as having a more positive valence (i.e., ratings of happy, proud, excited) when the accompanying context indicated the athlete had "won". However, the same facial expressions were rated as having a negative valence (i.e., ratings of sad and angry) when the context indicated an athlete's "loss". Given no context, participants rated facial expressions of winners as slightly positive and those of losers as slightly negative; the overall magnitude of these valence ratings were smaller compared to when the faces were paired with contexts.

Taken together, the studies cited above highlight how contextual cues that pertain to background knowledge in a given situation can elicit changes in categorical judgements or valence when assessing faces that can be accurately recognized in isolation.

1.5.3. Language

Lastly, linguistic cues provided in the form of emotional labels can also act as contextual cues during judgement of facial expressions. For example, in Halberstadt and Niedenthal (2001), morphed facial expressions that conveyed equal percentages of happiness and anger were recognized as being angrier if participants verbally described this expression as "angry" prior to the recognition task. Similarly, faces were recognized as being "happy", if they were previously described as expressing happiness. Their study highlights how emotional labels used during encoding of an individual's expression can influence subsequent classification, regardless of the objective emotion conveyed by the face.

In a separate study, Lindquist and colleagues (2006) asked participants to repeat out loud an emotional label either 3 or 30 times prior to indicating whether a subsequently presented expression matched the emotion label. Thirty (but not 3) repetitions led to semantic satiation where participants temporarily lose their ability to access the meaning of the label (Lewis & Ellis, 2000). This satiation in turn led to accuracy being impaired and response times being slower when participants judged faces expressing the same emotion as the repeated label. There are two main implications based on the above. First, there appears to be a strong link between emotional language and perception of emotion. Notably, contextual influence persisted even when the judgement task (i.e., matching the emotional expression to the label) did not require the explicit use of language. In other words, the influence of satiation invoked by emotional labels were able to influence the judgement of facial expressions (i.e., a different class of stimuli). Second, in the case of semantic satiation, contextual influence would in fact prevent individuals from judging emotions accurately altogether, especially when the context and face express congruent emotions. Therefore, such a bias (i.e., from semantic satiation) differs from the other contextual biases previously discussed. However, the effects of semantic satiation are likely to be rare in real-life scenarios, as repetitively accessing an emotional label is uncommon.

1.6. The effect of contextual cues arising from the expresser

Next, cues originating from the expresser refers to all characteristics sans the face of target individuals whose facial expressions are being judged (e.g., body language, vocal cues). Different works, much like Aviezer et al. (2012), have replicated the contextual effect of bodies when judging facial expressions, further supporting the view that facial characteristics are not the only source of information that determine the perceived emotion from facial expressions.

1.6.1. Vocal cues

First, vocal cues (e.g., intonation of spoken statements, laughter) have also shown to exert contextual effects when judging emotions from facial expressions. For example, in one of the experiments by de Gelder and Vroomen (2000, Study 2), participants were asked to judge facial expressions morphed on a continuum from happy to sad. These faces were simultaneously presented with a voice that had either a sad or happy intonation. At the end-point morphs, when conflict was communicated between the face and voice (e.g., intense sad face – happy tone), not only were participants slower to respond but they were prone to choose the emotion communicated by the voice rather than the face. Conversely, when there was greater agreement between the two cues (face-voice), participants were faster to respond. Interestingly, the magnitude of influence from the voice was greater on the morphs in the middle (i.e., closer to neutral) of the sequence compared to the end-point morphs (de Gelder & Vroomen, 2000, Study 2). Other studies have corroborated not only de Gelder and Vroomen's findings (2000, Study 2) but also further attested to the ability of vocal cues as a context to improve classification accuracy (de Gelder et al., 1999; Dolan et al., 2001; Kreifelts et al., 2007).Limited evidence with regard to brain region activation have also been mapped onto behavioural patterns. For example, Dolan et al. (2001) reported enhanced activation of the left amygdala for congruent face-vocal cues compared to incongruent cues and Kreifelts et al. (2007) observed greater classification accuracy corresponding to enhanced activation of the bilateral posterior superior temporal gyrus. Collectively, it is clear that contextual influence extends to cross-modal modulation. Given that information from different modalities remain present at any given time in real life situations, it remains plausible that our emotion perception mechanisms would therefore be susceptible to influence from cross-modal contextual cues.

1.6.2. Body gestures

Body gestures as contextual cues that directly originate from the expresser will be a focal point of this thesis. Hereafter, the terms “body gestures” and “body contexts” will be used interchangeably. For technical clarity, however, we refer to facial cues as “expressions”, but do not classify bodies as “body expressions”. This linguistic distinction reflects the fact that while facial expressions generally *express* emotions, body gestures may not do so all the time. For instance, a clenched fist may indicate anger, however pointing at an object is a gesture that serves a communicative function without conveying an emotional state. Thus, in the current work, we distinguish between facial *expressions*—which typically convey emotional states, and body *gestures*, which may or may not communicate emotions.

As mentioned earlier, body contexts can influence the interpretation of facial expressions in two main ways: 1) by playing a disambiguating role when facial expressions remain difficult to classify and 2) by directly eliciting categorical changes in an individuals’ interpretation of facial expressions. First, certain expressions, such as those expressing intense positive and negative emotions, pose difficulties when individuals attempt to classify them using the facial cues alone (Aviezer et al., 2012; Wenzler et al., 2016, Study 1). In two separate studies, participants gave highly negative valence ratings for isolated, yet intense facial expressions, irrespective of whether they depicted highly positive or highly negative emotions (Aviezer et al., 2012; Wenzler et al., 2016, Study 1). More importantly, Aviezer and colleagues demonstrated that these valence ratings shifted in the direction of the context emotion when facial expressions were paired with body gestures. The expressions used in these studies were extracted from emotionally intense, real-life scenarios, such as winning/losing moments in a tennis match (Aviezer et al., 2012) and soldiers returning home after deployment or terror attacks (Wenzler et al., 2016, Study 1).

These findings have been corroborated in studies where participants made categorical judgements too. For instance, Kret et al. (2013, Study 1) reported higher accuracy when facial expressions were accompanied by a congruent context (e.g., angry face – angry body), compared to when they were classified in isolation. Apart from intense emotions, expressions that share overlapping facial features, such as anger and disgust (Barrett et al., 2019; Susskind et al., 2007), can make classification difficult when judging the face alone. Under such circumstances, Aviezer et al. (2008) reported the highest classification accuracy when disgust expressions were paired with congruent contexts (i.e., disgust body gestures). In any case, whether it be intensity rating or categorical judgements, certain facial expressions can be inherently ambiguous and therefore, body gestures can play a crucial role in disambiguating these expressions.

Apart from resolving ambiguity (as discussed above), body cues have been seen to cause shifts in categorial judgements on facial expressions that are otherwise accurately classifiable when presented alone. For instance, in the case of easily discriminable expressions such as happy-angry (Kret et al., 2013) and angry-fearful (Meeren et al., 2005). Across both these combinations, congruent body gestures (e.g., happy expression with happy body) facilitated accurate classification, whereas incongruent body gestures (e.g., happy expression with angry body) caused viewers to guess (Meeren et al., 2005; Van den Stock et al., 2007). Furthermore, such expressions would ideally be classified accurately in isolation, as attested by validation studies (Calvo & Lundqvist, 2008; Thoma et al. 2013), given the lack of physical characteristics shared between them (Suskind et al., 2007). Accordingly, it suggests that when a context is present (akin to real-life situations), it appears to be integrated into the judgement of emotions from facial expressions even in circumstances where it is not essential.

Moreover, according to past studies, this integration of contextual cues into the judgement of facial expressions is often attributed to automatic changes to the perceptual representations of the expressions (Albohn et al., 2022; Aviezer et al., 2012; Aviezer et al., 2011; Aviezer et al., 2008; Meeren et al., 2005; Mondloch, 2012), based on several lines of evidence. First, contextual effects persist even when participants had been explicit instructed to "ignore" the context across all the cited studies cited above (Aviezer et al., 2008; Kret et al., 2013, Study 1; Meeren et al., 2005; Wenzler et al., 2016, Study 1). In other words, this suggests that the task irrelevant cue (i.e., body context) appears to "automatically" influence the judgement of expressions (e.g., elicit body-centric classifications)–beyond the decisional control of the participants. Second, body gestures have been reported to change how a facial expression would be scanned. In a seminal study by Aviezer et al. (2008, Study 3), when classifying incongruent face-body composites (e.g., angry face-disgusted body), participants' scanning pattern of the target face (e.g., angry face) mimicked the characteristic scanning patterns of the expression associated with the emotion of the body gesture (e.g., disgusted faces often receive equal fixations to the eye-mouth regions). Third, Aviezer et al. (2012, Study 3) used the face-composite paradigm to highlight how the face and body were processed as one "unitary" entity. Therefore, they presented faces and body gestures in different spatial alignments i.e., either seamlessly aligned or misaligned. The typical (and stronger) contextual effects were observed with face-composites that were aligned in space (i.e., better classification accuracy for the face), whereas, the strength of contextual effects diminished for those composites misaligned (i.e., more accurate, face-centric classifications). Aviezer et al. (2012, Study 3) attributed their findings to the fact that the face and body must be processed as a single "perceptual unit" and hence interference to this unit (i.e., spatial alignment) would accordingly diminish the influence the body gesture would have on the face. Lastly, electrophysiological (ERP) have also been cited in support of this early (perceptual) integration of face and body cues. In a seminal study by Meeren et al. (2005), they reported enhanced activation of the P1 component (i.e., sensitive to higher face order processing) at around 116 ms for congruent composites with incongruent composites yielding even larger amplitudes of activation–a finding corroborated by more recent evidence as well (Wang et al., 2017).

Taken together, the four lines of evidence discussed above has been consistently cited to support the conclusion that body contexts elicit a shift in participants' perception of the facial expression at very early stages of processing. Furthermore, this current thesis will further investigate the underlying nature of contextual effects (i.e., perceptual or non-perceptual) in Chapters 2-3, aiming to draw comparisons with prior studies, including those cited above.

1.7. Theories explaining contextual effects

By discussing the range of contextual cues above, we have established the undeniable link between these cues and emotion perception from facial expressions. Apart from the general consensus regarding the perceptual nature of context effects, several theoretical explanations have been proposed to account for these effects, each offering different mechanisms through which context influences perception.

1.7.1. Emotion seed hypothesis

The dominant one among these theories is the "emotion seed hypothesis" by Aviezer et al. (2008), which essentially uses the concepts underlying categorisation of expressions into discrete emotions (see Sections 1.3.1 and 1.3.2). Here, the perception of emotions relies on whether an expression has unique facial features or shares some common features with another emotion (dubbed emotion "seeds"). For example, anger-disgust expressions share furrowed eyebrows and fear-sad expressions share widened eyes along with raised eyebrows (Ekman & Friesen, 1976, 1978). These seeds would essentially remain inactive when judging expressions in isolation. However, they would activate in a fitting context. For instance, if a context (e.g., disgusted body) activates seeds for an expression (e.g., disgusted face) that shares many facial features with the target expression (e.g., anger), the resulting activation of the seeds could dominate and override accurate perception of the target emotion (Aviezer et al., 2008; Mondloch et al., 2013a).

The main supporting evidence for this theory is based on how the magnitude of contextual effect is modulated by the degree of physical similarity between target emotions. For example, Aviezer et al. (2008) found that disgust faces paired with angry bodies (high similarity) elicited the strongest contextual influence, followed by sad (medium similarity) and fearful (low similarity) bodies. In other words, easily confusable emotions (Aviezer et al., 2008; Lecker et al., 2020; Susskind et al., 2007) would exhibit stronger contextual effects compared to discriminable emotions (happiness and fear; Van den Stock et al., 2007).

However, Mondloch et al. (2013) argues that physical similarity as a factor may not comprehensively capture the complex nature of contextual effects. In their study, participants made categorical judgements on faces expressing sadness, fear, and anger that were paired with either congruent (e.g., sad face – sad body) or incongruent (sad face – fearful body, fearful face – sad body) contexts. One notable prediction according to the emotions seeds model would be that uniformly strong contextual effects would be elicited when sad faces were paired with fearful bodies, as sad faces share physical similarities with fearful expressions. Contrary to this prediction, in their error analysis of incongruent trials, Mondloch et al. (2013) only report fearful bodies eliciting more attributions of "fear" when paired with sad faces, but the complementary effect of sad bodies eliciting more “sad” attributions when paired with fearful faces was not observed. Similarly, the emotion seeds model would also predict strong contextual effects when sad faces were paired with angry bodies and vice versa, given the shared physical characteristics between sad-angry expressions. However, once again, no evidence supporting this prediction was observed in terms of contextual effects for either the combination of sad face – angry body or angry face – sad body.

Such asymmetries have been corroborated using other emotion combinations like happiness and fear. Van den Stock et al. (2007) highlighted that happy bodies affected the judgement of fearful faces but fearful bodies did not interfere with the perception of happy expressions to the same extent. In fact, in this instance, the emotions seeds model would predict minimal or lack of contextual effects given the lack of physical similarity between happy and fearful expressions. Overall, the emotion seed model cannot account for the complex asymmetrical contextual effects where some facial expressions are particularly vulnerable to context and some body postures are especially influential.

Lastly, the framework of the emotion seed model also dictates that contextual cues essentially change “how” facial expressions are judged when paired with a context at early stages of perception and it is in effect automatic in nature (Aviezer et al., 2008; Aviezer et al., 2011). The lines of evidence based on gaze behaviour (Aviezer et al., 2008, Study 3), spatial alignment (Aviezer et al., 2012, Study 3) and ERP findings (Meeren et al., 2005; Wang et al., 2017) applies here (see Section 1.6.2 for more details). Chapters 2 and 3 will examine and discuss in detail the validity of this assumption (from past studies) that contextual effects remain perceptual in nature.

1.7.2. Dimensional theories

Dimensional theories can also explain contextual effects to a certain extent. According to Mondloch et al. (2013), we can expect the largest magnitude of contextual influence when two cues (e.g., angry face – fearful body) signal emotions that are similar in both valence and arousal (i.e., both anger and fear have a negative valence with high arousal). In line with this expectation, for angry faces, the proportion of "fear" responses were greater when faces were paired with fearful bodies compared to when they appeared on angry bodies (Mondloch et al., 2013). Notably, there were no differences in the "fear" responses when classifying fearful faces on angry bodies compared to the same faces on sad bodies. After all, fear and anger cues have identical valence and arousal levels, therefore, dimensional theories would predict more pronounced contextual effects compared to the anger-sadness pairing. Taken together, context effects will diminish or even become negligible if two emotional cues differ only in one dimension (e.g., sad and anger; negative valence but low versus high arousal, or happy and anger; high arousal but positive versus negative valence) or two dimensions (e.g., sad and happy; different valence and different arousal).

That being said, not all observations have been in line with the above predictions. For instance, participants were more likely to attribute "fear" responses to sad faces paired with fearful bodies, compared to when they were paired with sad bodies (Mondloch et al., 2013). More interestingly, the proportion of "angry" attributions did not differ when sad faces appeared on angry bodies, compared to sad bodies. In other words, angry bodies did not increase the propensity to classify sad faces as "angry". Dimensional theories cannot account for this scenario where fearful bodies appear to elicit a larger contextual influence compared to angry bodies on sad faces. After all, we would expect uniform (but minimal) magnitudes of contextual influence from these two pairings, given that fear and anger both cue negative valence with high arousal, in relation to sadness that has a negative valence with low arousal.

Nevertheless, although dimensional theories cannot account for all types of contextual effects, it is generally accepted that the dimensional properties of the context can consequently alter the interpretation of the face. Participants' valence ratings for face-body composites adapted from real-life situations (e.g., winning / losing moment at sporting tournaments) shifted in the direction of the body's valence (e.g., expressions were rated as being more positive when paired with winning bodies compared to losing bodies; Aviezer et al. 2012; Wang et al., 2017). Conversely, when participants judged the face alone, they had greater difficulty distinguishing between winning and losing faces; both types of expressions were accorded negative valence ratings (Aviezer et al., 2012).

Furthermore, dimensional theories purport that this influence on perception occurs at early stages of integration (similar to the emotion seed hypothesis). Wang et al. (2017) reported enhanced activity of the P1 electrophysiological component for incongruent (e.g., win face – lose body) than congruent (e.g., win face – win body) face-body composites, similar to Meeren et al. (2015) with classification judgements. This P1 component has been consistently cited as an index of early integration of face and body cues. On the whole, contextual information can possibly disentangle ambiguous cues from intense expressions and subsequently, alter the perception of expressions along valence and arousal dimensions.

1.7.3. Appraisal theories

Assessing contextual effects in terms of appraisal theories remains more challenging, due to the limited research in this area. According to these theories, participants would experience different emotions, if their appraisal patterns of the accompanying context varied (Roseman, 1984). Consider a real-life example of two spouses going through a divorce (i.e., situational context). Their appraisal of the situation would greatly differ in that the one who filed for divorce might experience "happiness" due to their intention to separate, whereas the other spouse might experience “anger” as they did not want the divorce. Conversely, if the two individuals had similar appraisals of the divorce, their identical evaluations would elicit the same emotion (Roseman & Smith, 2001). Using the same analogy with spouses, if both had discussed and intended to separate amicably, their appraisals of the divorce are likely to be similar and, therefore, result in experience of happiness for both.

Extending the above viewpoint to classification of expressions, emotions can be differently classified based on the subjective appraisal and experience of the contextual cues. The resulting appraisal would allow us to assign a label to an expression that we believe is elicited by the context (Roseman & Smith, 2001). Mumenthaler and Sander (2012) highlighted the importance of appraising the contextual cue in relation to the to-be-judged target. They observed an interplay between social appraisal and contextual information when judging dynamic facial expressions. In their study, two faces were presented, one appeared at the centre as the target (emotions: anger, fear, happy) and another non-target face (emotions: anger, fear, happy, neutral) appeared in the periphery. The premise of their paradigm was that first, they had two baseline measures, whereby either the peripheral face signalled a “neutral emotion” or the gaze was never directed towards the target face. Second, these baseline measures were compared to a condition where the gaze of the peripheral face moved dynamically toward the target face (i.e., manipulating social appraisal). In all these conditions, six rating scales (extreme ends labelled as “a lot” and “a little”) corresponding to Ekman’s (1992) six basic emotions (e.g., rating target as “a little” happy) were presented. Participants could rate each target expression in one or all six scales, or not rate them on any scale. Based on the ratings given, they calculated a measure of accuracy (named “congruence index”) by obtaining the mean rating corresponding to the correct emotion expressed by the target face.

First, they expected typical contextual effects in the baseline conditions, where a congruent contextual cue (e.g., both faces signal anger) would facilitate judgements compared to a cue signalling neutral (e.g., target-anger, peripheral-neutral). Consistent with their prediction and past literature (e.g., Aviezer et al., 2012; Kret et al., 2013; Meeren et al., 2005; Wenzler et al., 2016, Study 1), recognition accuracy was greater (i.e., higher mean ratings on the congruence index) when angry and happy (but not fearful) were paired with peripheral faces signalling the same emotion compared to neutral faces (Mumenthaler & Sander, 2012, Study 1). Second and more importantly, they expected stronger contextual effects with congruent stimuli in the social appraisal condition (i.e., gaze towards target), due to the added component of now evaluating the target expression in relation to the peripheral expression. As predicted, mean ratings given were higher for the correct target emotion (index of greater accuracy) for congruent face pairs in the social appraisal condition, compared to the condition with contextual effect alone (i.e., averted gaze condition). Their observation remained true for both congruent pairings, namely, angry-target with angry-peripheral faces and happy-target with happy-peripheral faces. Based on these findings, we can surmise that appraisal of the contextual remains an important fixture if individuals were to accurately judge a facial expression. When two cues lead to identical appraisals (e.g., with congruent faces), facilitation in emotion recognition can occur. Accordingly, contextual information may provide cues on how the facial expressions need to be appraised (e.g., a perceiver's expression appraised as "anger" if surrounded by other angry faces). Therefore, it is plausible that over time we develop the ability to assign the same label to expressions occurring within contexts that elicit the same pattern of appraisals.

1.8. The bi-directional nature of contextual effects

In all the studies discussed thus far, the expression had been considered as the "target" and any other accompanying cue as the "context" (Aviezer et al., 2008; Carroll & Russell, 1996; de Gelder & Vroomen, 2000; Halberstadt & Niedenthal, 2001). However, studies have in fact observed the prevalence of bi-directional influences in contextual effects (we discuss below studies related to body gestures). It is plausible to posit that the body gesture can be the target, with the face now exerting a contextual influence (Kret, Stekelenburg, et al., 2013; Lecker et al., 2020). Two possibilities have been examined regarding the magnitude of contextual influence related to bi-directional effects. First, we could observe symmetrical contextual effects, whereby face and body would influence each other to the same extent. Second, asymmetries exist, whereby either the face or body could have a more dominant contextualizing power.

Thus far, experimental evidence supports the latter possibility. A pioneering study by Kret et al. (2013, Studies 2 and 3) was the first to establish bi-directional effects using happy, angry and fearful expressions that were paired with either congruent or incongruent body gestures. In line with past research, Kret et al. (2013, Study 2) established that for all three emotional expressions, accuracy was better (i.e., facilitation) when they appeared with congruent body gestures (i.e., context) compared to when faces were judged in isolation. However, results differed when the task was reversed where now participants classified the body's emotion with the face being a contextual cue (Kret et al., 2013, Study 3). Here, accuracy was only facilitated when congruent expressions were paired with happy bodies and not for angry or fearful body gestures. Similarly, Lecker et al. (2020) reported differences in the magnitude of contextual effects for incongruent face-body composites. They presented identical emotional categories to Kret and colleagues, with the addition of disgusted faces and body gestures. In their study, for all emotions, face accuracy reduced by 39.8% with incongruent body contexts compared to body accuracy which reduced by 20.5% with incongruent facial expressions.

Both these studies highlight striking asymmetries in contextual effects, where faces are more influenced by body gestures than vice versa. It is possible that we are more prone to interpreting the "face" based on other contextual information (Bjornsdottir et al., 2017). After all, we attend to the facial expression more in everyday situations when determining an individual's emotional state (Shields et al., 2012). Accordingly, it might not be a natural inclination to consider the face as a diagnostic contextual cue. Therefore, when the body gesture becomes the target, individuals may be less prone to allocate overt attentional resources to integrate information from the face as a context. In any case, it remains undeniable that contextual cues to some extent remain an important fixture in emotion perception.

1.9. Individual differences in classifying facial expressions

Thus far, evidence has been discussed to establish the role of context in the classification of emotions from facial expressions. Nevertheless, it is important to note that contextual cues are not the only factors known to influence interpretations of facial expressions. We also observe how characteristics of the perceiver can lead to individual differences in interpreting expressions. Some common perceiver-related factors include age, sex, culture and clinical traits.

1.9.1. Age

Regarding age, it has been reported that emotion classification ability peaks between 15 and 30 years, but a progressive decline in this ability can be observed after 30 years of age (Olderbak et al., 2019). A consensus exists where studies observe more age-related deficits in older adults (e.g., above 65) compared to younger populations (e.g., 15 – 30 years), when judging negative expressions, such as anger (Minton & Mienaltowski, 2021; Ruffman et al., 2008), than when judging positive expressions, like happy (Isaacowitz et al., 2007; Ruffman et al., 2008).

1.9.2. Sex

Similarly, we also observe consistent sex differences influencing the ability to judge emotions in faces. Females compared to males show a greater aptitude for emotion classification (Olderbak et al., 2019; Thompson & Voyer, 2014). Interestingly, these sex differences in emotion perception emerge as early as infancy (McClure, 2000). One notable study by Olderbak et al. (2019) observed in a large community sample (N = 100,257) that females were consistently better than males in judging expressions throughout the lifespan, but this disparity in ability between the two sexes decreased with age (i.e., after 30 years). Although we discuss factors influencing emotion perception (e.g., age and biological sex) as separate factors, findings such as Olderbak et al.'s (2019) highlight how multiple factors can work in tandem that ultimately influences our judgements of facial expressions.

1.9.3. Culture

Lastly, literature regarding culture remains polarized between the universality of emotion perception (Ekman et al., 1969; Ekman & Friesen, 1978) versus culture-specific effects (Young et al., 2012). According to the universality perspective, the six basic emotions proposed by Ekman (1992) appear to be classified with above chance levels of accuracy, across both Western populations and non-Western populations (Ducci et al., 1982; Ekman & Friesen, 1976; McAndrew, 1986). However, this perspective has since become less popular given the increasing evidence for how culture can facilitate emotion classification (i.e., better accuracy) when both the expresser and perceiver belong to the same culture and conversely, impair classification when the expresser belongs to a different culture (Young et al., 2012). Broadly, Wickline et al. (2009) reported cultural differences using 4 groups of participants (European American, African American, European international, and African international) who were collapsed into two cultures, namely of European or African descent. They reported that participants were generally more accurate when recognizing emotions from facial identities that belonged to their own culture rather than a different culture (target stimuli included European American and African American faces expressing happiness, sadness, anger and fear). However, more targeted analyses revealed that European Americans were significantly more accurate than African Americans when classifying European American faces. Moreover, both European cohorts (i.e., American and international) were more accurate than African international when classifying European American expressions.

Studies have corroborated the above findings to further establish that cultural differences exist across a broad range of emotions based on assessing underlying action-units, classification accuracies and perceptual matching of expressions (Elfenbein & Ambady, 2002; Jack et al., 2012; Segal et al., 2019; Yan et al., 2016). On the other hand, we also have populations exhibiting cultural differences for a specific emotion. For example, in Jiang et al. (2023), both European and East Asian participants exhibited impaired classification (i.e., lower accuracy) when judging expressions of anger from other-race identities compared to those from their own-race. Additionally, European participants were also less accurate when judging sad expressions from East Asian identities. Regardless of whether cultural exposure impacts judgments for all or specific emotions, the studies cited above remain in support of a more balanced perspective: while cross-cultural universals may exist in emotion recognition, the ability to recognise emotions is also shaped by cultural exposure, such as greater familiarity with own-race faces (Jiang et al., 2023; Wickline et al., 2009; Young et al., 2012). In any case, this section provides the foundation to understand that cultural differences exist and that they can potentially extend beyond the judgement of isolated expressions to the influence of context. Culture as a factor of individual differences and possibly a modulating factor of contextual effects will be examined in Chapter 4.

1.9.4. Clinical traits

Apart from the perceiver-related factors discussed above, Laukka et al. (2021) has drawn attention to individual differences in emotion perception arising from factors relating to socio-emotional dysfunction, which will also be one of the areas addressed in this thesis (see Chapters 2 and 3). The clinical traits discussed below have been associated with general deficits during emotion classification in clinical populations, namely, traits related to alexithymia (Grynberg et al., 2012), depression (Bourke et al., 2010), anxiety (Button et al., 2013) and autism (Uljarevic & Hamilton, 2013).

Alexithymia. This trait is characterized by difficulties in classifying, describing, and differentiating one's own emotional state (Grynberg et al., 2012). Alexithymia can significantly hinder an individual's ability to maintain interpersonal relationships, especially when adapting to one's social environment (Vanheule et al., 2007). Furthermore, difficulties associated with processing emotions often cause alexithymia individuals to appear cold, distant and detached in their interactions with others, according to Grynberg et al. (2012). Furthermore, these challenges with emotion perception (especially recognition) have been observed even in subclinical populations as well. For instance, Swart and colleagues (2009) asked sub-clinical participants who exhibited high or low Alexithymia traits to judge short facial expressions (i.e., brief presentation, 15ms) that unfolded from a neutral face to either one of the six basic emotions, and then back to neutral. Swart et al. (2009) observed how those who scored higher on the Bermond-Vorst Alexithymia Questionnaire (BVAQ; Bermond & Oosterveld, 1994) had reduced accuracy when labelling emotional faces compared to those who had lower scores.

To further exemplify, Montebarocci et al. (2011) examined recognition accuracies in a cohort of sub-clinical participants that were characterized as being high or low alexithymia based on their scores on the self-report Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994). First, they broadly observed lower recognition accuracies for high alexithymia group compared to the lower alexithymia group across all their emotion categories (anger, sadness, happiness, fear, surprise, disgust, neutral). This general impairment when classifying facial expressions has been witnessed in other studies too (Jessimer & Markham, 1997; Mann et al., 1994). However, upon closer inspection of Montebarocci et al.'s (2011) findings, high alexithymia individuals in fact had lower recognition accuracies for negative emotions (i.e., anger, sadness, fear, disgust) compared to positive emotions (i.e., happiness and surprise). In summary, the findings above suggest that, broadly, alexithymia individuals may have difficulty when judging stereotypical expressions and this difficulty is more pronounced for negative emotions.

Depression and Anxiety. These two traits have been closely linked to emotional dysfunction, whereby individuals not only struggle to understand others' emotions, but also have difficulty regulating one's own emotions (Demenescu et al., 2010). One such way in which emotional dysfunction can manifest is by influencing how anxious and depressed populations judge emotions from facial expressions. Highly anxious individuals appear to exhibit a greater bias towards processing and attending to threat-related expressions (e.g., anger, fear; Richards et al., 2002) and depressed individuals might tend to attribute more negativity when judging facial expressions (Leppänen et al., 2004). We discuss these two traits in tandem given the high incidence of comorbidity in clinical populations. Tiller (2013) reported that 85% of patients with depression also have anxiety and 90% of those with anxiety disorders also have depression. In any circumstance, social interactions for both anxious and depressed individuals might prove challenging considering their difficulties with interpreting emotions, after all accurately inferring the emotional states of other individuals is imperative for effective communication.

Nevertheless, findings from past studies remain mixed regarding both these disorders and emotion perception. An early study by Hale (1998) conducted on clinically depressed patients and healthy controls reported that in the former group increasing severity of depression correlated with increasing negativity being attributed to line drawings of faces that depicted different configurations of facial features (e.g., smiling mouth, eyebrows angled downwards). Furthermore, both patients and controls judged facial expressions defined as either general (i.e., facial features convey easily distinguishable emotions) or ambiguous (i.e., facial features convey equal levels of positive / negative emotions). Depressed patients compared to healthy controls gave more classifications of "sad" for both types of facial expressions. Taken together, such findings led the way to explore the possibility of a negative bias in depressed individuals, whereby they perceive facial expressions as more negative in general, irrespective of the category of emotion portrayed by the face. However, contrary to Hale's (1998) findings, more recent studies have observed no significant differences in how negative or positive expressions are perceived by depressed individuals when compared to healthy participants (Gollan et al., 2008; Leppänen et al., 2004).

When reviewing the mixed evidence, only neutral expressions seem to show consistent findings concerning depressed patients. For instance, studies observe neutral expressions being consistently judged as negative (Bourke et al., 2010; Gollan et al., 2008) and being misclassified as sad (Leppänen et al., 2004) more often in depressed individuals. This bias towards a negative interpretation has often been explained by mood congruency effects, whereby depressed patients who claim to consistently experience sadness are more likely to attribute greater negativity to neutral faces and therefore, judgements on neutral facial expressions would appear congruent with their current emotional state (Rottenberg, 2005). To provide experimental evidence supporting this view, van Vleet et al. (2019) asked participants to judge whether a pair of faces (e.g., sad-neutral faces, happy-sad faces, happy-happy faces) presented together expressed the same emotion. It was reported that clinically depressed participants' ability to accurately discern neutral-sad pairs decreased as a function of increasing severity of depression. Interestingly, only when neutral expressions were paired with sad expressions was this impairment observed, and patients showed no such deficits with neutral-happy or neutral-neutral pairings of faces. Therefore, van Vleet et al.'s (2019) patients with severe depression who experienced a sad mood more acutely would interpret neutral expressions as being more negative and consequently, this bias would lead to a difficulty in discriminating between sad and neutral (which now looks sad) faces.

Similar to depression, anxiety disorders have also been associated with expressing a negative bias when judging facial expressions, especially, those emotions related to threat such as anger and fear (Richards et al., 2002). However, unlike with depression, the research remains divided on how this negative bias manifests in high and low anxiety individuals. Studies remain polarized between high anxiety individuals having either heightened sensitivity to negative emotions (Richards et al., 2002, Studies 1 and 2) or exhibiting impairments when judging negative emotions (e.g., lower accuracy; Ferguson et al., 2021).

On the one hand, Richards et al.'s (2002, Study 1) findings show greater sensitivity within a sub-clinical population. Those categorized as having high social anxiety compared to those with low social anxiety gave more responses of "fear" when they viewed ambiguous expressions that contained more fear-related cues than cues related to other emotions (e.g., blended faces with 70% fear and 30% happy). This finding was replicated in two instances, where either mood was not manipulated (Richards et al., 2002, Study 1) or it was manipulated to invoke greater levels of state anxiety (Richards et al., 2002, Study 2). Additionally, the number of "angry" responses to ambiguous faces increased when state anxiety levels were greater (i.e., mood manipulated conditions), for both high and low trait anxiety groups (Richards et al., 2002, Study 2), whereas, in Richards et al. (2002, Study 1), "angry" responses were comparable between both groups. By means of interpreting these findings, it appears that anxious individuals show heightened sensitivity to fear more than to anger, indicating that the former might be a core emotion in anxiety. Moreover, Richards et al. (2002, Study 2) postulated that greater levels of state anxiety might be needed (e.g., as in mood manipulated conditions) to reach a threshold where anxious individuals would exhibit heightened sensitivity to anger. In other words, anger might only be a secondary emotion in anxious individuals compared to fear.

On the other hand, we also see evidence observing a difficulty in classifying negative emotions. Ferguson et al. (2021) recently reported that recognition of all negative facial expressions (e.g., angry, sad, disgusted, fearful) is impaired in those with high anxiety compared to those with low anxiety. More interestingly, in direct contradiction to Richard et al.'s (2002, Studies 1 and 2) findings, expressions of fear were classified with the lowest accuracy across both anxiety groups. Therefore, Ferguson et al.'s (2021) findings remain indicative of a specific deficit when recognizing negative emotions and may possibly reflect avoidance behaviour when judging these emotions (Bardeen et al., 2014). Therefore, if highly anxious individuals do not attend (i.e., avoid) to these expressions during a task, their avoidance may ultimately lead to significant differences in recognition accuracy between high and low anxiety groups. In any case, as asserted earlier, the evidence on anxiety has remained polarized between heightened sensitivity (Richards et al. 2002, Studies 1 and 2) and impaired classification of negative emotions (Ferguson et al., 2021).

Although the studies discussed above do not reach a clear consensus regarding how difficulties in classifying emotions may manifest in depressed/anxious individuals, it cannot be denied that the way these populations interpret emotions may not be the same as how typical adults interpret them. Interestingly, all the studies discussed above have focused on comparing recognition ability by categorizing individuals into two groups (i.e., group level effects; e.g., high anxiety and low anxiety groups; Ferguson et al., 2021). Therefore, it would be informative to establish whether trait severity measured on a continuous scale for above two clinical conditions could be systematically mapped onto behavioural measures of recognizing expressions.

Autism. Finally, individuals diagnosed with Autism Spectrum disorder (ASD) show characteristic difficulties when recognizing their own and others' emotions (Harms et al., 2010). Research regarding ASD and deficits in emotion recognition remain mixed. Some studies have found general impairments in their overall ability to recognize emotions from faces (Celani et al., 1999; Lindner & Rosén, 2006), whilst others find no such deficits in either high or low functioning ASD groups (Rosset et al., 2008).

Of particular interest to the current thesis is Eack et al.'s (2015) study, where adults with ASD and gender-matched healthy controls judged happy, fearful, angry, sad and neutral faces. The difficulty in recognizing emotions for ASD adults was reflected in reduced accuracy when judging happy, sad and neutral expressions, when compared to healthy individuals. Interestingly, they did not exhibit difficulties when classifying angry and fearful expressions (unlike with anxiety; cf., Ferguson et al., 2021). The ASD group struggled the greatest with happy and neutral expressions compared to healthy controls; ASD group was more likely to classify happy expressions as neutral and misclassify neutral as angry.

On the one hand, Eack et al.'s (2015) findings suggested that ASD individuals struggle to discriminate between emotional (e.g., happy expressions) and neutral faces. On the other hand, ASD participants were more likely to attribute greater negativity (i.e., bias), irrespective of whether they judged happy or neutral facial expressions. Based on the classification patterns observed by Eack et al. (2015), ASD individuals do not seem to exhibit difficulties in judging all emotional categories, rather the observations highlight emotion-specific difficulties/biases, given that accuracy for fear and angry expressions remained comparable between ASD and healthy participants.

1.10. Conclusion and thesis structure

The current chapter has discussed two key themes related to this thesis, namely, contextual effects (Sections 1.4, 1.5. 1.6) and factors of individual differences that influence the interpretation of facial expressions (Section 1.9). Briefly, first, we can clearly see that facial expressions are constantly being evaluated against contextual information originating from the environment (e.g., affective scenes) and from the expresser (e.g., body gesture, vocal intonation). Second, we established how individual differences (i.e., information from the perceiver) could possibly influence the classification of facial expressions appearing in isolation.

Accordingly, we first aimed to examine mechanisms underlying how body contexts influenced the judgement of easily discriminable expressions (Chapter 2) and confusable expressions (Chapter 2) i.e., whether contextual effects can be attributed to perceptual (Albohn et al., 2022; Aviezer et al., 2012; Aviezer et al., 2011; Aviezer et al., 2008; Meeren et al., 2005; Mondloch, 2012) or non-perceptual (Teufel et al., 2019) factors. Therefore, we implemented two separate paradigms: 1) Comparison-of-Comparison Method (COCM) which largely limits the influence of non-perceptual influences (e.g., changes in decisional criteria) when judging facial expressions and 2) the conventional paradigm of presenting isolated faces or face-body composites individually. Here, participants' judgements can be a product of both perceptual and non-perceptual influences.

Next, we examined several factors of individual differences that may modulate the magnitude of contextual influence participants experienced. The current work focused on 5 main factors of individual differences, namely: 1) clinical traits (Chapters 2-3), inherent biases in judging isolated expressions (Chapters 2-5), thinking styles (Chapter 4), view of oneself (i.e., self-construals; Chapter 4) and attentional allocation (Chapter 5). Specifically, in Chapters 2 and 3, we relate scores obtained from clinical questionnaires assessing autism, depression, alexithymia and autism with measures from the COCM and classification paradigms. Next, Chapter 4 involves a cross-cultural analysis, comparing Asian and British "Western" participants to determine the extent to which cultural differences in thinking styles and / or self-views could modulate the magnitude of contextual effects. Lastly, Chapter 5 employed eye-tracking metrics to assess whether overt attention preferentially directed towards the face and / or body context would drive these effects as well. Collectively, these chapters aim to provide a comprehensive analysis of factors of individual differences that may underpin the variability in contextual effects on facial emotion interpretation.

Chapter 2. The effects of body gestures (of the expresser) and clinical traits (of the perceiver) on the classification of facial expressions

2.1. Introduction

2.1.1. Facial expressions in context

Facial expressions do not always have a one-to-one mapping between the subjective feeling (e.g., sad, happy) and the physical expression of the emotion (e.g., tears, lips tilted upwards). For example, Figure 2.1 shows an image adapted from Martinez's (2019) commentary.

Figure 2.1

Image of how faces appear in context from Martinez (2019)

Note. Adapted with permission "Context May Reveal How You Feel" by A. M. Martinez, 2019, Proceedings of the National Academy of Sciences, 116 (15), p. 7169 – 7171. Copyright 2019 by Proceedings of the National Academy of Sciences.

The image above depicts several crying women, instantly conveying the impression that they are experiencing sadness. However, the same expression could arise from a situation where they were in fact seeing their favourite idol in person for the first time, and in that case, they would be experiencing happiness, despite the tears. In such circumstances, accurate judgment of the facial emotion can only be made if the context in which it occurred was considered. This example illustrates that facial expressions rarely occur in isolation and, therefore, highlights the important role context plays when inferring the underlying emotional state communicated by the face. This chapter focuses on the role of body gestures as contextual cues, given that bodies are the most immediate cues attached to a face and, in real-life, these two entities seldom appear separately.

2.1.2. The influence of body gestures as contextual cues

Meeren and colleagues (2005) were among the first to highlight how contextual information provided by body gestures influences the classification of facial emotion. In their study, angry or fearful bodies were paired with angry or fearful faces to create realistic looking face-body composites. Participants had to judge the facial expressions embedded on either a congruent face-body composite (e.g., angry face – angry body) or an incongruent composite (e.g., angry face – fearful body). Participants were more accurate and faster when judging the faces from congruent face-body composites, compared to incongruent composites. For the latter pairings, participants often categorized the emotion expressed by the body as the facial expression.

Generally, two contextual effects are reported in the literature. First, a facilitatory effect is observed when the body provides information that is consistent with the facial expression. Second, when the face and the body provide conflicting information, emotion attributed to the facial expression is shifted in the direction of the body's emotion. Consequently, this misattribution as the body's emotion impairs recognition. These effects of facilitation and impairment have been observed across both positive and negative emotions, using various emotion combinations, such as disgust/fearful (Aviezer et al., 2008, 2011), fearful/happy (Van den Stock et al., 2007), and angry/fearful/happy (Kret et al., 2013) expressions.

Since Meeren et al.'s (2005) seminal study, other studies have attempted to determine how contextual cues alter our interpretation of facial expressions. Aviezer et al. (2008, Study 3) provided evidence showing how body contexts can influence the scanning patterns adopted when processing a facial expression. They tracked participants' gaze movements as they categorized the expressions of faces embedded on a body expressing either a matching emotion (e.g., disgusted face – disgusted body) or conflicting emotions (e.g., disgusted face – angry body). Fixation patterns on the face changed as a function of the emotion conveyed by different body contexts. Participants fixated faster on the eye regions when angry faces were embedded on an angry body rather than a disgust body. Therefore, when the face-body pairings provide consistent information, faster RTs and greater accuracy could possibly be attributed to faster fixations. However, when the face-body pairing provided inconsistent information (e.g., angry face – disgusted body), eye movements scanning the target face were characteristic of facial expressions typically associated with the emotion conveyed by the body gesture. For example, when an angry face was paired with a disgust body, equal number of fixations were deployed towards the eye and mouth regions, which are characteristic scanning patterns associated with disgust faces (Wells et al., 2016). According to their findings, a serial relationship between contextual cues and emotion perception can be inferred, whereby body gestures influence the regions we attend to in a facial expression and consequently influence the emotion we perceive from the face.

Taken together, the findings above have two main implications. First, body gestures can provide a strong contextual influence, even to the extent of driving the process of judging emotions from facial expressions alone (de Gelder, 2006). Second, when participants become uncertain about judging a given cue (e.g., face) owing to conflicting information from incongruent face-body composites, they may rely more on the context (i.e., body gesture) than the face when inferring the emotional expression. Notably, it appears that these contextual effects occur regardless of whether people are assigning a categorical label to the emotion of the face (Meeren et al., 2005; Van den Stock et al., 2007) or evaluating the valence of the face (Aviezer et al., 2012).

As far as basic categories of facial expressions are concerned, there are some expressions that we can easily discriminate from each other, such as anger and fear or anger and happiness. Validation studies attest to the nature of such easily discriminable facial expressions (Calvo & Lundqvist, 2008; Thoma et al., 2013). We call these “discriminable emotions”, and this chapter will focus on how body gestures influence judgement of such emotions. Despite the ease of recognizing these expressions in isolation, studies have demonstrated the persistent influence of body gestures on categorical judgements, whereby classification aligns with the context emotion (Kret et al., 2013; Meeren et al., 2005; Van den Stock et al., 2007). These findings suggest that context (especially incongruent contexts; e.g., happy face – fearful body) can override accurate judgements of facial expressions. However, the magnitude of the body’s influence can vary. Van den Stock and colleagues (2007) asked participants to classify facial expressions morphed along a continuum ranging from happiness to fear, when paired with bodies conveying either emotion. Classification patterns reported highlight a minimal influence from body gestures at the end-point morphs but a more pronounced influence on the ambiguous mid-point morphs.

Therefore, in the current study, we first expand on the range of mid-level morphs with the aim of capturing a possibly systematic change in how body contexts influence perception among two discriminable emotions (i.e., happy and angry). Second, selecting these two discriminable emotions would allow us to qualitative compare contextual effects across different types of emotions (i.e., Chapters 3-5 will examine “confusable” emotions). These “confusable” emotions refer to those we often mistake for others, such as anger and disgust (e.g., Susskind et al., 2007).

2.1.3. Problems with using a single face-body composite

The studies discussed thus far have attested to how emotion classification results from incorporating simultaneously available information from the body context into our judgements of the face. Interestingly, all those studies reporting contextual effects had used an identical method of presenting stimuli. Participants were presented with a single stimulus (e.g., one face-body composite) and instructed to classify the emotion expressed by the face (e.g., Aviezer et al., 2008; Meeren et al., 2005; Van den Stock et al., 2007). This method to which we will henceforth refer as the “conventional method” involves the risk of participants being influenced by a response bias when making perceptual judgments. For example, in trials with incongruent face-body composites (e.g., disgusted face – angry body; Aviezer et al., 2008), participants may become aware of the incongruency and can consciously decide to consistently select the emotion of the body context whenever the face and body gesture provide conflicting information. Even under such circumstances, we can expect the classification of the face to be biased in the direction of the body’s expression, and we would still observe the reduced accuracy associated with incongruent face-body composites characteristic of typical contextual effects (Aviezer et al., 2008; Meeren et al., 2005). However, this pattern of responses then results from an individual’s criterion rather than a genuine influence of the body context on perception (i.e., not a perceptual bias).

Therefore, to confirm whether perception itself is changed by the body, it is important to minimise the contribution of non-perceptual (higher-level) processes to perceptual decisions. Here, “perception” refers to early, automatic neural processes involved in the interpretation of sensory information—specifically, from faces and body gestures in the current context. Therefore, if the body altered the perception of a facial expression, this suggests that information from both cues were integrated at very early stages of visual processing (Aviezer et al., 2008, Aviezer et al., 2011, Meeren et al., 2005). That being said, we acknowledge that perception does not cease when a decision or behavioural response is being made for a stimulus (e.g., face-body composite). For instance, some aspects of decision-making, such as conflict resolution concerning stimulus congruency, take place at various stages of perceptual processing, from early to late-perceptual stages (Diéguez-Risco et al., 2015; Gu et al., 2013; Xue et al., 2016; Xu et al., 2015). Nonetheless, to remain consistent with past studies (Aviezer et al., 2008, Aviezer et al., 2011, Meeren et al., 2005) investigating contextual effects, we use the term “perception” primarily to refer to processes occurring at the early stages of visual processing.

To the author’s knowledge, only one study by Teufel et al. (2019) has expressly examined the perceptual nature of contextual effects. Their study examined whether body gestures would influence both classification and adaptation related to facial expressions. The latter refers to how the extended exposure for a given expression (e.g., anger) could bias perception of subsequently viewed expressions in the opposite direction (e.g., disgust), resulting in a negative after-effect. Their viewpoint predicated that if body gestures can in fact influence adaptation and classification, then integration of cues from the context and face must occur before the sites responsible for face adaptation become activated (i.e., context influencing early stages perception). However, Teufel et al. (2019) only observed body contexts influencing their classification paradigm and not their adaptation paradigm (see Discussion; Section 2.4). In their classification paradigm, participants viewed disgusted facial expressions that were paired with body gestures expressing one of four emotions (i.e., disgust, anger, fear or sadness) and subsequently, classified the expression as one of the four emotions. In their adaptation paradigm, participants first adapted to either face-body composites (i.e., disgusted face-angry body, disgusted face-disgusted body) or the body context alone and then classified an ambiguous target expression as “angry” or “disgusted”. Their findings are among the first to provide experimental evidence for contextual cues not influencing the early stages of perception, contrary to evidence with single face-body composites. Furthermore, Teufel et al.’s (2019) results will be discussed in detail, in relation to our own findings in the discussion (Section 2.4).

Despite the problems associated with the conventional paradigm, past studies remain steadfast in viewpoint that body gestures do bias our perception of a given expression and in turn change how we attend to the facial expression (Aviezer et al., 2008, Study 3; Kret et al., 2013; Meeren et al., 2005; Van den Stock et al., 2007). Additionally, these studies postulate that our ability to integrate cues from the face and body may be occurring without our awareness. For instance, neural responses to face-body composites highlight that integration appears at the earliest stages of visual processing (i.e., within 115 ms of stimulus onset; Meeren et al., 2005). Such evidence was taken in support of contextual effects resulting from neural modulations at early stages of perception. Given that evidence remains polarized regarding the exact nature of contextual effects, several interpretations can be considered, in terms of them being perceptual (Aviezer et al., 2008, Study 3; Kret et al., 2013; Meeren et al., 2005; Van den Stock et al., 2007) or non-perceptual (Teufel et al., 2019) effects.

2.1.4. The comparison of comparisons method (COCM)

Therefore, to confirm whether the effect is perceptual, we aimed to minimize the contribution of non-perceptual processes to participants’ responses by using a method that has recently gained popularity as the “comparison-of-comparisons” method (Morgan et al., 2015). For example, Ismail et al. (2016) implemented this paradigm when examining the phenomenon of Tilt Aftereffect (TAE) in natural images. In their study, participants were shown in every trial two stimuli (i.e., images of houses) on either side of a fixation cross. One of the stimuli was referred to as the “pedestal” whereby they had two fixed tilts either -3^{o} or $+3^{o}$ (Ismail et al., 2016, Study 1), whereas the second stimulus referred to as the “comparison” had varying tilt angles (i.e., from -15^{o} to $+15^{o}$ in 3^{o} intervals). Accordingly, varying the characteristics of the two stimuli allowed the presentation of unique combinations of pedestal and comparison tilts. The pedestals would appear in a random position on either the left or right of the fixation. Participants were instructed to choose between the pedestal and comparison to indicate which one appeared more upright. Accordingly, the pedestal was expected to be chosen as closer to upright, if it appeared less tilted compared to the comparison (Ismail et al., 2016).

The premise of COCM lies in the fact that the task and pairs of stimuli (i.e., the pedestal and comparison) would force participants to compare their subjective perceptual representations of stimuli when determining which house appeared more upright. Moreover, because participants could not determine the position of the pedestal on any given trial, they could not rely on conscious decisional criteria, such as assuming the pedestal always appears on the left or consistently choosing the house that is tilted clockwise or anti-clockwise when uncertain about their judgement. In this manner, COCM could minimize the contribution of non-perceptual biases, whilst capturing genuine shifts in perception. This method has been widely used to measure perceptual biases for low-level visual features, such as the orientation of lines (Morgan, 2014), the effects of allocentric visual contexts (i.e., tilted frames; Morgan et al., 2015), the perception of collinearity (Morgan & Dillenburger, 2016), the effect of colour on perception (Lee & Mather, 2019), and even the susceptibility to different illusions (Manning et al., 2017; Morgan et al., 2013; Schreiber & Morgan, 2018).

In the current study, we adapted COCM to measure the influence of body context on the perception of facial expressions. In line with the methodology described above, we presented two face-body composites on every trial. In both composites, the body gestures were identical, but the two faces would have varying (although sometimes similar) levels of expressiveness between two different emotions (i.e., happy and angry). The participants' task was to discriminate between the two expressions and indicate which expression appeared closer to neutral, and they could not rely on the body to respond because the two bodies were identical and would not help with the comparison of faces in any way (i.e., avoid decisional biases). However, if the bodies change the appearance of the faces and, as a result, the perception of the faces, then it would reflect on participants' ability to discriminate between the two faces. For example, if we would present participants with a slightly angry face and a slightly happy face (both close to neutral) and ask them to choose which of the two is closer to neutral, they would choose at chance, because both expressions appear equally close to neutral. However, if the same two faces are now presented with angry bodies and the bodies alter the appearance of the faces to make both of them look angrier (i.e., what we would expect from a contextual effect), participants would more likely choose the happy face as closer to neutral.

Accordingly, in this chapter, we used the COCM to obtain measures of perceptual biases by estimating the appearance of a neutral face under three different conditions: face appearing in isolation (no-context), faces presented with angry bodies (angry context), and faces presented with happy bodies (happy context). This approach would allow us to determine the nature of contextual effects with discriminable expressions, whereby the contribution of non-perceptual biases would be largely minimized unlike past studies with the conventional paradigm.

2.1.5. Individual differences in perceivers: age, culture and psychological tendencies

Whereas the first aim of our experiment was to determine whether body posture changes the perception of facial expressions, we were also interested in exploring the role of the perceiver's characteristics in these contextual effects. Although convincing evidence observing contextual effects have been discussed above, we also know that the ability to classify facial expressions is not uniform across all perceivers (see Section 1.9). This ability could potentially change the extent to which perceivers rely on context when perceiving facial expressions. Here, we focus on how characteristics of the individual making the judgement (i.e., the perceiver) can also have a profound influence on the susceptibility to contextual cues. Examples of such perceiver-related factors include age (Richter et al., 2011), culture (Ko et al., 2011) and psychological tendencies (Lee et al., 2012; Noh & Isaacowitz, 2013).

For example, Richter and colleagues (2011) asked participants to classify facial expressions from a video with a single target character under either context-rich conditions (i.e., video and audio) or context poor conditions (i.e., only video). In both contexts, a target character was seen recalling a memory out loud that had elicited specific emotions. Overall, younger adults outperformed older adults when recognizing sad, angry and happy emotions. However, they also discovered that older adults compared to the younger cohort used a rich context to a greater extent when recognising happy expressions, whereas, with anger and sadness, both groups used contextual information to the same extent.

Richter et al. (2011) claimed that their finding regarding happy expressions was consistent with the theoretical framework of Socioemotional Selectivity Theory (SST; Carstensen et al., 1999). According to the SST, older adults appear to be more motivated to selectively process, attend to, and use information that is inherently positive (Mather &

Carstensen, 2005). This motivation to process positive information appears to be reflected in Richter et al.'s (2011) older adults when judging happy expressions. To be more certain of selective processing of happy stimuli in adults, studies may need to present happy expressions within negative contexts. After all, Richter et al. (2011) did not manipulate the congruency between context and target facial expressions.

Extending Richter et al.'s (2011) findings, Noh and Isaacowitz (2013) presented angry and disgust facial expressions embedded on congruent or incongruent body contexts to younger and older adults. First, the recognition patterns revealed that older adults have greater accuracy when the face and body provided consistent information. In other words, older adults benefitted more from a congruent context compared to the younger adults. More importantly, with incongruent face-body composites, recognition accuracy was more impaired for the older cohort compared to the younger cohort (Noh & Isaacowitz, 2013). One possible explanation is that older adults rely on contextual information more because of a general decline in their ability to classify facial expressions (Lambrecht et al., 2012) and, therefore, become more susceptible to contextual information.

Another factor that is known to interact with age and contribute to individual differences in emotion perception is culture (see Section 1.9.3). Ko et al. (2011) investigated the interplay and contribution of both these factors regarding contextual influence from body contexts, when rating faces along the emotional categories of anger, happiness, and disgust. The ratings given by Korean young adults were more biased in the direction of the body context when compared to American young adults, but no such cultural differences were observed between their older counterparts. The finding regarding younger adults is further supported by Bjornsdottir et al. (2017) who reported that younger Japanese participants attended more to the body context, unlike younger Canadians participants who selectively attended to the face when classifying emotions. Taken together, the above findings remain consistent with Asians being more inclined to holistically process information than Westerners (Masuda et al., 2008, Study 1) and, therefore, integrate contextual information with facial cues more. It is noteworthy that when cultural differences are emphasized, age-related effects on contextual effects disappear. Regardless of the cultural background, it appears that young adults' ability to process different emotional cues remain consistent, only the manner in which they integrate these cues differ (Bjornsdottir et al., 2017; Ko et al., 2011). In contrast, the absence of cultural differences in older adults could possibly imply that age-related cognitive decline may interact and even overshadow cultural biases.

Lastly, psychological tendencies have also been known to influence emotion perception and contextual effects. For example, Lee et al. (2012) investigated the relationship between individuals' ability to process positive and negative information and emotion classification. Self-report data on psychological tendencies revealed participants being more susceptible to a negative context (i.e., visual scene) when they exhibited a heightened tendency to process negative information, as reflected during the classification of facial expressions. Similarly, a greater affinity to process positive information increased participants' susceptibility to positive contexts. These psychological tendencies may play a role when examining the influence of individual differences, such as clinical traits, on contextual effects.

2.1.6. Individual differences in perceivers: Clinical traits

In Chapter 1, we discussed how certain clinical traits impair people's ability to classify facial expressions (see Section 1.9.4). With such difficulties, it is plausible that these individuals would rely more on, or be more susceptible to, context. In the case of alexithymia, individuals have inherent difficulties understanding, describing and expressing their own emotions (Grynberg et al., 2012). However, as we discussed in Chapter 1 (see Section 1.9.4), these difficulties appear to manifest even when judging the facial expressions of other individuals (Swart et al., 2009), especially when it involves verbalizing emotional judgements of facial expressions (Montebarocci et al., 2011). Given that severe alexithymia can lead to difficulties judging a wide range of cues, particularly language-related contexts like emotional labels, it raises the question whether contextual information could benefit such individuals.

The inherent challenges faced by those with alexithymia (Grynberg et al., 2012) suggest that even additional contextual information may not significantly improve their ability to judge emotions from faces. Among healthy participants who were categorized as high and low alexithymia based on self-report measures, those with severe alexithymia exhibited impaired recognition (i.e., lower accuracy) compared to individuals with low alexithymia when judging isolated expressions (Jongen et al., 2014). That being said, Nook et al. (2015) surprisingly observed that the presence of emotion labels could in fact facilitate the classification of facial expressions. Moreover, this facilitation was more pronounced in participants who self-reported greater severity of alexithymia symptoms.

The implications of the findings above are two-fold. On the one hand, those with severe alexithymia might be more susceptible to contextual information. On the other hand, deficits in emotion recognition associated with alexithymia might be overcome by presenting a meaningful context. However, given that this clinical trait can lead to widespread difficulties in judging emotional cues (Grynberg et al., 2012), a meaningful context may not benefit all individuals. In any case, it remains unknown whether contextual cues, apart from emotional labels, such as body gestures would similarly serve as facilitatory agents for individuals with differing levels of alexithymia traits during facial emotion classification.

Although we discussed alexithymia as a separate clinical trait, it has been commonly seen as a comorbid trait of another important clinical condition, namely, Autism Spectrum Disorder (ASD). Individuals falling into the latter group show characteristic difficulties when recognizing their own and others' emotions (Harms et al., 2010). Several studies discussed in Chapter 1 showed how ASD individuals struggled when classifying others' emotions (see Section 1.9.4), especially when they were judging happy, sad and neutral expressions (Eack et al., 2015; Lindner & Rosén, 2006). One possibility is that in such circumstances ASD individuals could benefit from additional contextual cues to overcome their inherent difficulties with emotion perception. Past literature has reported biases in prioritising local features in ASD groups with a minimal ability to form global, integrated percepts (Behrmann et al., 2006). For instance, autistic individuals tend to be good at tasks that require them to attend to target figures whilst ignoring background information (Ropar & Mitchell, 2001). Therefore, if ASD individuals have difficulty forming integrated percepts (e.g., face-body composites), then the influence from body gestures on emotion perception might be negligible or reduced for this population.

Interestingly, Brewer et al. (2017) found evidence to the contrary. In their study, clinically diagnosed ASD patients and healthy controls judged facial expressions morphed on a continuum between disgust and anger. These expressions were either paired with an angry or disgusted body gesture. Similar to previous studies examining contextual effects (Aviezer et al., 2008), participants were instructed to classify these expressions as either "disgust" or "anger". Brewer et al. (2017) observed that body contexts influenced both ASD and healthy individuals to the same extent. However, upon conducting correlational analyses between participants' decisional noise (i.e., perceiver-related difficulties when making judgements) and susceptibility to contextual modulation, some differences emerged within ASD individuals but not within control participants. Those who had greater difficulty when judging expressions in isolation had greater susceptibility to contextual information (i.e., relied more on context when classifying facial expressions). Nevertheless, this observation must be treated with caution given that: 1) the sample size ($N = 19$) is relatively small and 2) only three out of their nineteen ASD patients had extreme categorization difficulties, whereas the remaining sixteen ASD individuals performed similar to typical adults.

Based on Brewer et al.'s (2017) findings, we cannot completely disregard the influence that contextual cues can have on ASD, owing to difficulties in forming integrating percepts. However, what we can conclude is that a great deal of variance in functionality can be seen among those given a common diagnosis of autism. Therefore, it is not possible to convincingly conclude that ASD individuals would either not be influenced by body contexts or exhibit greater reliance on contextual cues when judging facial expressions.

2.1.7. The present study

To summarise, there is evidence demonstrating that alexithymia and autism play a role in people's ability to classify facial expressions appearing in isolation (see Section 1.9.4). In some cases (e.g., alexithymia), higher levels of these traits impair people's ability to classify facial expressions (either all basic expressions or some of them) and in some cases (e.g., depression), they bias the classification of certain expressions (e.g., neutral). In both cases, the result leads to inaccurate classifications. There is some evidence showing that clinically diagnosed autistic adults and individuals with high alexithymia experience stronger contextual effects. However, these studies do not inform whether there is a systematic relationship between alexithymia/autistic traits and the magnitude of contextual effects (from body gestures) experienced by individuals. We addressed this gap by measuring contextual effects in a sub-clinical sample with a broad range of trait scores. No studies in the past have examined the relationship between depression or anxiety and contextual effects. Therefore, we expanded the battery of trait measures to include depression and anxiety. It was important to measure these individual differences, because similar to individuals with alexithymia or autism, depressed and anxious people also struggle with classifying facial expressions, and therefore may be affected differently by contextual cues.

2.2. Method

2.2.1. Design

To measure perceptual biases and shifts in these biases when perceiving expressions that may result from the presence of body gestures, we used a within-subjects design. We had a single independent variable where the type of body context was manipulated with three levels: facial expressions to be judged appeared without a body gesture (no context condition), with an angry body gesture (angry context condition), or with a happy body gesture (happy context condition). The dependent variable measured was the perceptual bias for each condition, which represents the appearance of a neutral face to participants (see results for more details, Section 2.3).

We also examined individual differences in terms of perceptual biases, decisional noise and clinical traits using a between-subjects design. Here, we obtained self-reported scores for four clinical traits (i.e., alexithymia, depression, autism, anxiety) to establish how severity of symptoms differed across our cohort of participants. We assessed the relationship between these measures of clinical traits in relation to perceptual biases (as described above). Additionally, we also examined how severity of clinical symptoms would modulate decisional noise, that is, how good participants were when discriminating between expressions of different emotional intensities (see results for more details, Section 2.3).

2.2.2. Participants

We aimed to conduct a one-way analysis of variance (ANOVA) and a series of Pearson's correlations to establish relationships between the four clinical measures and perceptual biases / decisional noise. Therefore, an a-priori estimation of sample size using G*Power 3.1 (Faul et al., 2007) revealed that 43 participants were required for the ANOVA and 84 participants were required for the correlations to obtain moderate effects (Cohen's f = 0.25 and Pearson's r = 0.3, respectively) with 80% statistical power (alpha = .05, two-tailed).

Accordingly, we recruited eighty-four participants (66 females, 18 males) between (and including) the ages 18 and 34 years (M = 22 years, SD = 3 years) with normal or corrected-to-normal vision (as per self-reports). Only those with Asian origins (e.g., Malaysian, Chinese, Indonesian) and without a prior mental health diagnosis were recruited for the study. All participants were either alumni or current students from the University of Nottingham Malaysia. Participants received either a monetary compensation (MYR 10) or 2 course credits (only for students from the School of Psychology) upon completion of the experiment. This study was approved by the Science and Engineering Research Ethics Committee of the University of Nottingham Malaysia (NNNL280521).

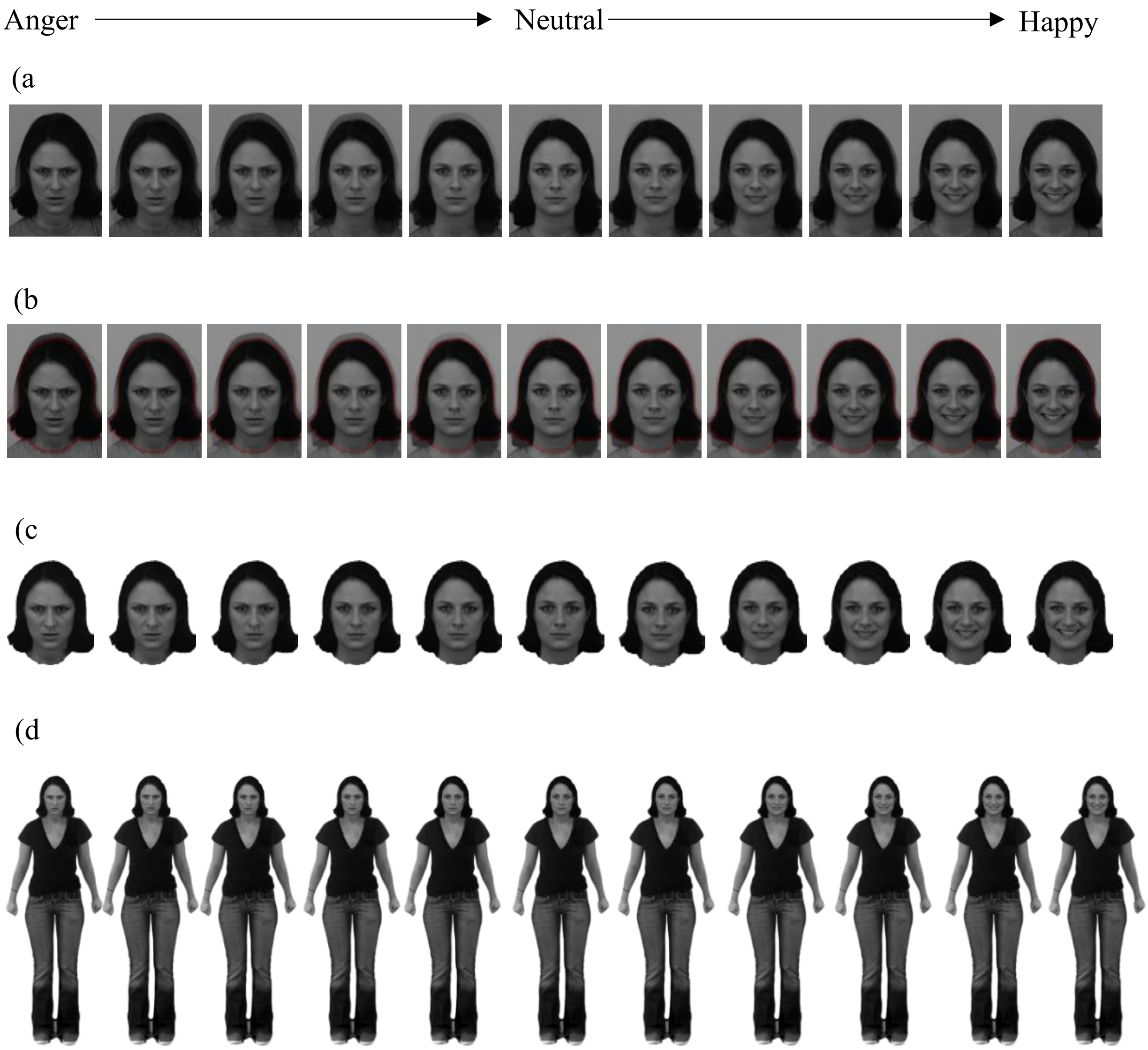
2.2.3. Stimuli and Apparatus

Morphing Sequences: Ten different Caucasian identities (5 female, 5 male) were identified from the Karolinska Directed Emotional Faces database (Lundqvist et al., 1998). After gathering the happy, angry and neutral facial expressions for each identity (3 expressions × 10 identities = 30 faces), they were converted to grayscale whilst retaining their original size (562 px × 762 px).

These images were used in the creation of face stimuli along morphed sequences which depicted a series of faces with increasing degree of intensities that unfolded from a neutral expression (0% emotion) to a full-blown expression (100% emotion). Using custom codes executed on MATLAB (V2021a; Mathworks), two types of morphed sequences were generated per identity, one from neutral to happy and the other from neutral to angry (10 identities × 2 morphs = 20 sequences). Each sequence consisted of six images, depicting 20% increments in the intensity of expressed emotion from the start expression (i.e., neutral) to the end expression (i.e., happy or angry). For any given identity, the resulting 12 images from 2 distinct morphs were combined and re-arranged to generate a single sequence of faces that unfolded from angry to happy through a neutral midpoint – the final sequence contained 11 images, because the neutral face was shared between the two initial sequences (Figure 2.2a). Following the same procedure, 10 morphed sequences were generated for the 5 male and 5 female face identities (110 face images altogether).

Figure 2.2

Preparing the face-body composites.



Note. (a) Target sequences created by combining two morphing sequences that unfolded from neutral to happy or angry were combined. (b) The same selection of pixels were chosen when cropping faces with external features in a morphing sequence. (c) Cropped faces without the background would be downscaled to appropriately match the dimensions of the paired body context. (d) Face-body composites within a single sequence would have faces that maintained a uniform size and position in relation to the body.

Face-body composites: The 11 images within any given morphed sequence were cropped to have identical dimensions using Adobe Photoshop (version CS6). Notably, uniformity in size was maintained within a single morphing sequence by selecting the same range of pixels in each of the morphed faces (Figure 2.2b). The resulting cropped faces (Figure 2.2c) only contained facial (e.g., eyes, nose, mouth) and some external (e.g., hair, neck) features, without the original background or shoulder regions. External features were retained to create realistic representations when paired with body contexts.

A set of twenty body gestures that had been classified with above 78% accuracy in our validation study was chosen to create face-body composites (see Appendix A for Happy and Angry Body Identity Data; Tables A1 and A2). Having been originally obtained from the Bochum Emotional Stimulus Set (BESST; Thoma et al., 2013), the chosen body contexts had an equal number of happy and angry body gestures for males and females (2 emotions × 5 identities × 2 genders = 20 body contexts).

Each unique face identity was paired with two unique body gestures (i.e., one happy and one angry). Therefore, per identity, when paired with body gestures, resulted in 22 face-body pairs (2 emotional body contexts × 11 facial expressions per morphed identity). Altogether, there were 220 pairs of face-body composites created for 10 face identities. The positioning of the faces with respect to a body context remained consistent across a morphing sequence (Figure 2.2d).

The final face-body composites were embedded on a white background (500 pixels × 500 pixels) and a single noise stimulus identical in dimensions to face-body composites was also generated using MATLAB (V2021a; Mathworks). The noise stimulus had a uniform distribution of grey values between black and white. This noise stimulus was presented after the face-body composites to limit the influence of carry-over effects when presenting trials in a sequential manner. Moreover, face-body composites and noise stimuli were presented against a gray background, using an experiment that was designed on PsychoPy (v2021.1.4; (Peirce et al., 2019) and administered through their online hosting platform Pavlovia.

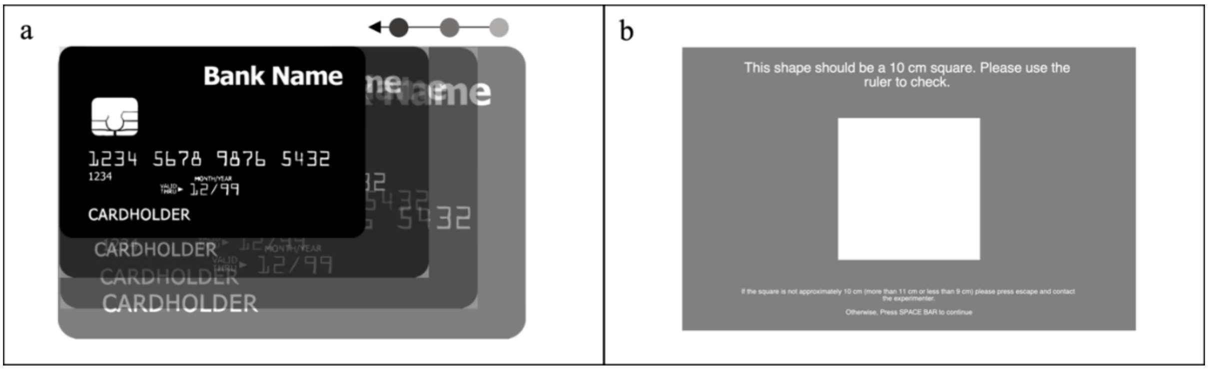
Scaling of stimulus size: Participants used their own computers to do the behavioural task described below (Section 2.2.5). The use of their own devices meant that the stimuli we created would be displayed differently, depending on the size and spatial resolution of the screens used by individual participants. We ensured that the visible size of stimuli (faces, face-body composites, and noise) was maintained across different screens. First, participants were shown a mock black credit card on-screen (resembling a rectangle) that can be adjustable to different sizes. Following which, participants were instructed to hold a debit card (largely standardized in size) on the designated on-screen rectangle (Figure 2.3a). They used the arrow keys on their keyboard to adjust the height and width (in pixels) of the on-screen rectangle (virtual debit card) to match their physical debit/credit card. Second, using this on-screen rectangle width (px) and the standard physical card width of 85.60 mm (Li et al., 2020), the logical pixel density (LPD) in pixels per mm can be calculated as shown in Equation 1.

$$\text{LPD (pix/mm)} = \frac{\text{Onscreen distance (px)}}{\text{Physical distance (mm)}} \tag{1}$$

Additionally, participants were explicitly instructed to be seated 60 cm away from their screen (given that distance can influence LPD). Consequently, by scaling images using the LPD, participants would be presented with uniformly sized stimuli, irrespective of different display sizes and screen resolutions. After successful matching of the on-screen rectangle to the physical object, participants pressed the space bar to proceed. They were then presented with a white square at the center of their screen, which upon successful scaling should be 10 cm in height and width (Figure 2.3b). Participants needed to use a ruler to check if the square had the desired dimensions. If the white square was less than 9 cm in height/width or more than 11 cm in height/width, they were asked to exit the experiment and contact the researcher, so that they could restart the whole process.

Figure 2.3

Scaling Procedure used to adjust stimuli size.



Note. a) Participants adjusted an on-screen debit / credit card to the size of the physical card. They used ‘up’ and ‘down’ arrows to match the physical and on-screen card. b) Successful scaling would produce a white square with dimensions of 10 cm x 10 cm. Participants were asked to use a ruler to measure these dimensions.

2.2.4. Measures of individual differences

2.2.4.1. Alexithymia

The self-reporting Toronto Alexithymia Scale (TAS; Bagby et al., 1994) was used to assess the severity of alexithymia symptoms. This questionnaire evaluated alexithymia based on three major characteristics (Montebarocci et al., 2011), namely: 1) difficulty to identify emotions, 2) difficulty to describe emotions, and 3) external oriented thinking (e.g., rather talk about an incident than feelings). Each of the 20 items were rated on a 5-point Likert scale

(1 = strongly disagree to 5 = strongly agree), and the total scores ranged between 20 to 100. Bagby et al. (2020) argued that alexithymia needs to be considered as a continuous construct and, therefore, it is not recommended to categorize individuals into two categories as either alexithymic or non-alexithymic. Nevertheless, studies (Heshmati et al., 2011; Pedersen et al., 2022) broadly classify individuals as having no alexithymia (≤ 51), possible alexithymia (between 52 – 60), and certain alexithymia (≥ 61).

2.2.4.2. Anxiety

Participants completed the Spielberger State-Trait Anxiety Inventory (STAI; Spielberger, 1983) to indicate the severity of their anxiety symptoms. The 40 items in this questionnaire assessed two subscales, 1) trait anxiety (STAI-T; n = 20 items) and 2) state anxiety (STAI-S; n = 20 items). The former pertains to evaluating anxiety as a personality characteristic, whereas the latter evaluates the current experience of anxiety (Tluczek et al., 2009). Although both subscales measure each individual item on a 4-point Likert scale, the four responses differ between T-Anxiety and S-Anxiety. For the latter subscale, responses include “not at all”, “somewhat”, “moderately so” and “very much so”, whereas for the former, responses entail “almost never”, “sometimes”, “often” and “almost always”. For each subscale, participants scored between 20 to 80, with higher scores being indicative of severe anxiety symptoms. Commonly, a score above the cut-off of 40 would indicate individuals eligible for a clinical diagnosis of anxiety (Emons et al., 2019).

2.2.4.3. Autism

The self-reporting Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001) was used to measure the extent to which healthy participants possess autistic traits. This 50-item questionnaire has five subscales that focused on skills where autistic individuals typically show deficits, such as communication, imagination, attention to detail, social skills, and shifting attention (Broadbent et al., 2013; Golan & Baron-Cohen, 2006). Each item is rated on a Likert scale with four choices; "definitely agree", "slightly agree", "slightly disagree" and "definitely disagree". For each item, participants are given a score of 0 for "definitely disagree" and "slightly disagree" and a score of 1 for "slightly agree" and "definitely agree". They can obtain a total score ranging from 0 to 50, with scores above 32 being indicative of a possible diagnosis of ASD (Baron-Cohen et al., 2001). Prior research has found AQ to be advantageous in screening ASD given the sensitivity in both general (Broadbent et al., 2013; Hoekstra et al., 2007) and clinical populations (Baron-Cohen et al., 2001; Hoekstra et al., 2008).

2.2.4.4. Depression

Participants completed the Beck's Depression Inventory-II (BDI-II; Beck et al., 1996) to ascertain the severity of depressive traits. The 21-items on the BDI-II were assessed along a 4-point scale from 0 (no symptoms) to 3 (severe symptoms). Final scores ranged from 0 to 63. Based on scores, Beck et al. (1996) categorizes individuals as being normal (0 – 10), mild mood disturbance (11 – 16), borderline clinical depression (17 – 20), moderate depression (21 – 30), severe depression (31 – 40) and extreme depression (> 40).

2.2.5. Procedure

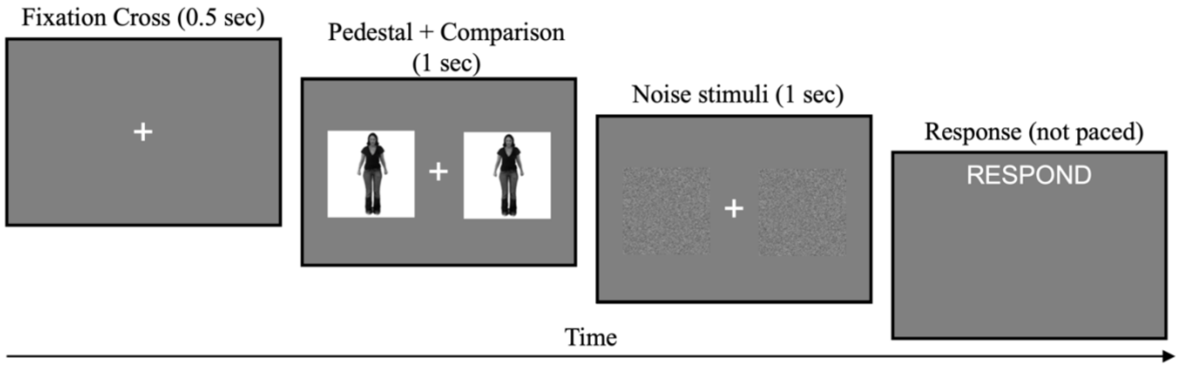
2.2.5.1. Comparison of comparisons method (COCM)

We used the comparison or comparisons method as the behavioural task, and participants were given instructions regarding the task before the experiment. During the task, facial expressions were shown under three contextual conditions characterized by the presence or absence of a body gesture, namely, happy body, angry body, or face alone. The condition in which no body gestures were presented acted as a baseline condition that measured perceptual biases (if any) in classifying isolated facial expressions.

As outlined in Figure 2.4, each trial began with the presentation of a fixation cross (0.5 s) at the center of the screen, followed by the simultaneous presentation of the two target facial expressions (1 s), both of which sometimes appeared with a body gesture too. One of these faces was defined as the "pedestal" which had a fixed level of intensity of either 20% anger (denoted as -10) or 20% happiness (denoted as +10) relative to the neutral face. The other facial expression was the "comparison" which had an offset intensity added to the fixed pedestal ($pedestal_{intensity}$ + offset = $comparison_{intensity}$). This offset was selected randomly without replacement from a set containing 20 repeats of these 9 offsets: -40, -30, -20, -10, 0, +10, +20, +30, +40. Each combination of pedestal and comparison intensity was presented 10 times and therefore, depicted 10 unique face identities. Accordingly, the entire experiment consisted of 540 trials in total across all three conditions ($3 \text{ contexts} \times 2 \text{ pedestals} \times 9 \text{ offsets} \times 10 \text{ trials per combination}$). The pedestal and comparison images were randomly presented either to the left or right of the fixation cross on every trial. After a duration of 1 second, the two target images were replaced by the noise stimulus appearing in the same spatial locations (Figure 2.4). Finally, the end of a trial was marked by a grey screen with a prompt to "RESPOND", and participants chose which facial expression looked more neutral by pressing either "z" (for the left image) or "m" (for the right image). No time constraint was imposed on participants as they responded.

Figure 2.4

Timeline of an experimental trial from COCM



2.2.5.2. Questionnaires

All four clinical questionnaires were combined into a single survey which was implemented through Qualtrics (Qualtrics, Provo, UT) and thus a link to this survey was provided, after they had completed the behavioural experiment on Pavlovia. The standard instructions for each of the questionnaires (TAS-20, STAI, AQ, BDI-II) were presented along with participants having to provide names of all the cities/towns they had lived in the past 10 years. We needed to ensure that participants had resided within an Asian region to minimize the potential influence of different cultural exposure (see Chapter 5 on culture and contextual effects).

2.3. Results

2.3.1. Psychophysical Model

Following the model proposed by Morgan et al. (2015), all data were analysed within the framework of signal detection theory. According to this model, the appearance of the pedestal (P) and comparison (C) is normally distributed: $P \sim N(p + \mu, \sigma^2 / 2)$ and $C \sim N(p + \mu + t, \sigma^2 / 2)$. Within these distributions σ refers to decisional noise unique to each participants' judgements, p denotes the expressiveness of the pedestal face (i.e., -10 and +10), t is the offset added to the pedestal to determine the comparison image (i.e., from -40 to +40) and μ is the perceptual bias specific to each type of context (i.e., no-context, happy body, angry body). The perceptual bias represents the appearance of the neutral (0% morph) face in the morphed sequence. A positive μ and a negative μ represent neutral expressions perceived as happy and angry, respectively. Accordingly, a positive shift in bias from one condition (e.g., no-context) to another (e.g., happy context) suggests that the latter condition biased expressions to be perceived as happier; a negative shift would therefore suggest that the latter condition made expressions to be perceived angrier. In the absence of a perceptual bias, the distributions for the pedestal and comparison would have means of p and $p + t$. The observer is likely to choose the pedestal as being closer to neutral when the pedestal face appears to have a less intense level of expressiveness than the comparison face. The probability of choosing the pedestal image has a doubly non-central F distribution described as $\Pr("P") = \Pr(|P| < |C|) = \Pr(P^2/C^2 < 1)$. For the variable P^2/C^2, the denominator's non-centrality parameter being $2(p + \mu + t)^2/\sigma^2$ and the numerator's non-centrality parameter being $2(p + \mu)^2/\sigma^2$.

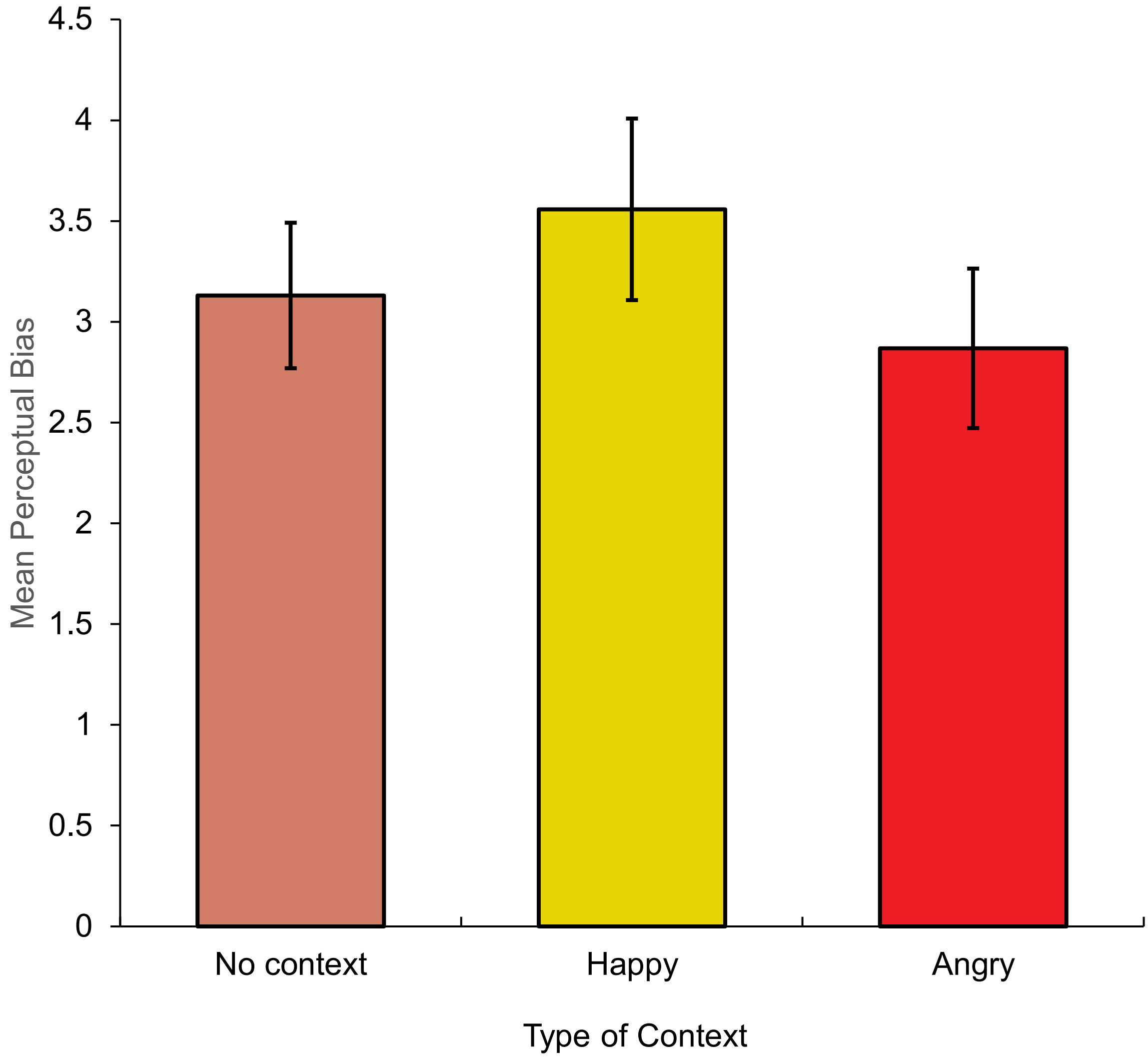
For each condition, we plot the proportion of times (out of 10 trials) participants chose the pedestal as closer to neutral (y-axis), as a function of the offset added to the pedestal to determine the comparison (x-axis).

2.3.2. Effect of context on perception

To investigate group-level effects of body contexts on perceptual biases, we compared estimates of bias between the three context conditions. A one-way repeated-measures ANOVA was conducted with the type of context as the within-subjects factor having three levels (i.e., no body gesture, happy body gesture, angry body gesture). No main effect of context was revealed, $F(2, 249) = 0.69, p = 0.502$, $\eta_p^2 = 0.006$. The mean estimates of biases did not differ between the three conditions. Notably, neutral faces were perceived as being happier (i.e., positive mean biases), irrespective of the type of body context (Figure 2.5); no context ($M = 3.204$, $SD = 3.275$), happy body gestures ($M = 3.709$, $SD = 4.067$), and angry body gestures ($M = 3.075$, $SD = 3.660$). This finding simply means that the morphed face which was perceived as subjectively neutral was a slightly angry morph in our sequence.

Figure 2.5

Mean perceptual bias for the three contextual conditions (discriminable expressions)



Note. Error bars denote standard error of the mean.

2.3.3. Magnitude of contextual effects

Despite the absence of significant differences in mean perceptual biases between the context conditions at the group-level, it does not inform us regarding changes in perception from one individual to another. The lack of contextual effects observed can be interpreted in two ways. First, it may indicate that no participants experienced any contextual influence.

Second, it is possible that participants did experience contextual influences, but with some participants experiencing positive perceptual biases and others experiencing negative perceptual biases, these effects ultimately cancelled each other out. Either of these possibilities could result in a null effect at the group level. Therefore, to examine these possibilities, individual estimates of bias were used to calculate the magnitude of a contextual effect for each participant by obtaining the difference in the bias for happy or angry contexts and the baseline measure of bias without a context.

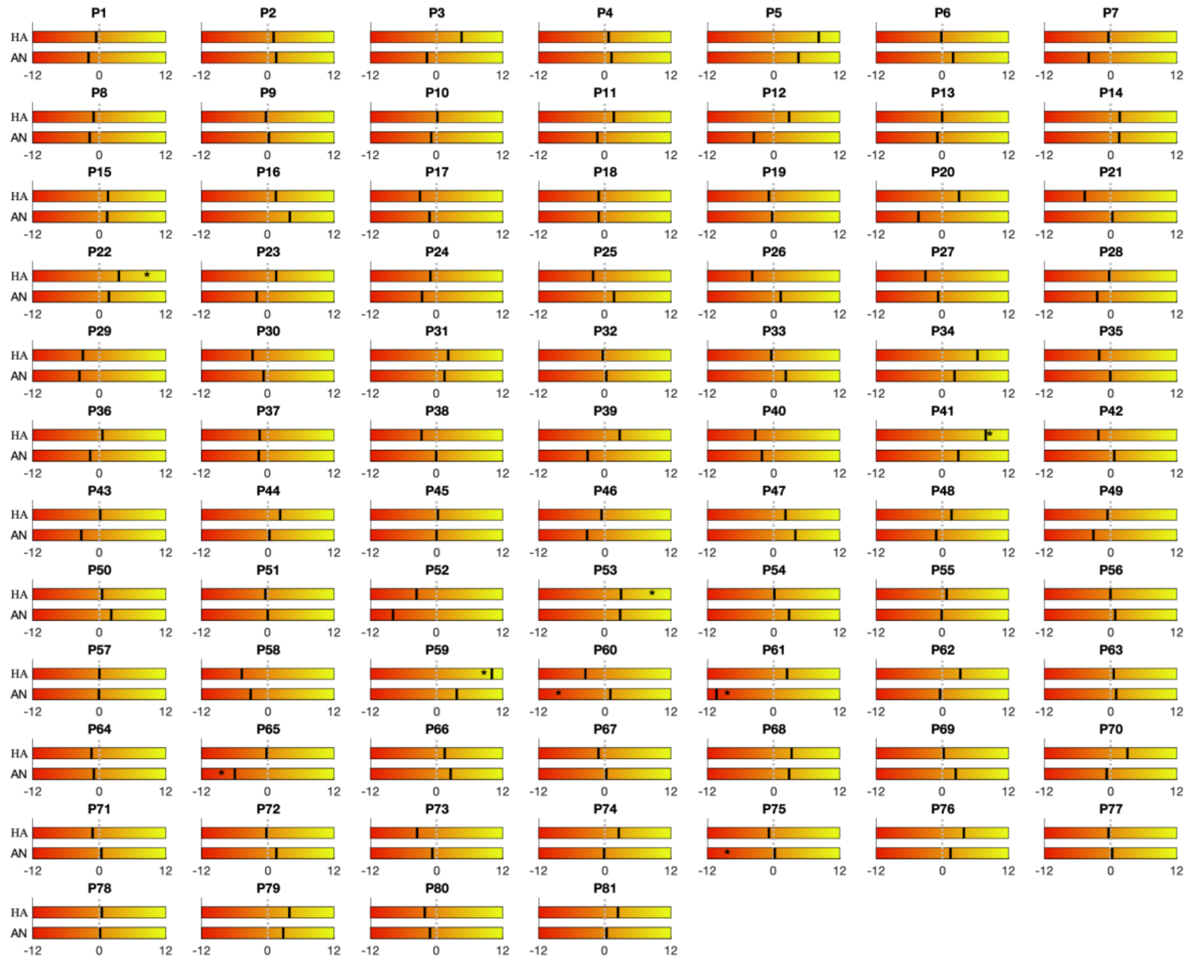
To calculate the magnitude of contextual effect caused by a contextual cue, we subtracted the μ estimated for faces judged with either a happy or angry body gesture from the μ estimated for the no context condition (e.g., bias with happy body contexts – bias without body contexts). For the contextual effect of a happy context, a positive value denoted a positive shift in bias (referred to as "happy shifts"), whereby participants judged faces as being happier when accompanied by happy body gestures when compared to their baseline judgements. Similarly, a negative value for the contextual effect of an angry context highlighted a negative shift ("referred to as "angry shifts"), where participants judged facial expressions presented with angry bodies as being angrier compared to baseline.

Next, we examined at an individual level how these perceptual shifts calculated differed between the two body contexts by conducting a series of likelihood ratio tests. Here, we fitted each participants' data from the no-context−happy body conditions and no-context−angry body conditions, separately. For each combination of conditions, we generated two separate fits, namely, constrained and unconstrained fits. In the former, the parameter of perceptual bias (μ) was assumed to be the same for the two conditions, whereas sigma (σ) was allowed to vary. In the latter fit, all parameters were allowed to vary freely. The ratio of likelihood of the constrained fit to the unconstrained fit was denoted as L and this value was expected to be less than 1. Next, we compared the criterion $\alpha = .005$ to the value of $1 - F\ (-2\ \ln L)$, where F denoted the cumulative χ^2 distribution with 1 degree of freedom. If the value was less than α, it was interpreted as the perceptual bias being significantly different from “0”. In other words, body gestures shifted the perception of an objectively neutral face. A total of 168 likelihood ratio tests (84 participants × 2 contexts) were conducted to ascertain whether happy / angry body gestures elicited significant shifts in perception. In the case of happy body gestures, there were four instances where significant shifts were observed in the expected direction– participants perceived the neutral expression as happier when paired with a happy body gesture (Figure 2.6). Similarly, we observed three instances of significant perceptual shifts with angry body gestures as well. Only two participants perceived the neutral face as angrier, consistent with its pairing with an angry body; however, one participant unexpectedly perceived the neutral face as happier in an angry context (Figure 2.6). No other significant effects were observed, as Figure 2.6 illustrates, the majority of participants did not deviate significantly from “0”– indicative of a lack of shift in perceptual bias attributable to the context.

Based on the results from our likelihood ratio tests, the first possibility mentioned at the beginning of this section seems unlikely, thus we have limited evidence favouring the second possibility. In other words, body contexts were indeed capable of eliciting shifts in perception. However, it appears that these perceptual shifts at an individual level are difficulty to capture uniformly across a cohort.

Figure 2.6

Magnitudes of context effects for individual participants (discriminable expressions)



Note. A single asterisk (*) represents significant shifts in perceptual bias. In each plot, the top bar denotes the contextual effect from a happy body context and the bottom bar denotes the contextual effect from an angry body context. The black bar within each plot represents the magnitude of effect experienced by the participant. Positive values denote faces being perceived as happier and negative values denote faces being perceived as angrier.

2.3.4. Individual differences in clinical traits

Next, we conducted a series of 24 Bonferroni-corrected Pearson's product moment correlations (adjusted significance criterion $\alpha = \frac{0.05}{24}$ = 0.0020) to examine potential relationships between four clinical traits and three variables: 1) decision noise, 2) perceptual biases, and 3) magnitude of contextual effects. The aim was to determine whether individual differences in the severity of symptoms could modulate any of these perception-related metrics. As shown in Table 2.1, mean scores across participants for depression fell within the range of mild mood disturbance (11-16), whilst mean scores for alexithymia (< 61) and autism (< 32) fell within the normal range (Baron-Cohen et al., 2001; Beck et al., 1996; Heshmati et al. 2011; Pedersen et al., 2022). Regarding anxiety, a large percentage of our participants exhibited "moderate anxiety" for state anxiety (38 – 44). However, for trait anxiety, scores were predominately within the "high anxiety" range (45 - 80). Figure 2.7 illustrates the range of scores we captured across our cohort of participants for the four clinical traits). In terms of variability, apart from depression, some participants had scores similar to those we could expect from individuals with a clinical diagnosis for a given trait (i.e., autism, alexithymia and anxiety; Figure 2.7).

Table 2.1

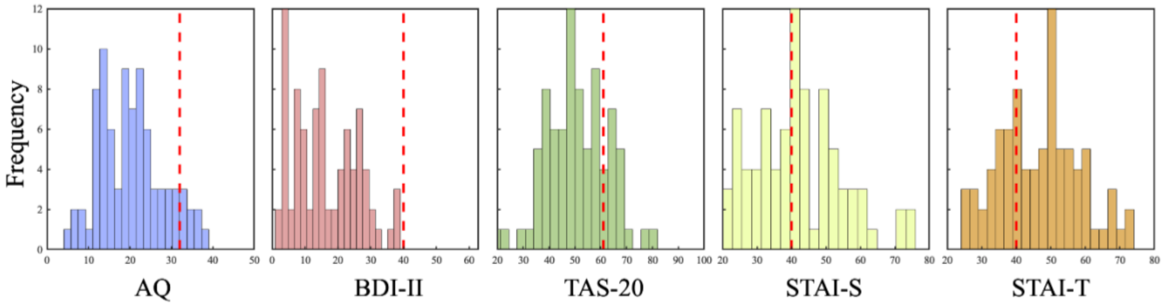
Means and standard deviations for the scores of clinical traits.

	Clinical Trait				
	BDI-II	AQ	TAS-20	STAI-S	STAI-T
M (*SD*)	16.167 (9.915)	20.179 (7.701)	50.679 (11.517)	41.869 (12.872)	46.452 (11.880)

Note. BDI-II = Beck's Depression Inventory II, AQ = Autism Quotient, TAS = Toronto Alexithymia Scale, STAI-S = Spielberger State-Trait Anxiety Inventory (State anxiety subscale), STAI-T = Spielberger State-Trait Anxiety Inventory (Trait anxiety subscale).

Figure 2.7

Range of self-reported scores for the four clinical traits



Note. Each plot denotes the questionnaires administered assessing autism, depression, alexithymia, state anxiety and trait anxiety respectively. BDI-II = Beck's Depression Inventory II, AQ = Autism Quotient, TAS = Toronto Alexithymia Scale, STAI-S = Spielberger State-Trait Anxiety Inventory (State anxiety subscale), STAI-T = Spielberger State-Trait Anxiety Inventory (Trait anxiety subscale). For a given questionnaire, the minimum value of the x-axis denotes the lowest possible score that can be obtained by participants. The maximum value of the x-axis denotes the highest possible score participants can obtain for the questionnaire. The dashed red line denotes the cut-off score beyond which symptom severity is considered eligible for a clinical diagnosis.

Clinical Traits and Decision Noise: Our premise when relating clinical traits and perceptual biases was predicated upon the fact that severity of symptoms for a given trait could translate to greater difficulty when classifying facial expressions alone (see Section 1.9.4). Accordingly, when participants' experience difficulty, it could in turn elicit greater reliance on the context i.e., when body gestures were presented (Brewer et al., 2017). Accordingly, we expected larger biases in the direction of the body's emotion. Therefore, we obtained an objective measure of difficulty (i.e., σ) that represented participants' ability to discriminate between expressions of varying intensities along the continuum of morphed faces. Larger estimates of σ denoted participants' difficulties when discriminating between expressions with varying intensities across a morphing sequence. Accordingly, we correlated these estimates of sigma (no-context condition) with participants' scores from the clinical questionnaires. However, no significant relationships were observed between the severity of clinical symptoms and no context estimates of difficulty ($p > 0.0020$; see Appendix B for Statistics from Correlations for Discriminable Expressions).

Clinical Traits and Perceptual Biases: Next, we intended to examine if biases originating from clinical traits would be related to participants' perception of isolated expressions (see Section 1.9.4). Therefore, we correlated estimates of bias in the no-context condition with our participants' scores for symptom severity across the four clinical traits. We did not observe any significant relationships at the level of $p < \alpha$ see Appendix B for Statistics from Correlations for Discriminable Expressions).

Clinical Traits and Magnitude of Contextual Effects: Additionally, we also wanted to assess whether clinical traits can influence the experienced magnitude of a contextual effect when happy and angry body gestures were presented. Therefore, we conducted Pearsons correlations between angry / happy shifts (i.e., magnitude) and scores from the clinical questionnaires. No significant correlations were observed at the level of $p < \alpha$ (see Appendix B for Statistics from Correlations for Discriminable Expressions).

Magnitude of Contextual Effects and Perception. Lastly, we investigated how inherent difficulties and biases when perceiving facial expressions alone (i.e., no-context) could possibly influence the strength of contextual effects participants experiences. By "inherent biases" we refer to idiosyncratic tendencies in interpreting the emotion expressed by a face, specifically in the absence of body contexts. These so-called "inherent" biases could be a product of several individual characteristics (e.g., clinical traits; Brewer et al., 2017) and they could shape how a given expression is interpreted across different individuals. For example, a neutral expression maybe perceived as slightly angry by one individual, however, the *same* expression may be perceived as slightly happy by another. Accordingly, consistent with past research, if participants demonstrate inherent biases when judging facial expressions in isolation, then these biases could modulate participants' susceptibility to contextual information (Brewer et al., 2017). Therefore, we correlated happy / angry shifts separately with: 1) estimates of decisional noise (no-context) and 2) perceptual biases from the no-context condition. No significant relationships at the level of $p < \alpha$ see Appendix B for Statistics from Correlations for Discriminable Expressions) was observed between the magnitude of contextual effects, decisional noise and perceptual biases.

2.4. Discussion

The current study investigated how body gestures could influence the perception of facial expressions using the comparison of comparisons method (COCM). Given the strong literature on contextual effects, we expected happy and angry body gestures to change participants' perception of faces in the direction of the emotion expressed by the bodies. For example, angry body gestures were expected to make neutral faces appear angrier. However, contrary to past studies, when we used a paradigm that limited the influence of non-perceptual biases (i.e., COCM), we failed to observe body gestures influencing the perception of facial expressions.

Furthermore, the present study also investigated whether sub-clinical traits would influence the extent to which participants rely on contextual information when classifying faces. Given the inherent difficulties associated with traits, such as depression, autism, alexithymia and anxiety (discussed in Section 1.9.4), we expected those with severe symptoms to depend more on contextual information to compensate for such difficulties. Nevertheless, we failed to observe any such relationships, and the susceptibility to contextual effects was roughly uniform across individuals across the broad range of sub-clinical traits we measured.

2.4.1. Are contextual effects perceptual?

Unlike past studies, our participants were not biased towards the emotion expressed by the body gesture when judging facial expressions. We discuss two potential explanations for our findings. First, contextual effects may not be perceptual in nature. Second, the two expressions we used (happy and angry) may not be confusing enough to elicit contextual effects.

In the majority of past studies demonstrating contextual effects from body gestures, participants judged the facial expression within a single face-body composite that depicted either congruent emotions (e.g., angry face – angry body; Meeren et al., 2005) or incongruent emotions (e.g., disgusted face – angry body; Aviezer et al. 2008). In this paradigm, typical contextual effects are characterized by participants being more accurate when judging congruent face-body composites when compared to incongruent composites. In such paradigms, if a participant views a facial expression incongruent with the body and classifies the face as having the same emotion as the body, it could be a result of changes in two processes: perceptual and decisional.

On the one hand, the body may have changed our perception of the face. There is some evidence favouring this viewpoint. Aviezer et al. (2008, Study 3) demonstrated that body gestures affect the first few fixations on the face, and fixations that occur on facial expressions incongruent in emotion with the body gesture were characteristic of fixations generally seen for facial expressions that are typically associated with body gestures. They interpreted this observation to mean that body context influences early stages of perception. Consequently, contextual influence in turn would modulate how facial expressions are scanned and, ultimately, interpreted in alignment with the context emotion.

In a notable departure from the conventional single stimuli paradigm, Aviezer et al. (2012, Study 1) used a face-composite paradigm to further support the perceptual nature of contextual effects. Their paradigm was implemented on the premise that the face and body are components of a "larger perceptual unit" (Aviezer et al., 2012), therefore any disruption (i.e., spatial alignment) to this perceptual unit would reduce the contextualising strength of body gestures. Accordingly, we could expect maximal contextual effects when the face-body composites remain seamlessly aligned. Facial expressions communicating anger, disgust, fear or sadness were paired with either congruent or incongruent body gestures. Participants were instructed to classify the expressions on these face-body composites, which appeared either seamlessly aligned or spatially misaligned. Consistent with Aviezer et al.'s (2012) predictions, participants exhibited better recognition accuracy in the seamlessly aligned condition for congruent composites compared to the misaligned condition.

More importantly, with incongruent composites, participants were more accurate (i.e., better recognition) when composites were misaligned compared to the aligned condition. In line with their expectations, these findings do support the notion of a "perceptual" unit (i.e., face and body), and any disruption (e.g., spatial alignment) to this unit was seen to diminish the influence of a context. In other words, Aviezer et al. (2012) corroborated earlier studies suggesting that information from the face and body context is automatically integrated at very early stages of perception (Aviezer et al., 2008; Meeren et al., 2005).

In addition, studies measuring ERP components through EEG have provided some tentative neurophysiological evidence to highlight early integration of face-body contexts. Meeren et al. (2005) reported an activation of the P1 component (i.e., thought to be sensitive to some high-order face processing) as early as 116 ms when viewing congruent face-body composites. More importantly, the amplitude observed from the P1 component increased when judging incongruent face-body pairings. Meeren and colleagues explained this observation as the rapid extraction of information from face-body composites as a "whole" at very early stages of perception. Further observations consolidating this explanation comes from the effect of the P1 component being observed only when participants judged composites rather than isolated faces or body gestures. Therefore, the authors attributed this activation pattern of P1 to be sensitive to the integration of face-body cues at very early stages of perception rather than the processing of individual cues.

However, recent evidence from Teufel et al. (2019) contested this perceptual nature of contextual effects. In Teufel et al.’s (2019) study, they investigated how body gestures would influence both “classification” (i.e., similar to Aviezer et al., 2008; Aviezer et al., 2012; Meeren et al., 2005) and “adaptation” to facial expressions. The latter referred to mechanisms where prolonged exposure to an “adaptor expression” would bias the perception of subsequently viewed expressions away from the adaptor (i.e., a negative after-effect). For example, by adapting to disgusted facial expressions, ambiguous faces morphed between anger and disgust would be perceived as being angrier (i.e., an after-effect in the direction opposite to the adaptor’s expression). According to Teufel et al. (2019), if face and body cues are integrated before or at the sites responsible for face adaptation, extended exposure to congruent or incongruent face-body composites should lead to after-effects in the opposite direction. For example, if a disgusted face was perceived as disgusted, the after-effect of that would result in subsequent neutral faces being perceived as angry. However, if the same disgusted face was perceived as angry due to it being paired with an angry body context, then we would observe subsequent neutral faces being perceived as disgusted (i.e., opposite to the perceived angry adaptor expression). Most importantly, the latter would only be the case if face and body integration took place “before” or “at” the sites for visual adaptation. Based on a series of experiments conducted by Teufel et al. (2019), it appears that face-body integration may not take place at very early stages. They reported that body contexts only influenced the classification of facial expressions, whilst after-effects resulting from adaptation were not impacted by the presence of context.

Teufel et al.’s (2019) findings raise two important arguments against early integration of cues. First, their observed after-effects were reflective of percepts arising from facial expressions that were “not” integrated with body gestures. For instance, adapting to a disgust face-angry body composite resulted in after-effects where target expressions were perceived as angry (i.e., not disgusted had the angry body changed the perception of the disgusted face). Second, their classification paradigm reflected the integration of face-body cues whereby body contexts biased the judgement of facial expressions consistent with past studies (Aviezer et al., 2008; Aviezer et al., 2012; Meeren et al., 2005). Therefore, findings from both these paradigms taken together highlight the clearly dissociable nature of classification and adaptation processes. More crucially, Teufel et al.'s (2019) findings imply that the integration of face-body cues occurs "after" the sites responsible for face adaptation rather than the early stages of perceptual processing.

From an alternative point of view, the body gestures may in fact alter decisional processes that we use to interpret perceived representations of images. Although some of the evidence discussed above would point to perceptual processes, they do not necessarily guarantee that decisional processes are not altered. With the use of single face-body composites, it is hard to isolate the contribution of perceptual processes from decisional processes. For instance, a perceptual conflict between the face and the body in an incongruent composite may change the participant's decisional criteria to respond too. To elaborate, if we view an angry face with a happy body, conflicting signals can prompt the participant to expand the range of facial expressions they would judge as happy (which now includes an angry face). Such an expansion in the range of expressions would be considered a shift in a decisional criterion, and it need not happen consciously. Changes in decisional criterion can produce biases that are qualitatively similar to perceptual biases (Morgan et al., 2013). According to Morgan et al. (2015), when we use the COCM to measure perceptual biases, it minimises the contribution of criterion shifts and response biases to a certain extent. Therefore, if a bias is obtained through the COCM, we can be more confident that it is indeed perceptual in nature. Accordingly, our findings lead us to claim that body gestures do not change the perception of easily discriminable expressions like happy and angry, because we did not find shifts in biases resulting from body contexts.

Besides shifts in decisional criteria, another possibility for the consistently observed contextual effects could be participants' "prior" expectations leading to the integration of cues from the face and body. In real life, faces and bodies rarely occur in isolation, and they infrequently signal contradictory information (e.g., deception). More often, there may only be slight disparity, with the body remaining neutral (we do not always display characteristic actions diagnostic of a specific emotion) and the face displaying comparatively more intense emotion (e.g., anger). In any case, studies on whole-person perception highlight how the face and body are explicitly attended when judging an individual's underlying emotional state (Shields et al., 2012). Therefore, it remains plausible that face-body composites might be processed as a "gestalt" rather than as individual cues, in line with experimental evidence from Aviezer et al. (2012, Study 1) discussed above. Their observations of how typical contextual effects diminished as a function of increasing physical distance between the body and face, implied that face-body pairings may be processed in a more integrated manner compared to individual cues. Based on this integrated processing of composites, it is plausible to assume that participants could "expect" faces and bodies to convey the same emotion or only have minimal disparity between the two cues, akin to most real-life situations. This "expectation" could then drive responses towards the contextual cue (e.g., body gestures) when they are unsure about the target cue being judged (e.g., facial expression).

Studies that observe bidirectional contextual effects hint at such an expectation (Lecker et al., 2020; Willis et al., 2011). For example, Lecker et al. (2020) asked participants to judge either the face or body from a composite and they observed how both cues were capable of being contextual agents depending on the task demand (i.e., whether the face or the body is being judged). Additionally, they went one step further by presenting face-body composites without explicit instructions on what the cue needed to be judged but rather to judge the emotion of the whole person. They found that in most cases both faces and body gestures appear to contribute when making judgements regarding the “whole” individual. Taken together, we speculate that prior expectations could drive contextual effects between face-body cues to an extent.

2.4.2. Does confusability play a role in contextual effects?

Thus far, we have suggested that the lack of influence on perception from body gestures may be due contextual effects being more related to decisional processes. Alternatively, this lack of contextual effect may also be attributed to the nature of the target emotions presented (i.e., anger and happiness). Past studies report that the magnitude of contextual effects was contingent upon the degree of confusability between specific expressions (Aviezer et al., 2008; Lecker et al., 2020). Multiple factors contribute to confusability and one of them is the “perceptual similarity” between facial expressions compared in a task (i.e., two expressions having overlapping action units). For example, whilst a “wrinkled” nose may be a unique feature of disgust faces, “furrowed eyebrows” remain common to both angry and disgusted expressions (Smith & Scott, 1997). Aviezer et al. (2008) presented the analogy of “emotion seeds”, defined as shared action units between two expressions (e.g., anger and disgust; Susskind et al., 2007). These “seeds” would remain dormant when classifying faces in isolation. However, when placed within a relevant context (e.g., disgust face – angry body), these seeds would be activated and thus drive judgement in the direction of context emotion (see Section 1.7.1 for more details). Based on this analogy, contextual effects should be stronger for expressions that share many emotional seeds between each other. For instance, stronger contextual influences were reported when disgust faces were paired with angry bodies and vice versa (Aviezer et al., 2008; Lecker et al., 2020; Noh & Isaacowtiz, 2013), because disgust and angry faces share many perceptual features (i.e., high similarity). Comparatively, Aviezer et al. (2008) reported systematic attenuation of contextual influence as perceptual similarity decreased for disgusted faces paired with sad bodies (i.e., medium similarity) and disgusted faces with fearful bodies (i.e., low similarity).

Relating this concept to the current study, the reduced perceptual similarity between happy and angry expressions (i.e., fewer shared emotional seeds) could have contributed to the absence of contextual effects. Validation studies with isolated expressions often highlight how happy and angry expressions are rarely confused with each other, regardless of it being bodily or facial expressions (Calvo & Lundqvist, 2008; Thoma et al. 2013). In a study by Van den Stock and colleagues (2007), expressions that were morphed along a continuum of happy to fear were paired with either happy or fearful body gestures. Participants were instructed to indicate whether the "face" expressed fear or anger. They observed minimal to no influence of an incongruent body gesture for the end-point morphs. For example, a fearful body paired with intense happy expressions did not significantly reduce the proportion of "happy" classifications given. Conversely, there were more attributions of the context emotions for the mid-morphs. In other words, when the morphed expression shared fewer facial features (as in the case of "purely" happy and fearful), the experienced contextual effect diminished. However, as the confusability between the two expressions increased (like in mid-morphs), there was more influence from the context, that is, the reliance on body gesture increased. By replicating the current experiment with two facial expressions well-known to be confused with each other (e.g., angry and disgust), we would be able to verify the idea discussed above (see Chapter 3). Based on the findings by Aviezer et al. (2008), Aviezer et al. (2012, Study 3) and Lecker et al. (2020), we could possibly expect contextual effects to be more pronounced when judging confusable emotions.

2.4.3. Do individual differences in clinical traits influence contextual effects?

Additionally, we investigated whether clinical traits could influence the extent to which participants used contextual information. Greater reliance on body gestures was expected from individuals with more severe symptoms for any of the four assessed traits (i.e., depression, autism, alexithymia, anxiety). Our expectations were based on the assumption that contextual information can potentially compensate for inherent difficulties with emotion classification that have been associated with these disorders (Eack et al., 2015; Ferguson et al., 2021; Leppänen et al., 2004; Montebarocci et al., 2011). However, at least within a sub-clinical population, we failed to observe differences in the susceptibility to contextual cues as a function of increasing severity of symptoms for the four clinical traits.

One plausible explanation could stem from the very nature of clinical traits that make it difficult for body gestures to have a contextualizing effect during emotion classification. In a notable study by Nook et al. (2015), high alexithymia individuals were more accurate at classifying expressions when faces were paired with emotional labels that acted as contextual cues. In other words, emotional labels enabled those with severe alexithymia to overcome facets of their symptoms, namely difficulties in understanding their own and others' emotions (Grynberg et al., 2012). However, this facilitating effect might be unique to explicit unambiguous emotional labels and may not generalize to body gestures. Evidence suggests that alexithymia can impact the classification of emotions from both facial expressions (Grynberg et al., 2012; Lane et al., 2000) and body gestures (Borhani et al., 2016). In an EEG study by Borhani et al. (2016), brain wave patterns for high alexithymia seem to only be modulated by the motion of the body, rather than static gestures of the body, whereas with low alexithymia individuals responded to both the motion and emotions expressed by body gestures according to EEG recordings.

Therefore, when alexithymia individuals have comparable difficulties perceiving both cues presented in our study (i.e., faces and body), two outcomes may occur. First, those scoring high may experience smaller contextual effects compared to those scoring low (consistent with Borhani et al., 2016). Second, it would be possible that individuals scoring high would indeed rely more on context, but their poor perception of the context itself overshadows this reliance. Perhaps our findings support the second possibility to a certain extent. The reliance on the body gesture appeared comparable across all participants, irrespective of whether their scores reflected high or low alexithymia symptoms. That being said, this interpretation needs to be considered with caution given that symptom severity for any of the four clinical traits did not contribute to any difficulties when discriminating expressions without a context. It is possible that observable difficulties and reliance on contextual information will only appear in clinical populations rather than sub-clinical populations.

Regarding autism, a strong body of research attests to autistic individuals having difficulty with the integration of multiple cues (Behrmann et al., 2006; Ropar & Mitchell, 2001). ASD individuals perform exceptionally well compared to healthy controls on tasks that require limited incorporation of contextual information, such as detecting target figures from an image (i.e., visual illusions; Ropar & Mitchell, 2001) or deciphering homographs when reading (Lopez & Leekam, 2003). This line of evidence suggests that contextual cues would not have facilitating effects during face classification given these inherent difficulties with the integration of multiple cues.

However, Brewer et al. (2017) presented evidence to the contrary. Their clinical ASD individuals and healthy controls were instructed to classify facial expressions of anger and disgust which were either presented alone or with a body gesture. They discovered typical contextual effects much like Aviezer et al. (2008) or Meeren et al. (2005), and both ASD and healthy controls showed comparable patterns of bias when categorizing facial expressions in the presence of body gestures. Nevertheless, upon closer examination, they observed a relationship between contextual modulation and the ability to judge isolated expressions. In individuals clinically diagnosed with ASD, increasing difficulties with classifying isolated expression led to increased susceptibility to contextual effects (Brewer et al., 2017). Interestingly, they also observed a similar pattern of results with healthy individuals even though the analysis did not reach significance. Their findings imply that when individuals can easily distinguish between expressions, they rely minimally on contextual information. However, as the difficulty to judge attributes of the face alone increases, participants' dependence on the contextual information becomes more pronounced to compensate for this difficulty.

That being said, although Brewer and colleagues (2017) observed significant differences in the susceptibility to contextual effects in their study, there was high variability in terms of how well ASD individuals classified facial expressions. Most of them classified expressions at a comparable level to typical healthy controls (based on estimates of decision noise). Nevertheless, Brewer et al. (2017) asserted that difficulties with emotion classification whilst common may not be a universal feature of ASD and these difficulties may be more pronounced when ASD individuals have comorbid conditions, such as alexithymia (Cook et al., 2013). Therefore, we tentatively conclude that our findings may result from our participants being subclinical in nature. After all, in Brewer et al (2017), no significant relationships were observed between decision noise and magnitude of contextual effect for healthy individuals (identical to our own observations). This connection between emotion classification difficulties and reliance on contextual information may only emerge once individuals have symptoms that allow a clinical diagnosis, much like the minority in Brewer et al.'s (2017) ASD group of participants.

We also found no relationship between depressive traits of participants and the magnitude of contextual effects experienced by them. We expected an association, because individuals with clinical traits, in this case those with high depression scores, may have difficulties with classifying isolated expressions and therefore might rely more on context to compensate for the difficulty. We did not find any such relationships. To begin with, the correlation between BDI-II scores and our estimates of decision noise for the no context condition was not significant, suggesting that individuals with higher depressive traits did not really have greater difficulty discriminating facial expressions. Therefore, they probably did not need to rely relatively more on context.

Research regarding depression and emotion classification has provided a divided perspective. Some studies have observed selective deficits for only positive emotions like happy (Csukly et al., 2009; Surguladze et al., 2004), whereas others have also provided evidence for deficits but for negative emotions like anger (Persad & Polivy, 1993). To add further complexity to this issue, there are those who claim that depressed and healthy participants exhibit comparable abilities when categorizing, emotions regardless of the emotional valence (Gotlib et al., 2004; Leppänen et al., 2004). The only consensus appears to be regarding neutral expressions. Clinically depressed patients exhibit an increased tendency to classify neutral expressions as more negative (Gollan et al., 2008; Leppänen et al., 2004). For example, Leppänen and colleagues (2004) found healthy controls and depressed patients to have similar accuracies when classifying happy and sad expressions, but depressed patients were more prone to classifying neutral expressions as sad (i.e., less accurate) compared to healthy controls.

Such findings can be extended to the current research given that we estimate perceptual biases by determining how the perception of a neutral face shifts along a morphed sequence. Therefore, based on the findings by Leppänen et al. (2004), we could potentially expect larger magnitudes of shifts when highly depressed participants judge facial expressions paired with angry body gestures. Such an expectation is predicated upon individuals being susceptible to contextual information when facial emotion classification becomes difficult; consistent with how depressed individuals in Leppänen et al. (2004) exhibited poor recognition accuracy for neutral expressions. Nevertheless, the author acknowledges how deficits in emotion classification might not be present in all clinically depressed individuals. Thus, such inconsistencies in emotion classification ability might be one contributing factor that has led to such mixed literature.

Lastly, regarding anxiety, to the author's knowledge, this is one of the first studies to examine whether the severity of anxiety symptoms modulates perceptual biases and susceptibility to context. Limited evidence using conventional paradigms (i.e., single face-body composites) report that highly anxious individuals when classifying facial expressions find it difficult to ignore contextual cues signalling anger. For example, participants with high STAI scores in (Kret et al., 2013, Study 3) were more likely to interpret a happy body gesture (i.e., the target) as threatening, when paired with an angry face. However, they did not find a reciprocal effect when the happy face (i.e., target) was judged with an angry body context. Similarly, Koizumi et al. (2011, Study 1) reported how highly anxious individuals were more influenced by angry faces compared to happy faces when judging incongruent voices (e.g., happy voice, angry face). The reciprocal effect of angry voices influencing the classification of happy faces was not observed. Findings from these two studies together suggest that when the face becomes the target of judgement, anxiety traits do not modulate the susceptibility to contextual information in any modality (visual, body gestures; auditory, voice). Consistent with the above findings, we also failed to observe any relationship between anxiety scores and the strength of contextual effects on perception.

Most interestingly, recognition of emotion from isolated voices or facial expressions did not differ between high and low anxiety groups (Koizumi et al., 2011, Study 2). Similarly, Kret et al. (2013, Study 1) did not observe any relationships between anxiety scores and recognition of happy or angry faces and body gestures in isolation. The findings from the above studies on isolated expressions are qualitatively similar to our own results, where we did not discover that the severity of anxiety symptoms influenced perception in the no-context condition. Given that both these studies had sub-clinical participants (much like our own), it is plausible to assume that inherent biases related to anxiety may not manifest when judging isolated expressions in healthy individuals.

2.4.4. Conclusion

In one of the first instances in the literature, we aimed to establish the exact nature of contextual effects by employing a method that attempted to minimise non-perceptual biases (e.g., decisional criteria). Contrary to past studies on the influence of context (Aviezer et al., 2008, Aviezer et al., 2008; Meeren et al., 2005; van den Stock et al., 2007), we used a robust paradigm (i.e., COCM) to show that body gestures (possibly generalizing to other contextual cues) do not change our perception of easily discriminable emotions from faces. However, more research is required to firmly conclude whether contextual influence acts upon later decisional stages, but some evidence currently available favours this perspective (Teufel et al., 2019).

Apart from observing that the perception of easily discriminable facial expressions does not appear to be altered by body gestures, our findings add to an emerging avenue of research that considers individual differences in how people experience contextual effects. We assessed four clinical traits known to affect emotion classification in clinical populations, namely depression, autism, alexithymia and anxiety. At least within a subclinical cohort of participants, we did not find the severity of symptoms for any of these traits to influence the perception of facial expressions nor the reliance on body gestures.

Chapter 3. Confusable emotions: Effect of body gestures and clinical traits on perception and classification of facial expressions

3.1. Introduction

In the previous chapter, we examined whether body gestures influence the perception of facial expressions conveying easily discriminable emotions (i.e., anger and happiness). When we used the COCM methodology that minimises the contribution of non-perceptual biases to decisions about an expression (unlike the conventional paradigms), we failed to observe any changes in perception due to context. Therefore, in this chapter, we aimed to extend the scope of our research to confusable emotions, such as anger and disgust (Susskind et al., 2007). Furthermore, we also intended to replicate previous findings (Aviezer et al., 2008; Lecker et al., 2020) by presenting single face-body composites using the conventional paradigm and measuring contextual effects. By using two separate paradigms, we wanted to establish whether contextual effects would be present when using COCM as well as when using the conventional paradigm. However, if contextual effects were observed only in the latter but not in the former (despite presenting identical stimuli), this discrepancy would suggest that previously reported contextual effects may have been primarily driven by non-perceptual (e.g., decisional) processes rather than changes in perception.

Regarding individual differences, we did not observe in Chapter 2 any significant modulatory effects on the perception of expressions or susceptibility to context owing to the severity of clinical traits (i.e., autism, alexithymia, depression and anxiety). Nevertheless, we administered the same battery of clinical questionnaires to further examine whether clinical traits can influence the judgement of confusable emotions as well. This inclusion was based on the premise that the confusable expressions tend to be more ambiguous; therefore, the increased difficulty in judging them might lead to more pronounced contextual effects related to clinical symptoms. In the next few sections of the introduction, we explain the motivation behind the use of confusable emotions.

3.1.2. Ambiguity

One possible explanation for the lack of perceptual effects with easily discriminable expressions stems from the nature of emotions used (i.e., happiness and anger). Past studies have not only observed that happy and angry faces are classified with high rates of accuracy, but they are rarely misclassified as each other (Calvo & Lundqvist, 2008; Thoma et al., 2013). Therefore, when facial expressions are unambiguous and can be discriminated without much difficulty, the need for contextual cues diminishes, consequently leading to the null effects observed in Chapter 2. In contrast, past studies attest to contextual effects being stronger when presenting highly confusable emotions (i.e., anger and disgust; Aviezer et al., 2008; Lecker et al., 2020). For instance, Susskind and colleagues (2007) examined how machine learning algorithms classify facial expressions based on the configuration of facial features across six main emotions (i.e., anger, disgust, fear, sadness, happiness, surprise). They found that disgust expressions were most often misclassified as "anger", more so than any other emotion category. Their findings attested to how physical similarity, that is, a large overlap of facial features between two facial expressions, led to confusability (discussed further below). Accordingly, confusability leading to heightened ambiguity between expressions, like anger and disgust, could ultimately increase the reliance on and susceptibility to contextual information.

That being said, contextual effects and ambiguity may need to be interpreted differently when facial expressions are derived from morphed sequences. Although the explanation provided above may apply to extreme emotions (i.e., unambiguous) at the ends of a morphing sequence (e.g., intense happiness or intense fear), it may not hold for mid-sequence expressions (i.e., those closer to neutral), where ambiguity is typically greater (Karaaslan et al., 2020; Van den Stock et al. 2007). In such cases, it is plausible to assume that contextual effects would be stronger consistent with the heightened ambiguity. However, this ambiguity might only be the case if these mid-sequence facial expressions contain features from more than one emotion. Therefore, a blend of features from two emotions could intensify ambiguity (i.e., confusability) and, consequently, lead to more pronounced contextual effects, as seen when expressions are “directly” morphed between two emotions (Karaaslan et al., 2020; Van den Stock et al. 2020). Conversely, if the morphing sequence has an objectively neutral face (no blend of features) originating from using the morph-through-neutral strategy, mid-sequence expressions may be less susceptible contextual effects. In this case, ambiguity is reduced, as these expressions would ideally only signal one emotion and neutral. Section 3.1.3.2 will discuss in detail both the morphing strategies mentioned above (i.e., direct morphing, morph-through-neutral) in relation to the current work.

Ultimately, we emphasize that the strength of contextual effects may vary depending on the factors contributing to ambiguity. Accordingly, we discuss below two main sources of ambiguity that has been observed in past studies, namely the physical similarity between two facial expressions and the degree of expressiveness in facial expressions (i.e., subtle, mixed and intense expressions).

3.1.2.1. Physical similarity

The first source of ambiguity is based on the similarity in physical features of expressions. Expressions, like anger and disgust, share physical features, like furrowed eyebrows (Ekman & Friesen, 1976, 1978), and tend to be consistently misclassified as each other (Calvo & Lundqvist, 2008; Thoma et al., 2013). We observed the same in our stimulus validation for Chapter 2 as well.

This physical similarity between expressions can modulate the extent to which contextual effects occur. In the seminal study by Aviezer et al. (2008, Study 1), physical similarity was manipulated by pairing disgusted expressions with bodies signalling emotions that varied in their degree of physical similarity (with reference to the corresponding facial expressions). In other words, their manipulation referred to the degree of similarity between the target facial expression (i.e., disgust face) and the expression commonly associated (or activated) by the emotion of the contextual cue (e.g., angry body gesture activates an angry expression). Accordingly, disgusted faces were paired with either angry bodies (highest similarity), sad bodies (medium similarity) or fearful bodies (low similarity). Participants were instructed to make a forced choice judgement regarding the expression (either as "anger" or "disgust") and were explicitly asked to ignore the context. As expected, the strongest contextual effects were elicited for disgust-anger pairings (i.e., highest similarity) followed by disgust-sad (medium similarity), and lastly, disgust-fear (i.e., low similarity). Aviezer et al.'s (2008) work, along with more recent work by Lecker et al. (2020) and Karaaslan et al. (2020), attest to how the attenuating degree of overlap between facial features for two emotions (e.g., angry-disgusted faces) can systematically influence the strength of contextual effects. This overlap reinforces the idea that physical similarity can modulate ambiguity when classifying expressions, which in turn can lead to differences in the magnitude of contextual effects experienced by individuals.

3.1.2.2. Degree of expressiveness (subtle, mixed, and intense emotional signals)

The second source of ambiguity is one that results from the intensity and number of emotional signals conveyed by an expression (e.g., morphed face communicating 30% anger and 70% disgust). An early study by Van den Stock et al. (2007, Study 2) showed how contextual effects became more pronounced when facial expressions were subtle (i.e., less expressive). In their experiment, faces were created by morphing two extreme emotions (i.e., happy and fearful). Subsequently, they combined these faces with body gestures expressing one of the two target emotions (happy or fearful) to create face-body composites, following which participants classified the expressions as either “happy” or “fearful”, whilst being expressly instructed to ignore the body context. Van den Stock and colleagues demonstrated that participants’ accuracy for classification was greatest when happy/fearful bodies were paired with morphs that communicated greater congruency (e.g., extremely fearful face paired with a fearful body). However, when the same extreme morphs were paired with incongruent gestures (e.g., fearful face-happy body), we observe happy bodies driving judgements away from the fearful faces but the reverse effect of a fearful body on intense happy expressions was not observed. However, with mid-sequence faces (i.e., closer to neutral) where ambiguity was greater (i.e., corresponding to lower levels of expressiveness), participants mostly judged facial expressions by attributing the emotion expressed by the body. In other words, contextual effects were stronger for these subtle mid-sequence expressions compared to the those at the extreme ends of the morphed sequence.

The findings reported above support the ambiguity account in several ways. First, unlike with anger-disgust that share overlapping facial features, here ambiguity arises as a result of the mid-point morphs communicating contradictory cues of emotions (Kinchella & Guo, 2021), as they communicate both fear and happiness to different extents. Therefore, this heightened facial ambiguity associated with mid-sequence morphs will ultimately elicit stronger contextual effects, given that participants may need to rely more on contextual information to disambiguate and ultimately classify these expressions. Conversely, expressions at the two ends of the morphed continuum clearly communicate a single emotion (i.e., either intense happiness or intense fear), thereby considerably reducing facial ambiguity (Kinchella & Guo, 2021). Additionally, emotional categories of happiness and fear are rarely confused with each other, on the grounds of physical similarity (Goeleven et al., 2008; Susskind et al., 2007; Thoma et al., 2013). Taken together, the comparatively clear emotional signals communicated by the end-point morphs would translate to either weakened (as seen with fearful faces-happy bodies) or negligible contextual influences (as seen with happy faces-fearful bodies; Van den Stock et al., 2007).

That being said, intense expressions can also be inherently ambiguous (at least where real-life situations are concerned; Aviezer et al., 2012; Wenzler et al., 2016, Study 1). When expressions communicated intense positive or intense negative emotions, participants uniformly rated both these types of isolated expressions as having a negative valence. In fact, the inherently ambiguous nature of real-life expressions has also been witnessed with other complex emotions, such as pain and pleasure (Boschetti et al., 2022). Furthermore, in the case of Aviezer et al. (2012), when either a congruent or incongruent body context was paired with the faces, participants' ratings were biased towards the valence communicated by the body. Taken together, these findings would suggest that, in real-life, information from the context maybe necessary when disentangling the signal communicated by naturally ambiguous facial expressions (see Section 1.4 for more details). However, such an implication remains contradictory to those from laboratory-based experiments where contextual effects with intense expressions have been reported to be either minimal (Van den Stock et al., 2007) or absent altogether (Karaaslan et al., 2020, Study 2; see below). In real-life, "intense" expressions may be less exaggerated compared to those used in lab-based studies (Wenzler et al., 2016), given that often stimuli obtained from validated databases (e.g., Karolinska Directed Emotional Faces, KDEF; Lundqvist et al., 1998) could instruct actors to exaggerate their expressions to capture extreme emotions.

In any case, we also observe stronger contextual effects elicited in the context of heightened facial ambiguity with multiple pairs of emotions (in laboratory-based studies). For example, Karaaslan et al. (2020, Study 2) used blended face morphs depicting anger and disgust. In their study, face-body composites were created by combining faces morphed to be unambiguous (e.g., 100% anger) or ambiguous (e.g., 75% anger, 25% disgust) with angry or disgusted bodies. Interestingly, congruency between the ambiguous face and the body was manipulated at multiple levels to examine contextual effects. Here, congruent face-body composites were characterized by bodies (e.g., angry) conveying the emotion expressed greatest in the ambiguous face (e.g., 75% anger and 25% disgust). An incongruent face-body composite was characterized by bodies conveying the emotion least expressed in an ambiguous facial expression (e.g., 75% anger and 25% disgust face paired with disgust body). Participants were primed with a composite where the body gesture was paired with either an ambiguous (e.g., 75% anger and 25% disgust) or unambiguous facial expression (e.g., 100% anger). Subsequently, the same facial expression was presented in isolation following the prime, which the participants ultimately judged. Karaaslan et al. (2020) reported that for ambiguous expressions (e.g., 75% anger and 25% disgust), the preceding presentation of a congruent face-body pair facilitated (i.e., increased accuracy) participants' judgements. The opposite was observed with incongruent face-body composites where participants' accuracy attenuated. Most importantly, the presentation of a congruent or incongruent context did not influence participants' judgements of unambiguous expressions (i.e., 100% emotion).

Karaaslan et al. (2020) did not explicitly explain why contextual effects were absent for unambiguous expressions, unlike past studies that did observe such effects using the same target emotions (i.e., anger and disgust) and body gestures as contextual cues (Aviezer et al. 2008; Lecker et al. 2020). One possibility is that their priming paradigm contributed to this result. The incongruent or congruent prime preceding the target expression could very well influence participants' judgement of the facial expression. However, when the isolated target expression was subsequently presented, the priming effect may have been overridden for intense expressions and participants relied on the unambiguous target face instead. In other words, the strong communicative value of an expression conveying an extreme emotion (e.g., intense anger) overcame any possible influence from the preceding face-body composite. Accordingly, there was less need for participants to depend on the body gesture from the prime, because the target expression itself communicated an unambiguous emotion (e.g., anger). Therefore, under these circumstances, contextual effects would not be observed, as reported by Karaaslan et al. (2020) for their unambiguous face condition. In contrast, for ambiguous faces, the influence of the prime persisted given that participants needed to resolve the uncertainty arising from an inherently ambiguous facial expression. Participants would then be more likely to classify the expression in line with the body's emotion, leading to observable contextual effects.

Collectively, the studies cited above suggest that facial ambiguity increases in the presence of mixed emotional features, intense (in real life expressions) and lower levels of expressiveness. Therefore, participants are more likely to rely on contextual information to possibly resolve this ambiguity. Furthermore, all studies discussed above contribute to the literature supporting the automatic and perceptual nature of contextual effects, given that they observe contextual influences in spite of explicitly instructing participants to ignore the body context (Aviezer et al., 2012; Karaaslan et al., 2020; Van den Stock et al., 2007).

3.1.3. The current study: The influence of a body gesture

3.1.3.1. Using COCM to examine contextual effects with confusable emotions

Having established that ambiguity resulting from confusable emotions can increase the reliance on contextual cues (see Section 3.1.2.1), the present study aimed to add to our findings from Chapter 2 by using anger and disgust as the target emotions conveyed by the facial expressions and body gestures. Similar to the experiment with discriminable emotions, the current experiment also used the Comparison of Comparisons Method (COCM). Our justification for using the COCM remained the same, in that we intended to minimize the contribution of non-perceptual biases to contextual effects, while attempting to capture genuine shifts in the perception of facial expressions owing to body contexts. As discussed in Chapter 2, in the current work, “perception” refers to the early, automatic processing of sensory input from the face and body. Facial expressions used in this study were taken from a sequence of morphed faces between anger and disgust. These expressions were paired with either an angry or a disgusted body context, or were presented alone (i.e., no contextual information). Based on participants’ responses, we estimated perceptual biases for facial expressions when they were presented alone (i.e., no context) as well as with a body gesture (i.e., angry context or disgust context). These biases informed us of how (and whether) participants’ perception of neutral faces changed based on the type of context provided. For instance, we expected an angry context to shift perceptual biases so that a neutral face would appear angrier than it did with no context.

3.1.3.2. Replicating the conventional (single stimuli) paradigm

We used the COCM to isolate perceptual biases. If the nature of contextual effects we observe remains inconsistent with past literature, we need to ensure that it is only because we used a paradigm that isolates the contribution of perceptual changes to contextual effects. Any differences we find should not be because of factors unrelated to the change in paradigm, such as the type of stimuli we used. To rule out these possibilities, we also measured contextual effects using a paradigm that has conventionally been used to measure the effect of body gestures on facial expressions. More importantly, if contextual effects were observed only with COCM and not with the conventional paradigm, although both paradigms presented identical stimuli, it would imply that contextual effects observed in the past were likely driven by decisional processes rather than genuine changes in perception.

This paradigm (which we call the "conventional method") entails the presentation of a single face or face-body composite and participants are required to classify the face emotion. Past literature attests to how this method has produced strong and reliable contextual effects for the anger-disgust emotion combination (Aviezer et al., 2008; Karaaslan et al., 2020, Study 2; Lecker et al., 2020). Accordingly, we presented both angry and disgusted faces paired with body contexts that were angry or disgusted in the current study. Our method differed from that of previous studies in three ways: 1) instead of letting participants freely explore the face-body composite for an indefinite duration as past studies did, we restricted the viewing duration to 1 second; 2) we only provided two response choices for participants, whereas some past studies had provided more than two response choices; and 3) we expanded the range of emotional intensities presented by morphing along a continuum from extreme anger to disgust, passing through neutral.

Whilst Karaaslan et al. (2020) directly morphed expressions between two emotions (e.g., anger-disgust), we opted to morph-through-neutral when generating our stimuli. According to past research, biases in emotion recognition can differ based on whether a direct or morph-through-neutral strategy has been implemented (Vikhanova et al., 2022). Direct morphing strategies can produce mid-sequence expressions that seem unnatural (lacking ecological validity) and introduce artefacts (e.g., shadows of teeth). Importantly, this strategy can introduce additional ambiguity owing to blending facial features from two different emotions. Therefore, our rational for choosing the morph-through-neutral strategy was that an introduction of a neutral face when morphing ensured the resulting faces only contained features from one emotion combined with the neutral expression. This strategy would allow us to manipulate confusability in terms of the perceptual similarity between the target expression (e.g., disgust face) and the representation of the expression elicited by the context emotion (e.g., angry body activates an angry expression), similar to Aviezer et al. (2008).

3.1.4. Individual differences

One of the aims of the current work was to examine the nature of contextual influence (i.e., perceptual or non-perceptual) from body gestures when judging confusable expressions (using both COCM and the conventional method). Additionally, similar to Chapter 2 (with discriminable expressions), we also aimed to explore whether perceiver-related factors (i.e., clinical traits) would influence these contextual effects related confusable emotions. The accurate classification of our target emotions (i.e., anger, disgust) holds a significant relevance within a societal context. These two facial expressions have been considered as condemning emotions because they communicate an individual's possible violation of rights or norms (Rozin et al., 1999). In Giner-Sorolla and Espinosa (2011), healthy participants were instructed to convey their immediate reactions when presented with angry and disgust faces. They observed how angry faces invoked feelings of guilt related to violations of norms (e.g., being fair to others) and disgust expressions invoked feelings of shame in response to violations of sexual misconduct. These findings underscore the broader implication of these two emotions in a social context, whereby they help guide behaviours and actions that align with acceptable social norms. Therefore, the importance of accurately identifying expressions of anger and disgust remains crucial and cannot be overestimated.

However, as discussed throughout this current work, not all individuals exhibit the ability to recognize emotions accurately, including expressions of anger and disgust (see Section 1.9.4). This is particularly true for individuals with clinical traits, such as depression, autism, alexithymia and anxiety (Button et al., 2013; Eack et al., 2015; Mikhailova et al., 1996); Montebarocci et al., 2011; see Section 1.9.4). One possibility is that, under such circumstances where clinical symptoms translate to greater difficulty in judging expressions, providing contextual cues may help alleviate or compensate for their difficulties with emotion perception (Nook et al., 2015). This possibility suggests that individuals would rely more on contextual information when interpreting the emotion conveyed by an expression, leading to greater susceptibility to context. Alternatively, that reliance on context may be more uniform between clinical and healthy individuals, but the latter group might benefit more from a context, as Brewer et al. (2017) reported with ASD patients using body gestures as contextual cues and target expressions of anger and disgust.

In either case, most studies have examined emotion recognition abilities (face-alone), contextual effects and clinical traits using group-level analyses. Therefore, these studies do not inform whether there is a systematic relationship between the severity of symptoms for a given trait and the ability to classify emotional expressions, either in isolation or with contextual information. To address this issue, similar to Chapter 2, we assessed a broad range of clinical traits (i.e., autism, depression, alexithymia and anxiety) that have been linked to difficulties with emotion recognition (for isolated faces) in the past (Button et al., 2013; Eack et al., 2015; Mikhailova et al., 1996); Montebarocci et al., 2011; see Section 1.9.4). More importantly, we aimed to establish how individual differences in the severity of clinical symptoms might modulate the magnitude of contextual influence experienced across our cohort.

To the author's knowledge, only Brewer et al. (2017) thus far has directly examined the relationship between contextual reliance and clinical traits for the emotions of disgust and anger, but this was done at a group level. Therefore, it remains largely unknown how individual differences in clinical symptoms may affect the influence of body gestures as contextual cues on perception (using COCM) and classification (using conventional method) of facial expressions. By examining individual differences across both paradigms, we can determine if and how clinical traits contribute to the strength of contextual effects and whether these effects originate from perceptual or non-perceptual (decisional) processes.

3.2. Method

In the current work, two distinct paradigms were implemented (i.e., COCM and conventional method) to test the influence of body gestures on the interpretation of confusable expressions. Additionally, a series of questionnaires were administered to examine the relationship between contextual effects (resulting from both paradigms) and the severity of clinical symptoms (i.e., autism, depression, alexithymia and anxiety).

3.2.1. Design

The experimental design used here was identical to the comparison-of-comparisons method implemented in Chapter 2 (Section 2.2.1), but the stimuli were different (see below). The type of context was manipulated as the within-subjects factor with three-levels: no body gesture (no-context condition), angry body gestures (angry context condition), or disgust body gestures (disgust body condition). The dependent measures were estimates of perceptual bias obtained for each contextual condition, which indicated the appearance of a neutral facial expression (see results for more details, Section 3.3).

Additionally, we also investigated individual differences in perceptual biases, decisional noise, and clinical traits in relation to COCM. The self-report measures for the same clinical conditions from Chapter 2 (i.e., alexithymia, depression, autism, and anxiety) were obtained to assess severity of given symptoms for each trait across the cohort, following which we separately examined how the severity of symptoms (per clinical trait) would possibly modulate perceptual biases. Next, we explored how the severity of clinical symptoms influenced decisional noise—participants' ability to discriminate between facial expressions of varying emotional intensities (see Section 3.3 for detailed results).

Similarly, for the conventional method, a within-subjects design was implemented to draw qualitative comparisons with COCM. We presented expressions ranging from anger to disgust at one of 11 intensities, and for each intensity we manipulated the context in which expressions appear, separately. The dependent measure was the proportion of times expressions of a specific intensity was classified as "anger" (i.e., out of the total number of expressions shown for a given intensity). Additionally, based on our dependent measure, we calculated two separate scores defined as "angry shifts" and "disgust shifts" to quantify the magnitude of influence from the body gestures (see Section 3.3 for more details). Based on these metrics, we examined individual differences by establishing relationships between clinical traits, proportion of "angry" classifications (no context condition) and the magnitude of contextual effects (i.e., angry / disgust shifts), separately.

3.2.2. Participants

Given that we planned to conduct statistical analyses similar to those used in Chapter 2, this experiment also recruited 84 participants (68 females, 16 males). These participants had a mean age of 21 years (range 18 – 36). The same cohort participated in both experimental methods (i.e., COCM and conventional). Moreover, out of these 84 participants, 18 had also previously taken part in the experiment involving discriminable expressions in Chapter 2. All participants were either undergraduates or postgraduates from the University of Nottingham Malaysia. Furthermore, only those that were above 18 years old with Asian origins (e.g., Malaysian, Indonesian) and without any prior mental health diagnoses were recruited for this study. Upon completion of both experimental methods and questionnaires, students enrolled in Psychology courses would receive 2 SONA credits as compensation. However, students from other courses would receive RM14 as monetary compensation. Both paradigms implemented were approved by the Science and Engineering Research Ethics committee (NNNL280521).

3.2.3. Stimuli and Apparatus

First, we selected 10 angry body gestures and 10 disgusted body gestures that were not significantly misclassified as each other and were also classified above the chance level of 16% (see Appendix C for Angry and Disgusted Body Identity Data: Tables C1 and C2). A total of 26 body gestures were included in the validation study. Lastly, among the 20 body gestures chosen, there were 17 unique identities, whereas 3 identities contributed to both angry and disgust body gestures.

Next, expressions of anger, disgust, and neutral emotions were validated by a cohort of 21 Asian participants. From this validation study, ten unique face identities were chosen whose disgust and angry facial expressions were confused with each other to a large extent (see Appendix D for Angry and Disgusted Face Identity Data: Tables D1 and D2). Our first criteria was that all expressions needed to be accurately classified above chance level of 16% (all accuracies were above 28%). The chance level was determined based on the fact that six response choices were given in each trial when participants classified the emotion conveyed by the body gesture. Second, we selected identities where disgusted expressions (mean misclassification as angry: $M = 0.114$, $SD = 0.103$) and angry facial expressions (mean misclassification as disgust: $M = 0.167$, $SD = 0.096$) were most frequently confused as each other (according to our validation). Although the mean misclassification rate for angry expressions was not above chance level, angry faces were classified with high levels of accuracy across the 10 selected identities ($M = 0.710$, $SD = 0.186$), which may have contributed to the attenuated rate of misclassification. Lastly, some validated expressions and identities, despite meeting our two criteria more effectively, could not be included due to challenges in pairing them with body gestures.

Whilst we intended to introduce ambiguity between the facial expressions used, we made sure that the body gestures (i.e., contexts) were not confused with each other. The same stimuli (facial expressions and body gestures) were used in both the COCM and conventional methods. Please refer to Chapter 2 (Section 2.2.3) for full details regarding the creation of face-body composites.

Finally, the four self-report scales administered to measure clinical traits (i.e., autism, depression, alexithymia and anxiety) remained identical to those used in Chapter 2.

3.2.4. Procedure

The questionnaires were distributed through the web-based survey platform Qualtrics (Provo, UT). The behavioural experiments (COCM and conventional paradigms) were designed using PsychoPy (v2021.1.4; Peirce et al., 2019) and administered through their online hosting platform Pavlovia. The scaling procedure described in Chapter 2 (Section 2.2.3) was administered across these two experiments prior to presenting the stimuli.

3.2.4.1. COCM

On any given trial, participants were presented with two expressions, that either appeared on their own, or as paired with body gestures (anger or disgust). This approach led to three contextual conditions characterized by the presence and/or absence of a body gesture, namely, angry body, disgust body, and no-context. The condition in which no body gestures were presented acted as the baseline condition. Participants were required to compare between the two expressions presented and indicate which of the two appeared more neutral to them in a 2-alternative forced-choice task. One of these faces, the “pedestal”, had a fixed level of intensity of either 20% anger (denoted as −10) or 20% disgust (denoted as +10) relative to the neutral face. However, the intensity of the other “comparison” expression was determined by adding an offset to the fixed pedestal ($pedestal_{intensity}$ + offset = $comparison_{intensity}$). This offset was randomly selected without replacement from a set containing twenty copies of these nine offsets {−40, −30, −20, −10, 0, +10, +20, +30, +40}. Each combination of pedestal and comparison intensity was presented 10 times, each time depicting a unique face identity. This resulted in 540 trials in total across all three conditions (3 contexts × 2 pedestals × 9 offsets × 10 trials per combination).

As illustrated in Figure 2.4 in Chapter 2, each trial began with the presentation of a fixation cross (0.5 s) at the centre of the screen, followed by the simultaneous presentation of two target facial expressions (1 s). In every trial, the position of the pedestal and comparison images was randomly selected as they appeared on either the left or right of the fixation cross. Next, noise stimuli of identical dimensions (500 pixels × 500 pixels) and positions to the target images appeared on the screen for 1 second. The noise stimulus had a uniform distribution of grey values between black and white. Lastly, a gray screen with the word “RESPOND” appeared indicating that participants needed to select either ‘z’ for the left image or ‘m’ for the right image. Participants were given unlimited time to respond.

The procedure highlighted above remained identical to that used in Chapter 2 with discriminable emotions and only the stimuli differed in the current study.

3.2.4.1. Conventional method

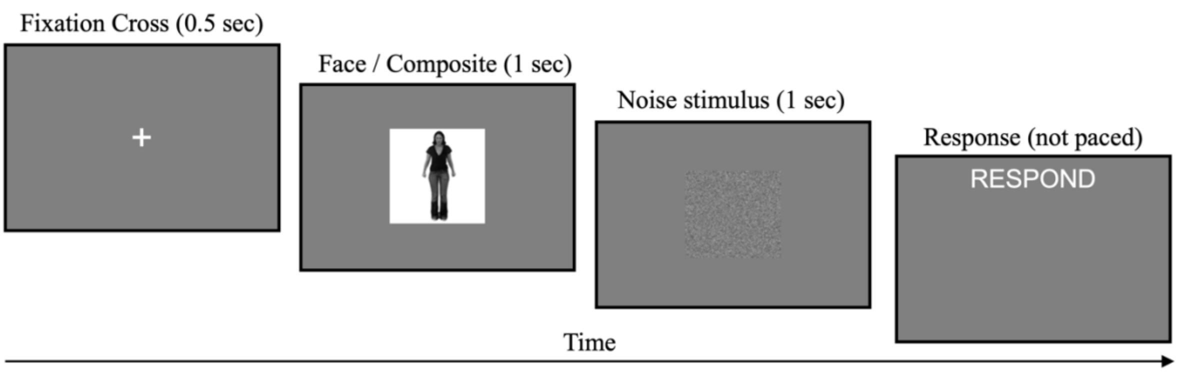
On-screen instructions informed participants that face images would be presented either alone or with a body context. They were instructed to classify the emotion expressed by the face by pressing either ‘m’ for anger or ‘z’ for disgust on the keyboard (Figure 3.1).

Trials were characterized by the type of contexts in which the face appeared (i.e., no-context, angry body gesture, disgust body gesture) and intensity of facial expression. For the latter, one of eleven percentages of emotional intensities between extreme anger (-50) and extreme disgust (+50) going through neutral (0), was chosen for each trial: $\{-50, -40, -30, -20, -10, 0, +10, +20, +30, +40, +50\}$. Each percentage of emotional intensity was presented ten times depicting ten unique face identities, resulting in 110 trials per context. Altogether, participants classified facial expressions across 330 trials (3 contexts × 11 emotional intensities × 10 trials per intensity).

Each trial began with a fixation cross (0.5 s) presented at the centre of the screen, followed by a face-body composite or the face alone (depending on the context) for 1 s, which was also presented at the centre (Figure 3.1). This stimulus presentation was followed by a noise stimulus shown for 1 s. The properties of the noise stimulus remained identical to those used with COCM (i.e., a uniform distribution of grey values between black and white). Immediately after the noise stimulus, participants were prompted by a screen with the label "RESPOND". Finally, the next trial began with the presentation of another fixation cross at the centre for 0.5 s (Figure 3.1).

Figure 3.1

Timeline of a trial in the conventional paradigm



3.2.4.3. Questionnaires

Participants were instructed to follow the Qualtrics link provided to answer the questionnaires, after they had completed both behavioural experiments on Pavlovia (i.e., the COCM and the conventional method). The standard instructions were presented at the beginning of each given questionnaire (TAS-20, STAI, AQ, BDI-II).

3.3. Results

We will first discuss all analyses related to COCM, followed by those pertaining to the conventional method. Regarding the former, we will assess (at a group level) the influence of body contexts on the perception and discrimination of confusable expressions, focusing on estimates of perceptual bias (i.e., μ). Subsequently, we will quantify and examine how the magnitude of contextual influence varied across our morphing sequence unfolding from intense anger (-50) to intense disgust (+50), through neutral (0). Next, for individual differences, we will first establish the composition regarding the severity of symptoms for our four clinical traits that were assessed (i.e., autism, depression, alexithymia, anxiety). These scores from the clinical questionnaires will then be correlated with our metrics related to emotion perception (i.e., decision noise, perceptual biases, and magnitude of contextual effects). Additionally, we will also explore the relationship between no-context perceptual biases and the magnitude of contextual influence. For the conventional paradigm, the structure and analyses will remain largely identical to that of COCM with the exception of the dependent measure being the proportion of “angry” responses.

3.3.1. COCM

For each context condition, we plot the proportion of times (out of 10 trials) participants chose the pedestal as closer to neutral (y-axis), as a function of the offset added to the pedestal to determine the comparison (x-axis). The likelihood of choosing the pedestal increases when participants perceive it to be less expressive (i.e., more neutral) compared to the comparison. Next, psychometric functions were fitted to this data, in accordance with the psychophysical model described in Chapter 2 (Section 2.3).

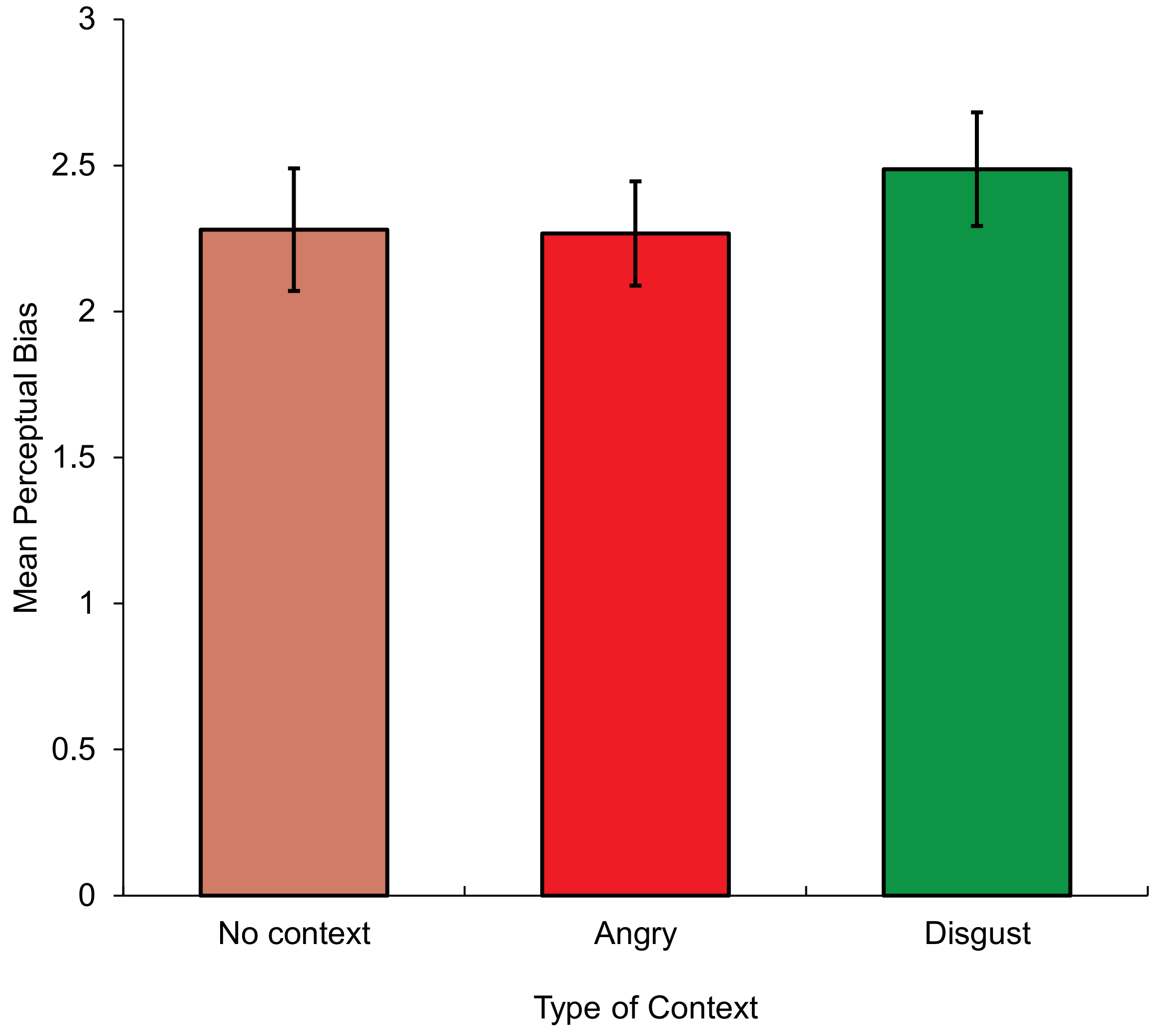
From these functions, estimates of perceptual bias (μ) and decisional noise (σ) were obtained for each type of context (i.e., no body gesture, angry body, disgust body). Positive values for μ denoted that neutral expressions were perceived as disgusted, whereas negative values denoted neutral faces being perceived as angry.

3.3.1.1. Effect of context on perceiving and discriminating expressions

A one-way ANOVA was conducted to compare the estimates of μ between the three context conditions, namely, faces with either no-context, angry body gestures or disgust body gestures. Much like with discriminable expressions (Chapter 2), we found no significant differences between the biases of the three conditions, $F(2,249) = 0.40$, $p = 0.668$, $\eta_p^2 = 0.003$). Furthermore, neutral faces were perceived as expressing slight disgust in general, irrespective of the context (Figure 3.2): no context condition ($M = 2.280$, $SD = 1.923$), angry body condition ($M = 2.267$, $SD = 1.626$), and disgust body condition ($M = 2.487$, $SD = 1.783$). In other words, the morphed face perceived to be subjectively neutral was a slightly angry morph from the sequence.

Figure 3.2

Mean perceptual bias for the three contextual conditions (confusable expressions)



Note. Error bars denote standard error of the mean.

3.3.1.2. Magnitudes of contextual effects for confusable expressions

Similar to Chapter 2, we established here whether the absence of global contextual effects originated from: 1) all participants uniformly not experiencing contextual effects or, 2) participants experiencing contextual effects, but in opposite directions (i.e., some positive and others negative shifts in biases) resulting in a null effect overall. Therefore, to examine these possibilities, individual estimates of biases were used to calculate the magnitude of a contextual effect for each participant by obtaining the difference between the bias for the baseline condition (i.e., no-context) and biases from angry / disgust contexts. To calculate the magnitude of contextual effect from an angry body context, we subtracted the μ in the no-context condition from the μ estimated for the angry body condition (i.e., no context bias – angry body bias). Therefore, an "angry shift" with negative values denoted angry body gestures biasing neutral expressions to be perceived as angrier. A "disgust shift" was calculated by subtracting the bias for the no-context condition from the bias for the disgusted context (i.e., no context bias – disgust body bias). Here, positive values represented a disgusted body gesture biasing neutral expressions to be perceived as more disgusted.

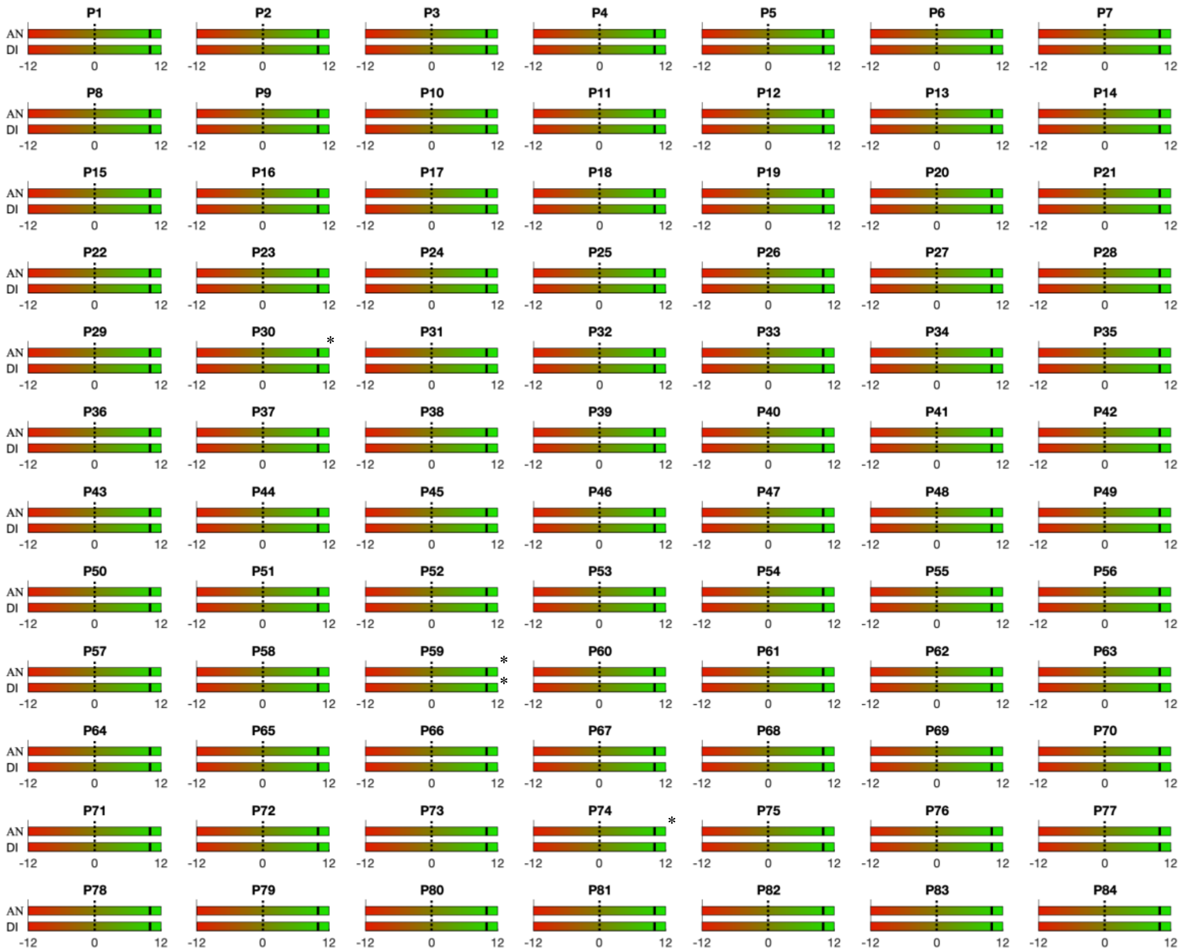
Next, to ascertain which of the two possibilities mentioned above would be true, we conducted a series of likelihood ratio tests per individual. Here, we fitted each participants' data from the no-context−angry body conditions and no-context−disgusted body conditions, separately. The characterisation of the likelihood ratio tests remained identical to those conducted in Chapter 2 (see Section 2.3.3 for more details). If the estimated values from likelihood tests were less than α (i.e., 0.05), then it was interpreted as the perceptual bias being significantly different from "0". In other words, body gestures shifted the perception of an objectively neutral face.

Accordingly, a total of 168 likelihood ratio tests were conducted to test perceptual shifts when presenting angry and disgusted body gestures (84 participants × 2 contexts). In the case of angry bodies, only two instances highlighted significant shifts in perception. Contrary to the expected direction, in both cases, participants perceived the neutral expression as more disgusted (i.e., positive shifts) when paired with angry bodies. For disgusted body gestures, three significant effects were seen, whereby participants' perception shifted in the direction of the body's emotion (i.e., disgust). No other likelihood ratio tests yielded any significant effects. Figure 3.3 illustrates these perceptual shifts in bias for the two contexts per participant.

Lastly, based on the likelihood ratio tests, we can surmise that the first possibility mentioned at the beginning of this section seems unlikely and the second possibility remains true to some extent. After all, we do see some variability in the effect of body gestures on our participants' perception. However, effects at the individual level appear to be more subtle and difficult to capture.

Figure 3.3

Magnitudes of context effects for individual participants (confusable expressions)



Note. Single asterisks (*) represents significant shifts in perceptual bias. Each plots represents a unique participant's data, and in each plot, the top bar denotes the contextual effect from an angry body context and the bottom bar denotes the contextual effect from a disgusted body context. The black bar within each plot represents the magnitude of effect experienced by the participant. Positive values denote faces being perceived as more disgusted and negative values denote faces being perceived as angrier.

3.3.1.3. Individual differences in clinical traits and perception

Next, identical to the comparisons from Chapter 2, we conducted 24 Bonferroni-corrected Pearson's product moment correlations (adjusted significance criterion $\alpha = \frac{0.05}{24} = 0.0020$) to establish how (or if) severity of clinical symptoms influences our three metrics related to expression perception: 1) decision noise, 2) perceptual biases, and 3) the magnitude of contextual effects. Table 3.1 shows a summary of means for each clinical trait assessed.

As Table 3.1 highlights, the mean for autistic traits suggests that participants scored within "normal" range (< 32; Baron-Cohen et al., 2001). Next, for depressive traits, although the mean suggests that majority scored within the "mild mood disturbance" range for depression (11 – 16; Beck et al., 1996), there was still a substantial number of participants (*n* = 40) that scored between 17 – 40 representing categories with greater severity of symptoms (categories included: "borderline clinical depression" (17 – 20); "moderate depression" (21 – 30); "severe depression" (31 – 40)). For alexithymia, quite a number of participants appear to score in the range of "possible Alexithymia" (51 – 60; Heshmati et al. 2011; Pedersen et el., 2022). Finally, state anxiety scores appear to be largely in the range of "moderate anxiety" (38 – 44), whereas trait anxiety scores seem to indicate a large percentage of participants having "high anxiety" (45 – 80).

Regarding variability of scores, apart from depression, we captured a comprehensive range of scores (including those eligible for a clinical diagnosis) for trait and state anxiety, with some alexithymia scores also being within the clinical range. Figure 3.4 highlights this variability in participants' scores for a given clinical trait.

Table 3.1

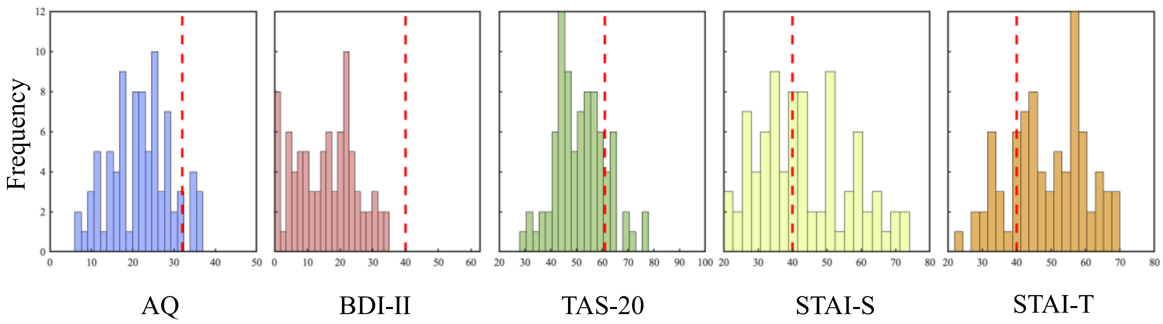
Means and standard deviations for the scores of clinical traits

	Clinical traits				
	AQ	BDI-II	TAS-20	STAI-S	STAI-T
M (*SD*)	21.89 (7.31)	15.54 (9.39)	51.36 (9.91)	43.37 (13.40)	49.08 (11.40)

Note. M indicates mean and *SD* indicates standard deviation. BDI-II = Beck's Depression Inventory, AQ = Autism Quotient, TAS-20 = Toronto Alexithymia Scale, STAI-S = Spielberger State-Trait Anxiety Inventory (State anxiety subscale), STAI-T = Spielberger State-Trait Anxiety Inventory (Trait anxiety subscale).

Figure 3.4

Range of self-reported scores for the four clinical traits



Note. Each plot denotes the questionnaires administered assessing autism, depression, alexithymia, state anxiety and trait anxiety respectively. AQ = Autism Quotient, BDI-II = Beck's Depression Inventory II, TAS-20 = Toronto Alexithymia Scale, STAI-S = Spielberger State-Trait Anxiety Inventory (State anxiety subscale), STAI-T = Spielberger State-Trait Anxiety Inventory (Trait anxiety subscale). For a given questionnaire, the minimum value of the x-axis denotes the lowest possible score that can be obtained by participants. The maximum value of the x-axis denotes the highest possible score participants can obtain for the questionnaire. The dashed red line denotes the cut-off score beyond which symptom severity is considered eligible for a clinical diagnosis.

Clinical Traits and Decision Noise. Our rationale when relating clinical traits and decision noise was predicated upon greater severity of symptoms making it difficult to accurately perceive and discriminate expressions appearing in isolation. Accordingly, we correlated estimates of decision noise (no-context condition) with the scores from clinical traits. No correlations emerged significant at the level of $p < \alpha$ (alpha = 0.0020; see Appendix E for Statistics from Correlations for Confusable Expressions). It appears that increasing severity for any given trait did not increase participants' difficulty when discriminating between facial expressions.

Clinical Traits and Perceptual Biases. Next, we examined whether participants' inherent biases when judging expressions would be related to the severity of clinical symptoms. As previously defined (see section 2.3.4), "inherent" refers to individual differences in emotion perception observed in the absence of contextual cues—likely stemming from person-specific factors (e.g., clinical traits) that can modulate how facial expressions are perceived. Therefore, we conducted Pearson correlations between estimates of bias in the no-context condition and scores for clinical traits. However, we failed to observe any significant relationships (see Appendix E for Statistics from Correlations for Confusable Expressions). These results suggest that the severity of clinical traits did not influence participants' perception of facial expressions without a context.

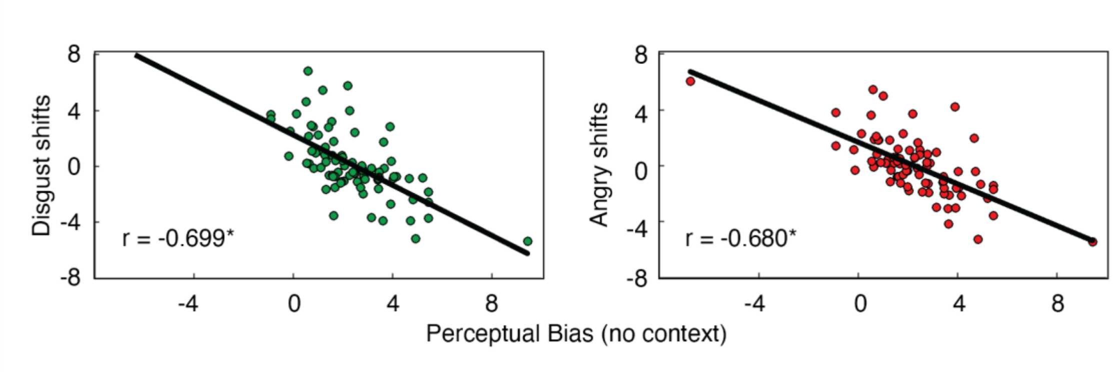
Clinical Traits and Magnitude of Contextual Effects. We aimed to determine whether clinical traits would play a role in the strength of contextual effects experienced by the participants. Therefore, we correlated angry shifts and disgust shifts (separately) with the scores from clinical traits. However, we failed to find any significant correlations in this respect either (see Appendix E for Statistics from Correlations for Confusable Expressions).

Magnitude of Contextual effects and Perception. We then examined whether inherent biases related to how participants perceived isolated facial expressions would influence the strength of the contextual effects they experienced. Therefore, we correlated estimates of decision noise (no-context condition) with angry and disgust shifts (separately), to establish whether difficulties in judging the face alone may modulate the magnitude of contextual influence. However, no significant correlations were observed (Appendix E for Statistics from Correlations for Confusable Expressions).

Lastly, we correlated estimates of μ obtained from the no-context condition with disgust shifts and angry shifts. There was a significant negative correlation between μ and disgust shifts, $r(82) = -0.699$, $p < 0.001$. As shown in Figure 3.5 (left panel), biases close to zero in the no-context condition (i.e., when neutral expressions looked less disgusted) produced the largest disgust shifts. As biases in the no-context condition deviated further from zero, in the direction of a disgusted percept, the disgust shifts reduced in magnitude, eventually resulting in shifts in the opposite direction (i.e., biased to perceive neutral expressions as angrier). A similar relationship was observed for angry shifts (Figure 3.5; right panel), with a significant negative correlation between estimates of μ and angry shifts, $r(82) = -.680$, $p < 0.001$. When neutral expressions appeared more disgusted (i.e., less angry) in the no-context condition, angry shifts were larger. As biases approached zero (i.e., more in the direction of anger), angry shifts reduced, and eventually switched directions, making participants perceive neutral expressions as disgusted.

Figure 3.5

Correlations between no-context bias and angry / disgust shifts

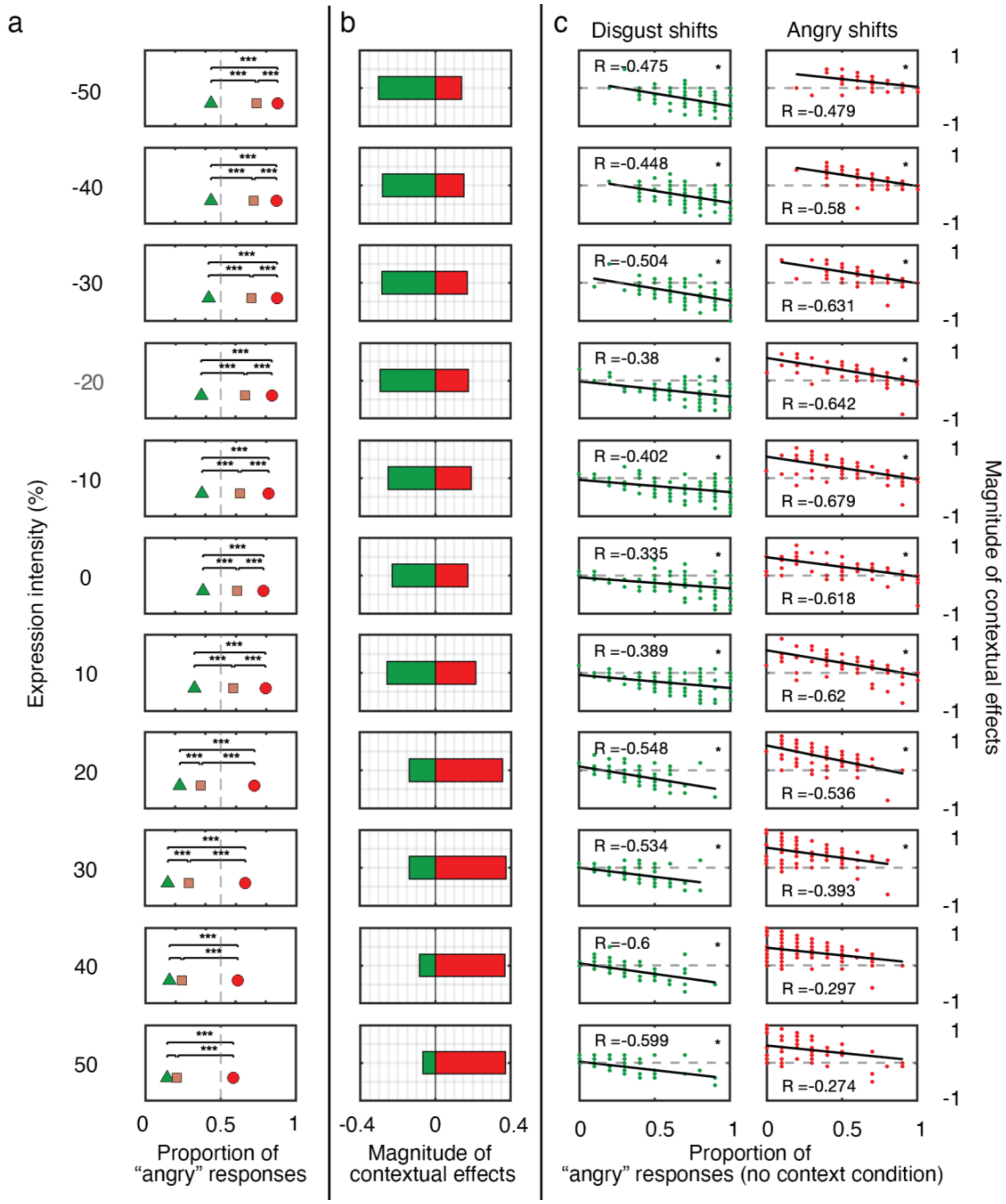


3.3.2. Conventional method

For each expression intensity, we calculated the mean proportion of angry responses across participants for the three experimental conditions (no-context, angry body, and disgusted body) separately (see Figure 3.6a). First, we assessed whether the facial expressions in the morphed sequence were categorized according to the emotion and intensities they conveyed. For the no-context condition, we observed that the mean was highest (.73) for the −50% intensity (depicting extreme anger) and it was significantly above the chance-level classification (0.5), according to a one-sample *t*-test (two-tailed), $t(83) = 12.15$, $p < 0.001$, *Cohen's d* = 1.325. The means decreased as the intensities increased positively. The lowest mean (.21) was reported for +50% intensity (depicting extreme disgust), and it was significantly below chance (one-sample *t*-test), $t(83) = -1.93$, $p < 0.001$, *Cohen's d* = −1.302. The results of one-sample t-tests comparing means for the no-context, angry context and disgust context conditions at each intensity against chance-level classification are reported in Appendix F (Tables F1-F3). The above analyses indicate that the classifications closely aligned with the emotional categories and intensities conveyed by our facial expressions, given that above-chance represents predominantly “angry” responses and below-chance means predominantly “disgust” responses.

Figure 3.6

Contextual effects measured using the conventional method



Note. Contextual effects in Experiment 3: a) Mean proportions of "angry" responses across all participants for each condition; angry body (red circles), no-context (yellow squares) and disgusted body (green triangles). Horizontal lines indicate post-hoc paired samples t-tests conducted, *** = $p < .001$, b) Mean of disgust shifts (green bar) and angry shifts (red bar) at each expression intensity, c) Participants' proportion of "angry" responses in the no-context condition (x-axis) correlated against disgust shifts (left panel; green circles) and angry shifts (right panel; red circles) in the y-axis, * = $p < .002$.

3.3.2.1. Effect of context on the classification of confusable emotions

Next, we analysed contextual effects at the group-level, by comparing mean proportion of angry responses between the three experimental conditions for each intensity separately, using a series of one-way repeated-measures ANOVAs. All the ANOVAs revealed significant main effects of condition (all $p < .001$; effect sizes ranging from .236 to .504; see S10), showing that the means differed between conditions. To identify the directions of effects, Bonferroni-corrected two-tailed paired-samples t-tests were conducted to compare the three unique pairs of conditions within each intensity (the adjusted $\alpha = \frac{0.05}{3} = 0.016$; see Figures 3.6a). At all intensities, we found that the mean proportion of angry responses was significantly higher for the angry body condition than the no-context condition (all $p < .001$; *Cohen's d* values ranging from 0.579 to 1.709) and the disgust body condition (all $p < .001$; *Cohen's d* values ranging from 1.347 to 2.382). In addition, with the exception of +40 and +50 intensities, mean proportion of angry responses in the disgust condition was significantly lower than that in the no-context condition for all other intensities (all $p < 0.001$; *Cohen's d* values ranging from -1.544 to -0.601). Overall, angry bodies produced higher rates of angry classifications and disgusted bodies produced lower rates of angry classifications (i.e., higher rates of disgust classifications). Appendix G (Table G1) provides all the statistics related to the one-way ANOVAs conducted to analyse contextual effects.

3.3.2.2. Magnitude of contextual effects

The facial expressions communicated different emotions and intensities as the morphing sequence unfolded. Therefore, this manipulation led to systematic differences in the level of agreement (i.e., congruency) or conflict (i.e., incongruency) between the objective emotions conveyed by the face and body gesture. Accordingly, we aimed to determine whether this shift in congruency / incongruency along the morphed continuum would influence the magnitude of contextual effects. For a given intensity, we calculated the effect of an angry body for each participant separately, by getting the difference in the proportion of angry responses between the no-context and angry body conditions (i.e., angry body – no context). This value is labelled as the “angry shift”, with more positive values showing larger effects. Angry shifts were averaged across participants to calculate the mean effect of an angry body for the selected intensity. Similarly, the effect of a disgusted body can be calculated separately for each participant, by getting the difference in the proportion of angry responses between the no-context and disgusted body conditions (i.e., disgusted body – no-context). This value is labeled as “disgust shift”, with more negative values showing larger effects. Disgust shifts were averaged across participants to calculate the mean effect of a disgusted body. The angry / disgust shifts calculated here denote the magnitude of influence from body gestures on the classification of facial expressions.

As can be seen from Figure 3.6b, the mean effect of an angry body increased with increasing intensity (from −50% to +50%) and the correlation between the two was significant, $r(9) = 0.916$, $p < 0.001$. In contrast, the mean effect of a disgusted body decreased with increasing intensity, revealing a significant correlation again, $r(9) = 0.931$, $p < 0.001$

(Figure 3.6b). In brief, as the conflict between the emotions signaled by the face and body increased (i.e., more incongruent), the influence from the body context increased accordingly, reaching peak magnitude at the extreme intensities of the emotions.

3.3.2.3. Individual differences and contextual effects

Next, we examined individual differences in terms of clinical traits by correlating scores from the questionnaires with angry / disgust shifts and with classification of isolated expressions, separately. A series of 12 correlations per intensity were conducted (adjusted $\alpha = \frac{0.05}{12} = 0.004$). At all intensities, we did not observe any significant relationships at the level of $p < \alpha$ (alpha $= 0.004$).

Subsequently, we assessed how individual differences in participants' classification of isolated expressions, characterized by proportion of angry responses in the no-context condition would drive contextual effects. For each intensity, we correlated the mean proportion of angry responses of all participants in the no-context condition with their magnitudes of contextual effects (i.e., disgust and angry shifts; Figures 3.6c). At all intensities, we found that the mean proportion of "angry" responses from the no-context condition negatively correlated with disgust shifts (all $p < 0.002$; r values ranged from -0.600 to -0.335). When participants judged the face alone more often as angry (indicated by higher "angry" classifications), larger disgust shifts were observed (Figure 3.6c left panel). As the proportion of "angry" classifications reduced (i.e., faces alone classified more often as disgusted), the disgust shifts reduced in magnitude. We also observed comparable relationships at all intensities (except +40 and +50) for angry shifts (all $p < 0.001$, r values ranged from -0.679 to -0.393), wherein the mean proportion of "angry" responses (no-context condition) was negatively correlated with angry shifts. In other words, when participants judged expressions in the no-context condition more often as disgusted (as indicated by fewer “angry” classifications), angry shifts were larger. Conversely, when they judged the faces alone more often as angry (indicated by higher “angry” classifications), angry shifts were smaller. Appendix H (Tables H1-H11) reports the full statistics related to the correlations described above.

3.4. Discussion

In this chapter, we first investigated how contextual effects could emerge when people discriminate between confusable facial expressions, namely anger and disgust, using the comparison of comparisons method (COCM). When implemented such a method that isolated the contribution of non-perceptual biases, we failed to observe any group-level influence on perception from body contexts. In Chapter 2, we postulated that the lack of contextual effects on perception may be attributed to the easily distinguishable nature of angry and happy expressions, as they are physically dissimilar (Calvo & Lundqvist, 2008; Thoma et al., 2013). However, if that explanation would have held true, then we should have observed contextual effects with more confusable emotions like anger and disgust here, but we did not. Therefore, confusability cannot account for the lack of contextual effects on perception.

Unsurprisingly, when we used the conventional method and asked participants to classify expressions, body gestures biased classification in the direction of the context’s emotion at a group-level. This finding on classification adds to a highly replicated effect in the literature (Aviezer et al., 2008; Kret, Stekelenburg, et al., 2013; Meeren et al., 2005; Mondloch, 2012; Wang et al., 2017; Xu et al., 2017). Considering our findings from the two experimental methods used, group-level contextual effects only occurred in the conventional method that allows both perceptual and non-perceptual factors to contribute to the judgement of an expression. Contextual effects did not occur in a method that isolates the contribution of perceptual factors. Accordingly, contextual effects on classification, as reported throughout the literature and in our experiment, are most likely the result of context influencing post-perceptual decisional processes.

This claim is in line with the results from Teufel et al. (2019), who reported that body gestures did not alter perceptual representations of faces that are involved in visual adaptation. Moreover, although Teufel et al. (2019) suggested the possibility that body gestures may alter perceptual representations beyond those involved in visual adaptation (i.e., in the face processing hierarchy), we rule out that possibility too.

3.4.1. Contextual effects may not be perceptual

Similar to Chapter 2 (with easily discriminable emotions), we also failed here to observe body gestures changing the perception of facial expressions when using COCM. However, it was only when using the conventional paradigm (with single stimuli) did we observe contextual effects. This discrepancy suggests that the influence from a context appears to only be prevalent when the methodology allows the contribution of non-perceptual biases (i.e., conventional method) and not when it limits such processes (i.e., COCM). Past studies that had demonstrated contextual effects using the conventional method make a strong claim that body gestures change the perception of facial expressions by automatically acting on early perceptual processes (Albohn et al., 2022); Aviezer et al., 2008; Aviezer et al., 2012; Aviezer et al., 2011; Karaaslan et al., 2020; Meeren et al., 2005; Mondloch et al., 2012). The evidence for this early effect comes primarily from: 1) participants remaining biased even when instructed to ignore the body context, 2) gaze measurements and, 3) electrophysiology components. None of the evidence above can be considered as direct measures of perception per se.

First, the notion of automatic integration was largely based on participants remaining biased towards the context emotion when classifying faces, in spite of being explicitly instructed to ignore the body context (Aviezer et al., 2008; Meeren et al., 2005; Noh & Isaacowitz, 2013). In other words, they highlight how a task irrelevant cue (i.e., body gesture) was capable of influencing participant's judgement of a facial expression. However, this viewpoint can be challenged based on the argument that task demands can modulate perceptual focus and, consequently, lead to pronounced contextual effects. For instance, in support of this criticism, we discuss Lecker et al.'s (2020) experimental findings based on face-body composites where facial expressions displaying anger, disgust, fear, or happiness were paired with body gestures expressing one of the four emotions (i.e., anger, disgust, fear, or happiness). Participants were either instructed to explicitly ignore the body context (i.e., explicit condition) and classify the expression or not given any explicit instructions on whether to prioritise the face or body (i.e., naturalistic condition). Participants' classification patterns appeared to be driven by the type of instructions given for most of their face-body pairings. Categorisation appeared to be more face-centric in the naturalistic condition even for incongruent composites compared to the pronounced contextual effects (i.e., body-centric judgements) observed in the explicit condition when body needed to be ignored. This pattern was especially evident across all combinations where happy expressions were paired with incongruent body gestures and for fearful faces paired with angry body contexts. Lecker et al.'s (2020) findings have been corroborated by other research that had a similar naturalistic condition. For instance, Shields and colleagues (2020) also reported that participants classification of facial expressions were in the direction of the face emotion when judging incongruent composites for range of face-body combinations (e.g., happy face-fearful body, angry face-sad body, sad face-happy, fearful face-angry body).

Taken together, the findings above suggest that in naturalistic conditions (akin to real-life) participants appear to rely on the face as the primary source of information when judging emotions. In fact, eye-tracking data highlights how overt attention (i.e., more fixations) are accorded to the face region when judging incongruent composites (Shields et al., 2020). Conversely, when explicit instructions are given to ignore the context, the perceptual focus shifts completely towards the face and inadvertently may heighten sensitivity to incongruence, resulting in stronger contextual effects. These stronger contextual effects would mean that it is not necessarily automatic integration of face-body cues but rather effects elicited from the task demands.

That being said, there are some face-body combinations that elicit robust contextual effects, regardless of task instructions. For example, participants consistently classified the face based on the body's emotion for face-body combinations, like disgusted-angry and fearful-angry, both under explicit and naturalistic task instructions (Lecker et al., 2020). This finding indicates that contextual effects may not be equally strong or uniform for all facial expressions but instead manifest when there is an inherent difficulty or confusability involved when judging the expression. As discussed earlier (see Section 3.1.2.1), anger and disgust expressions are often confusable owing to their shared physical features (Aviezer et al., 2008; Karaaslan et al., 2020; Susskind et al., 2007), and recognizing fearful expressions have been known to be particularly challenging (Rapcsak et al., 2000). Therefore, under such instances of heightened difficulty, participants may rely more on contextual information, thereby exhibiting greater susceptibility to contextual cues, irrespective of task instructions.

Second, the perceptual nature of contextual effects is inferred based on gaze measurements. Body gestures that are emotionally incongruent with the face alter early gaze movements on the face to be characteristic of those typically associated with expressions conveying the same emotion as the body (Aviezer et al., 2008; Mondloch et al., 2013, Study

2). For instance, when an angry face was paired with a disgusted body, participants deployed an equal number of fixations to eye and mouth regions, mirroring the typical scanning patterns observed when judging disgust faces (Wells et al., 2016). The short timescale of this effect leads to the inference that context affects overt attention on the face, which in turn affects perception of expressions. However, this observation may reflect modulatory effects of context-guided scanning, qualitatively similar to how scene contexts can direct search patterns when detecting a target (Malcolm & Henderson, 2010). For example, targets in highly informative regions of the scene are located with faster scanning times (< 41.93 ms) compared to less informative regions (> 56.69 ms). Interestingly, such scene-context effects manifest even earlier than the gaze metrics reported by Aviezer et al. (2008); 900 ms was the shortest latency reported for a first gaze movement into a region of interest. Alternatively, some studies propose that the location of fixation prior to stimulus onset could direct attention towards specific areas (Gu et al., 2013; Wang et al., 2017). Hence, a central fixation (as presented by Wang et al., 2017; Aviezer et al., 2008; and Meeren et al., 2005) could result in the body gesture being sampled before the facial expression. Under such circumstances, scanning patterns of the face could be more goal directed (Schurgin et al., 2014), aiming to verify if the body and expression convey consistent information.

Supporting this viewpoint, research has observed how the emotion category cued by a label preceding the target face influenced subsequent scanning patterns executed when evaluating isolated expressions (Bombari et al., 2013). For example, when the emotion cued was “sad”, more fixations were directed towards the eye region compared to if the cue was “happy”. Similarly, it is plausible that once participants have extracted the body’s emotion from their initial fixations, the derived emotional category can act as cue (as suggested by Bombari et al., 2013). Consequently, participants may then attempt to search for diagnostic facial features associated with the cued emotion, such as fixating on the eyes and mouth when body gesture expresses disgust (Aviezer et al., 2008; Wells et al., 2016). This explanation is an alternative to the interpretation of Aviezer et al.'s (2008) findings. In any case, the alternative explanations discussed above collectively emphasize that gaze metric-based evidence for contextual effects appear weak and may not necessarily confirm perceptual changes.

Third, electrophysiological evidence, such as the event-related potential (ERP) component P1 (occurring around 100ms after stimulus onset), has been popularly proposed as an early marker of perceptual integration taking place between the face and the body. For example, studies by Wang et al. (2017) and Meeren et al. (2005) report larger amplitudes of P1 (i.e., a component thought to be sensitive to both early visual and higher-order face processing) when judging incongruent face-body composites (e.g., angry face – fearful body), compared to congruent face-body composites. However, there are inconsistencies in the research findings regarding ERP components. For instance, Gu et al. (2013) reported opposing activation patterns for positive and negative face-body composites. Enhanced P1 activation was elicited for fearful (negative) expressions when paired with fearful bodies (i.e., congruent) compared to incongruent composites, inconsistent with Meeren et al. (2005) and Wang et al. (2017). Happy expressions in congruent composites (i.e., with happy bodies) reduced the activation of P1 compared to incongruent composites (i.e., with fearful bodies). Most importantly, the amplitude of the P1 component was larger for any face-body composite if the body gesture conveyed fear (i.e., negative) rather than if it conveyed happiness (i.e., positive). Taken together, Gu et al. (2013) interpreted their findings as evidence of an "early negative bias", where threat-related information is extracted at very short latencies (even without visual awareness). Moreover, this bias towards heightened P1 activation for negative stimuli has since been corroborated by ERP studies in similar research areas, such as with isolated fearful expressions over neutral (Zhang et al., 2015), isolated fearful body gestures

(Borgomaneri et al., 2015), and body gestures communicating negative valence in general (Li et al., 2021).

Adding to this complexity, Li et al. (2020) did not observe any P1 activation for congruent or incongruent composites, regardless of whether the face and body cues communicated positive (i.e., happiness) or negative emotions (i.e., anger, disgust, fear, sadness, and surprise). However, they did observe an enhanced amplitude of P1 for their isolated body gestures expressing negative emotions. Therefore, in contrast to Meeren et al. (2005), it remains plausible to interpret the P1 activation as reflecting the extraction of threat-related information. After all, both the body gestures presented by Meeren et al. (2005) in their composites (e.g., angry face-fearful body, fearful face-angry body) communicated emotions of negative valence that are commonly associated with threat. Taken together, the evidence above supports a stronger case for early threat detection rather than the automatic integration of face and body gestures at early stages of visual processing.

Collectively, the cited studies underscore why the literature has not convincingly demonstrated that the influence of context when judging facial expressions results from a change in perceptual processes. Our findings from the two experiments with the COCM makes the claim even less convincing.

3.4.2. Individual differences in clinical traits do not influence contextual effects

An often-overlooked factor in contextual effects is how individuals differ in their susceptibility to it, and we addressed this individual difference rigorously. Our rationale was predicated upon individuals with severe symptoms for these four clinical conditions having inherent difficulties with emotion perception (Button et al., 2013; Eack et al., 2015; Mikhailova et al., 1996; Montebarocci et al., 2011). Therefore, contextual information from body gestures could potentially alleviate such difficulties when judging facial expressions (Brewer et al., 2017; Nook et al., 2015). However, in our study, the variability in the severity of clinical traits did not influence the perception and discrimination of confusable emotions, and neither did it affect the classification in the conventional paradigm.

Although sub-clinical, our participants varied substantially in the severity of their clinical traits (see Figure 3.4), especially for depression, trait anxiety, and state anxiety that included a substantial number of individuals who may be eligible for a clinical diagnosis. However, we did not see evidence of its relationship to the susceptibility of contextual effects. This absence must be interpreted with caution because difficulties in expression-related judgments may only relate to the susceptibility to context in clinically diagnosed individuals (Brewer et al., 2017), and our sample is largely sub-clinical. In other words, we cannot discount the fact that a relationship between the ability to discriminate and susceptibility to context may only appear beyond the threshold for clinical diagnosis.

3.4.3. Perception of isolated expressions and susceptibility to context

Clinical traits aside, we found new evidence that individual differences in how isolated (confusable) expressions are perceived influenced people's susceptibility to context. This relationship was contingent on the emotional disparity between the perceived emotion of isolated (objectively) neutral faces and the emotion conveyed by the context. With high disparity (e.g., neutral faces perceived as disgusted and the body signaling anger), we observed larger attractive shifts in biases (e.g., neutral faces paired with angry bodies perceived angrier than when presented alone). These effects reduced and eventually switched directions with decreasing disparity. At very low disparities, we observed repulsive effects, where expressions were biased to be perceived away from the body's emotion (i.e., an objectively neutral face appeared more disgusted when paired with an angry body than when presented alone). Moreover, the relationships described above between isolated expressions and contextual effects were only observed with confusable emotions and not easily discriminable emotions (i.e., anger-happy) in Chapter 2.

Nevertheless, although the relationship was true and statistically large in effect size for contextual effects resulting from both angry and disgusted gestures (see Figure 3.5), the repulsive component of the relationship is not compatible with the literature. Past studies have only demonstrated attractive (or no) contextual effects (Aviezer et al., 2008; Gao et al., 2022; Meeren et al., 2005; Van den Stock et al., 2007; Wu & Ying, 2023). Why subtle, yet systematic, perceptual shifts occur in opposite directions, depending on the disparity in emotions between the face and the body, remains unclear. Nevertheless, we can explain our attractive shifts within the context of assimilation effects, as observed in studies where valence was judged from faces surrounded by other faces / descriptive sentences as context (Wu & Ying, 2023) or complex emotional scenes (Palumbo et al., 2017). Across these two studies, a common finding was the assimilation of context valence into the judgement of the target (i.e., response in the direction of context valence). For example, in Wu and Ying (2023), faces were perceived as more positive when the other faces (i.e., context) signaled a positive valence compared to the baseline (i.e., a face with no surrounding context).

Extending these findings to our own observations, perhaps with higher disparity, what we observe is assimilation whereby perception of the expression is driven towards the context emotion (i.e., attractive shifts). Bayesian frameworks could potentially explain why these shifts align towards the context (Maier et al., 2022). Top-down influences from prior expectations and probabilistic inferences shaped over our lifetime would predict that faces and body gestures typically cue identical emotions (i.e., consistent information except in infrequent circumstances like deception). Therefore, only through assimilation of contextual information can our perception of the face align with these prior expectations (Hsu & Wu, 2020). However, Bayesian accounts cannot fully explain the repulsive shifts that drive perception away from the context emotion. Given that our studies are among the first to investigate the perceptual nature of contextual effects based on individual differences, further research may be required before we can explain this novel peculiarity observed with repulsive shifts.

Nonetheless, these perceptual shifts could account for the lack of group-level contextual effects in the current study (with COCM). With some experiencing attractive shifts and others experiencing repulsive shifts, the overall global shift would be close to zero. Despite not being able to fully explain why we observe attractive and repulsive shifts depending on the emotion disparity between the face and the context, we still would like to emphasize two points. First, neural mechanisms driving perceptual shifts in our case are fundamentally different from those driving contextual effects on classification reported in the past. After all, our paradigm (COCM) specifically limits the influence of non-perceptual processes, whereas in the conventional paradigm, these processes can contribute to a participants' judgements. Accordingly, we suspect that distinct neural mechanisms would lead to the processing and judgment of stimuli presented across these two paradigms (i.e., COCM and conventional). Second, perceptual shifts caused by body gestures are not uniform across individuals. Their direction and magnitude depend on how facial features are perceived by the observer.

3.4.4. Contextual effects when classifying facial expressions

We have thus far discussed contextual effects in relation to COCM and examining the influence of body gestures within the context of inducing perceptual changes when judging facial expressions. The question still remains as to why we consistently observe contextual effects in the conventional method where both perceptual / non-perceptual processes may play significant roles. In other words, what factors could potentially change our interpretation of the target cue (e.g., face) and consequently our decisional processes.

The majority of the research examining contextual effects using the conventional paradigm has demonstrated contextual effects, even when participants were explicitly instructed to ignore the context (Aviezer et al. 2008; Karaaslan et al., 2020; Lecker et al., 2020; Meeren et al., 2005; Van den Stock et al. 2007). In Section 3.4.1, we discussed evidence suggesting that explicit instructions do not necessarily mean face-body integration occurs at early perceptual stages. Building on that premise, we provide here an explanation as to why body gestures may lead to participants consciously changing their interpretation of the face. Although the body gesture may appear irrelevant within the context of the experimental task, people have learned in daily life to associate a face as connected to a body gesture, thereby forming an invariant association between the two cues over time. Accordingly, they have come to “expect” stability and predictability in the emotions signalled by the face and body. Therefore, when judging composites that elicit uncertainty (e.g., incongruent composites) and especially, in the absence of any other supporting cues, people may choose to implicitly or voluntarily fall back on this invariant association (despite the instructions given) that they had come to expect between the face and body. Accordingly, this situation too would bias responses in the direction of the body context but it does not automatically purport an automatic change in perception.

Alternatively, classification of the face may be weighted in line with the reliability accorded to the face and body as emotion-expressing cues. For this explanation we drew inspiration from different patterns of integrating bimodal cues to achieve depth perception (Morgan et al., 2008). According to Jacobs (2002), all visual cues are ambiguous to some extent and the level of ambiguity can determine the reliability of the cue. When the cue becomes increasingly more ambiguous, then its reliability decreases, whereas cues considered to be less ambiguous are deemed more reliable (Jacobs, 2002). In line with these assessments of reliability, participants can assign different weightages to these cues and adapt their cue integration strategy. When both cues hold equal measures of reliability, no biases would emerge when making judgments, but a disparity in reliability between two cues would elicit participants to respond in favour of the cue considered more reliable (Jacobs, 2002; Triesch et al., 2002). For example, in Triesch et al.'s (2002) study, participants were asked to identify a target object from distractor objects that were characterised by three different visual cues (i.e., colour, shape, size). In any given trial, two of these cues would change across the trial (e.g., colour from blue to green) and one cue would remain stable. Consequently, Triesch et al. (2002) observed how participants adapted their judgements so that it was largely based on the cue that remained stable (i.e., more reliable) across the trial.

Relating this interpretation to the conventional method, especially with faces from incongruent composites (i.e., disgust face-angry body), a conflict arises between these two visual cues. According to assessments of reliability, this conflict might increase the uncertainty (i.e., ambiguity) surrounding the target facial expression and, therefore, be deemed a less reliable cue compared to the body gesture. Therefore, participants would be more inclined to assign the emotional category of the body gesture to the facial expression, as the former cue is deemed more reliable. It is important to emphasise that objectively both facial expressions and body gestures when judged in isolation had comparable accuracy ($M^{\text{faces}} = 0.695$, $M^{\text{body}} = 0.647$). Therefore, it is the resulting conflict from the presentation of two contradictory visual cues that possibly biases measures of reliability in favour of the non-target cue (i.e., body gestures) rather than the characteristics of the stimuli changing (e.g., object changing colour; Triesch et al., 2002).

Moreover, we assert that conflict might result from two main ways: 1) between the face and body signalling objectively different emotional categories (e.g., angry face-happy body) and, 2) between one's internal representation of an expression and the expression elicited by the context emotion (e.g., angry body gesture activates an angry face). We propose the second source of potential conflict to be the most likely factor driving contextual effects. This idea will be revisited later and be explained in greater depth.

In contrast, when judging congruent face-body composites, the absence of conflict would not reduce the reliability of the target expression. Accordingly, participants would not need to rely on the body gesture (as the more reliable cue) when judging the face. Therefore, the emotional category assigned to the facial expression may be primarily based on the face. Consequently, the shorter RTs and higher accuracy observed with congruent composites may reflect this lack of need to resolve conflict or assign different weightages of reliability towards the two cues (unlike with incongruent face-body composites).

3.4.5. Classification of isolated expressions and susceptibility to context

We extended the analysis of individual differences to our data from the conventional paradigm as well. Similar to the findings discussed in Section 3.4.3 with the COCM, we aimed to examine possible relationships between classification of isolated expressions and the strength of contextual effects experienced with the conventional method. Our participants varied substantially in how they classified isolated expressions. This variability was strongly related to participants' susceptibility to body gestures, and, once again, we find emotion disparity playing a crucial role here. If a participant classified an expression of a given intensity more often as an emotion incongruent with that of the body (e.g., an expression paired with an angry body was more often classified as disgusted when presented alone), they were more likely to experience attractive contextual shifts in classification. The magnitudes of these shifts were proportionate to the level of disparity, and we did not see clear evidence of repulsive shifts in any case. For example, we observed smaller group-level effects at extreme ends of the morphing sequence (e.g., +50%, intense disgust). As end-point morphs convey the highest emotional intensity, a larger percentage of participants would classify the face alone (e.g., disgust) more accurately. This classification pattern would mean that the majority of participants experienced reduced disparity / conflict when the faces were paired with a body gesture that expressed an identical emotion (e.g., disgusted body). In contrast, the smaller group level effects capture the few participants who experienced greater disparity / conflict between the emotions signalled by the face (e.g., intense disgusted face seen as "angry") and body gesture (e.g., disgusted), owing to being less accurate when judging these morphs at the extreme ends.

Therefore, disparity between the judgement of the isolated expression and the body gesture appears to be a pivotal factor in driving the strength of contextual influence for both perception and classification of emotional expressions.

3.4.6. Limitations and future directions

However, a possible limitation of our study is that the isolated angry / disgusted expressions presented were not significantly confusable with one another. The participants from our validation study were highly accurate when judging the diagnostic emotion (M_{angry} = .710 , $M_{disgust}$ = .681), which may have inadvertently contributed to the lack of confusability. Nevertheless, we do acknowledge that the lack of inherent ambiguity between these two expressions may have limited the potential for body gestures to exert a stronger influence (at least where perceptual influences are concerned with COCM). Therefore, future research can ascertain whether heightened confusability can in fact have an impact at a perceptual level when interpreting facial expressions, especially in terms of susceptibility to context. Regarding our conventional paradigm, we postulate that the nature of our facial stimuli may have had minimal influence, given that studies with even lower rates of misclassification for angry / disgust expressions observed contextual effects (Lecker et al., 2020), similar to our own findings.

3.4.7. Conclusion

We have successfully demonstrated using a robust paradigm that body gestures (possibly generalizing to other contextual cues) do not change our perception of emotions from faces. Apart from this demonstration, our findings add to an emerging avenue of research that considers individual differences in how people experience contextual effects. More importantly, for the first time, we propose that the strength of contextual effects is related to the assessment of conflict between the face (alone) and body cues, in contradiction to much of the past work. Therefore, we have proposed our own “seeds and conflict theory” to capture the nuanced nature of contextual effects, especially with regard to individual differences. This theory will be explained in the general discussion (see Chapter 6).

Chapter 4. Relating individual differences in thinking styles and self-construals to contextual effects in facial emotion perception: A cross-cultural study

4.1. Introduction

In Chapters 2 and 3, we had established that contextual effects on classification may be attributed to late-decisional processes rather than early perceptual processes. More importantly, in Chapter 3, we observed subtle shifts in perception and classification that varied systematically with how participants perceived or classified isolated expressions. In other words, individual differences in participants' inherent biases when judging faces alone had a modulatory effect on how faces would be judged when a body context was provided. However, individual differences characterised by clinical traits did not influence the experience of contextual effects (see Chapters 2 and 3).

In this chapter, we examine "culture" as another factor that characterises individual differences. Culture encompasses a framework of norms, conceptions and routine practices that can actively shape psychological processes in an individual (Shweder et al., 2010). Cultural frameworks vary among individuals, whether that be within a single population (e.g., ethnicities; Asian American and Native Hawaiian) or broadly across different nationalities (e.g., American vs Japanese). These differences are thought to manifest in a range of emotion-related processes, such as in the experience of emotions (Markus & Kitayama, 1991; Pugh et al., 2022), the display or expression of emotions (Matsumoto, 1990; Waxer, 1985), and the processing of different emotional cues (e.g., expressions, context; Bjornsdottir et al., 2017; Masuda et al., 2008). With regards to processing emotional cues, we briefly discussed in Section 1.9.3 that there are agreements and also inconsistencies in how expressions from various categories of emotions are recognized across cultures. These findings form the basis of this chapter, as they link cultural differences to the interpretation of emotions.

4.1.1. Cultural orientation and emotion perception

Individuals from different cultures differ on many dimensions, and social orientation is an important one. Constructs of social orientation, namely collectivism and individualism, broadly delineate a set of norms that define the relationship between the individual and society (see Oyserman et al., 2002 for a review). Collectivism considers "society" as the core unit and believes that individuals must fit into this society by means of common goals. Conversely, Individualism considers the "individual" as the core unit and societal practices serve to promote the wellbeing of the individual. Early studies in the field of emotions established important links between these two social orientations and emotion perception.

Past studies demonstrated that the ability to identify specific categories of emotions from faces can differ between individuals from individualistic and collectivist cultures. For instance, an early study by Matsumoto (1992) examined emotion recognition between Americans (labelled as "individualistic") and Japanese (labelled as "collectivist") for Ekman's (1992) six basic emotions, using a conventional classification task (i.e., presentation of a single target expression that participants needed to classify). Apart from happiness and surprise, across all unambiguously "negative" emotion categories (i.e., anger, disgust, fear, and sad), Americans outperformed (i.e., higher accuracy) Japanese participants. Matusumoto (1992) interpreted this observation within the societal norms and liberties set forth by collectivist versus individualist cultures in relation to emotion (Matsumoto, 1992, 2001). Accordingly, the poor recognition in Japanese participants reflect collectivist ideals that discourage the display of negative expressions, as such emotions are considered detrimental to group harmony and conformity (inconsistent with the collectivist worldview; Matsumoto, 2001). Because negative emotions are less openly expressed, people from collectivist cultures encounter them less often and are therefore less apt at recognising them. This discouragement in displaying negative emotions can also extend to an attenuated sensitivity or ability to recognise such expressions, as observed in Matsumoto (1992). Comparatively, individualistic cultures (e.g., Americans) encourage the display of any given emotion (including negative expressions), and, thus, the higher rate of recognition across all categories was believed to reflect their ability to display emotions in an unrestricted manner (consistent with an individualistic worldview).

Accordingly, we see that cultural norms concerning emotions in Western cultures encourage the experience and expression of any given emotion (De Leersnyder et al., 2021). Conversely, Eastern cultures appear to favour emotions (i.e., in terms of overt displays, expression recognition, and subjective experience) that facilitate societal harmony, such as shame (Boiger et al., 2022; Matsumoto et al., 1998). Based on this difference, we surmise that these distinct practices in terms of experience and expression of emotions between Western and Eastern cultures appear to shape how individuals will ultimately perceive / recognise positive and negative emotions.

In any case, individualistic and collectivist norms are thought to form the foundation upon which individuals shape their patterns of thinking (e.g., holistic vs analytical; Nisbett & Miyamoto, 2005) and views of oneself (i.e., self-construals; Mesquita, 2001) Here, patterns of thinking refers to how individuals either perceive the world by assessing relationships between different cues (i.e., holistic) or by focusing on a single focal stimulus (i.e., analytical). Self-construals entail how individuals view themselves, whether that be in relation to others (i.e., interdependent self-construal; Markus & Kitayama, 1991) or against one's own ideals and thoughts (i.e., independent self-construal; Markus & Kitayama, 1991). These concepts will be explained in detail below. Notably, patterns of thinking and self-construals that may differ between cultures can play a role in how people interpret emotional cues in their context. This will be discussed in the next section.

4.1.2. Cultural differences in contextual effects

4.1.2.1. Patterns of thinking and contextual effects

Individuals from Eastern or Asian cultures tend to perceive the world by assessing relations between different elements (e.g., judge an individual's emotion in relation to the environment, situation, other people present at the time), and therefore are deemed to have a holistic style of thinking (Nisbett & Miyamoto, 2005). Conversely, Westerners are thought to be analytical, whereby they focus on a central target without according much relevance to the surrounding elements or context. Such patterns of thinking may lead to differences in the use of contextual cues when judging emotions from expressions.

In an early study by Masuda et al. (2008), American and Japanese students were asked to rate the intensity of an emotion conveyed by a central figure (happy, angry or sad) that appeared among 4 other background figures (i.e., social context). The central figure conveyed either a congruent (e.g., angry central figure – angry background figures) or incongruent (e.g., angry central figure – happy background figures) emotion with the background figures. Notably, Masuda et al. (2008) presented cartoon figures for both target / background figures, they reported that these cartoon figures communicated the intended emotion with greater accuracy then real-life expressions i.e., photographs.

In any case, for all three target emotions, Japanese participants rated the central figure as depicting more intense emotions when the background figures' emotions were congruent than when their emotions were incongruent. Comparatively, although American participants demonstrated the same contextual effect, the discrepancy in intensity ratings between congruent and incongruent stimuli were relatively smaller when compared to their Japanese counterparts.

Masuda et al. (2008) emphasized that the target expression was perceived differently between the two cultural groups. Accordingly, Americans tended to infer an individual's emotion by relying more on the target itself, whereas Japanese were more inclined to assess the target expression in relation to the emotions depicted in the social context. Therefore, Masuda et al.'s (2008) interpretation of their findings remained consistent with the idea that Westerners are more analytical (i.e., not taking contextual cues into consideration) in nature. In contrast, Asians adopt a more holistic thinking style, whereby information from multiple sources (i.e., including context) is integrated into their interpretation of a facial expression.

In another noteworthy study by Bjornsdottir et al. (2017, Study 2), sad or disgusted facial expressions were paired with body gestures conveying one of the four emotions (i.e., sadness, fear, anger, or disgust). Therefore, face-body composites were either congruent (e.g., sad face-sad body) or incongruent (e.g., sad face-disgusted body). Participants were then instructed to make categorical judgements regarding the face emotion. Across two cultural groups (i.e., Canadians and Japanese), a facilitatory effect was observed when presented with congruent face-body composites (e.g., angry face-angry body) whereby greater classification accuracy was observed compared to the baseline condition where faces were judged alone. Similarly, for both cultures, presenting incongruent face-body composites hindered and impaired judgements, resulting in lower classification accuracies. These findings replicate the typical contextual effects observed in the literature (Aviezer et al., 2008; Aviezer et al., 2012; Kret et al., 2013; Meeren et al., 2005).

However, Bjornsdottir et al. (2017) also reported that both facilitation (from a congruent context) and impairment (from an incongruent context) were more pronounced in Japanese participants compared to the Canadian participants. Based on these findings, Bjornsdottir et al. (2017) suggested that, Japanese participants, as holistic thinkers, were affected to a greater extent by contextual information compared to Canadians who were assumed to be more analytical. However, it is important to note, that both Japanese and Canadians did experience contextual effects. Therefore, it would not be accurate to assume that Westerners entirely make context-independent (analytical) judgements. Rather, the magnitude of influence from the context was smaller in Westerners compared to Easterners (Bjornsdottir et al., 2017; Stanley et al., 2013). Additionally, the presence of contextual effects in the Canadian participants replicates the observations from studies with Western participants (Aviezer et al., 2012; Aviezer et al., 2008; Meeren et al., 2005).

The relationship between thinking styles and the experience of contextual effects is supported by findings showing cultural differences in how much individuals attend to contextual information compared to the target of judgement. For instance, Masuda et al. (2008) reported that American participants allocated significantly more overt attention (in terms of average time spent viewing) to the central figure compared to the Japanese participants, regardless of the emotions conveyed by the target and the context (i.e., angry, sad, happy).

This finding has been replicated by Stanley et al. (2013) who asked participants to classify expressions rather than rate emotional intensity as in Masuda et al.'s (2008) study. Stanley et al. (2013) also observed greater fixation durations allocated to the target expression with their American participants compared to their Chinese participants. In addition, the Chinese cohort fixated longer on the context (i.e., background figures) compared to the Americans. Regarding contextual effects, in Stanley et al. (2013), although contextual effects were observed in both cultural groups (i.e., Americans and Chinese), Chinese participants were generally less accurate in classifying the target figures' emotions when surrounded by background faces in the context that displayed emotions that were different from the target.

To summarise, attending more to the context represents a more holistic attentional style and suggests that the target is evaluated in relation to the contextual information. This holistic approach resulted in larger contextual effects in the Chinese participants. In contrast, attending more to the target represents a focused and analytical attentional style and therefore, target is judged independent of any other contextual cues. This analytical approach resulted in smaller contextual effects in Americans.

Interestingly, some of the past studies claim that the type of context can determine the extent to which analytical-Western and holistic-Eastern individuals experience contextual effects. These findings challenge the explanation that a general holistic tendency to incorporate the context when processing expressions leads to larger contextual effects in some cultures. For instance, Ito et al. (2012, Study 1) and Ito et al. (2013, Study 2) reported that Westerners (Americans, Canadians) and East Asians (Chinese, Japanese, Koreans) were both influenced to the same extent by background scenes of positive (e.g., beach) or negative valence (e.g., location of a disaster) acting as a context, when rating the intensity of emotions from target figures conveying either sadness or happiness. However, when the same target figures were paired with background figures (acting as the context) expressing sad or happy emotions, the influence of context was only observed with East Asian participants and not the Western cohort (Ito et al., 2013, Study 2).

In our view, the explanation for this discrepancy is not clear-cut, but Ito et al. (2013) speculated that salient information from contextual cues can (automatically) influence the interpretation of emotional expressions, irrespective of culture. This automatic processing is probably why both Western and East Asians cultures experienced contextual effects when the context is a background scene. However, when background figures serve as the context, only Westerners with individualistic ideals may deliberately access their so-called “dominant meaning system” (Ito et al., 2013). This meaning system contains individualistic ideals highlighting that individuals are causal agents of their facial expressions and that they have a high degree of control over their overt display of emotions. When these ideals are accessed and activated, Westerners would actively suppress the automatic influence of context. This explanation would hold true for Masuda et al.’s (2008) and Bjornsdottir et al.’s (2017) findings as well, whereby Western participants (Americans, Canadians) may have also operated under the rules of agency and accordingly, deliberately downplayed the emotions conveyed by background figures. Nevertheless, the fact that Western participants are susceptible to contextual effects in the absence of volitional agents is not fully consistent with their so-called “analytical” pattern of thinking.

That being said, the attributions of thinking styles may not be sufficient to explain all cultural variations in contextual effects. For instance, Ko et al. (2011) asked participants to rate the intensity of happiness or fear expressions embedded in positive, negative or neutral background scenes. They aimed to test not only cultural differences between Korean and American participants but also possible age-related effects. Ko et al. (2011) only replicated cross-cultural differences in contextual effects for young participants, with Koreans experiencing larger contextual effects than Americans. However, this cultural difference was completely absent in their older cohort of Koreans and Americans (i.e., both cultures experienced contextual effects to the same extent). If only thinking styles are responsible, within the older cohort, we could expect contextual effects to be more pronounced among older Koreans, given their extended practice of holistic processing over time. Conversely, we could expect minimal (or absent) contextual influence among older Americans, given their consistent consolidation of analytical thinking over time. Clearly, this age effect was not observed. Therefore, the question can be raised whether thinking styles alone can account for all cultural differences (or lack thereof) in contextual effects captured across these studies. Accordingly, the next section will discuss another construct (i.e., self-construals) that is known to differ between cultures, which might also explain differences in contextual effects experienced by different cultures.

4.1.2.2. Cultural differences in self-construals and contextual effects

Cultures characterized by social orientation (individualism vs collectivism) and thinking patterns (holistic vs analytical) are also believed to differ in terms of "self-construals" held by individuals (i.e., the perception of oneself). In Western cultures that are believed to be individualistic and analytical, the self is thought to be a unique, autonomous entity and therefore, any behaviour would be referenced against one's own internal thoughts, feelings and actions (i.e., independent self-construal; Markus & Kitayama, 1991). In contrast, Eastern cultures that are believed to be collectivistic and holistic in thinking, emphasize the individual as belonging to a larger social group, and accordingly, an individual's thoughts, feelings and actions are closely tied to others, hence resulting in interdependent self-construals (Markus & Kitayama, 1991).

We believe that self-construals could be related to the experience of contextual effects for three reasons. First, the literature has raised the possibility that self-construals are linked to thinking styles, and some have even used this link to explain cross-cultural differences in contextual effects observed in other studies. For instance, Kafetsios & Hess (2013) interpreted Masuda et al.'s (2008) findings in terms of how individuals with more interdependent self-construals (like Japanese) would be more predisposed to a holistic thinking style and, accordingly, be more susceptible to context. Similarly, those with more independent self-construals (like Americans) would adopt an analytical thinking style, and, hence, separate the target of interest from its context when making judgements. Accordingly, the same explanation can also account for the cultural differences observed in other studies (Bjornsdottir et al., 2017; Ito et al., 2012, 2013; Stanley et al., 2013).

Second, there is also some evidence showing that self-construals can influence the extent to which observers are sensitive to the congruency between a target and its background context, although this influence has only been shown for semantic congruency and not for emotion congruency. For instance, Goto et al. (2010) reported that Asian Americans (compared to European Americans) were more sensitive to contextual congruency, when judging the animacy of focal objects (e.g., crab) embedded on either semantically congruent contexts (e.g., beach) or incongruent contexts (e.g., parking lot). They demonstrated this by measuring the N400 event-related potential (ERP), a component that is sensitive to the semantic incongruency between the object and the scene. Goto et al. found that the N400 amplitude was negatively correlated with independent self-construals, suggesting that individuals with higher independent self-construals are more sensitive to semantic incongruency.

Third, there appears to be a relationship between self-construals and the interpretation of emotions. For example, Kafetsios and Hess (2013) directly examined the link between self-construals and judgements of facial expressions embedded in a context (i.e., background figures). They conducted their study on Greek participants and administered a revised version of the often used Self-Construal Scale (Kwan et al., 1997; Singelis, 1994) to obtain estimates of independent and interdependent self-construals. Additionally, they adopted a paradigm whereby they also (temporarily) primed or activated either a self-independent or self-interdependent construal in two separate experimental groups. After having self-construals momentarily activated, participants rated central figures conveying either happy, sad, angry, or neutral emotions. These central figures were surrounded by four background figures as context, who expressed one of the four emotions (e.g., central figure angry, background figures happy). One of the interesting findings was that, when interdependent participants were primed with independent (rather than interdependent) self-construals, they exhibited lower accuracy in recognising negative emotions of central figures. This finding was attributed to self-construals modulating attention, either towards or away from the context (i.e., background figures; Kafetsios & Hess, 2013). When primed by self-independent construals, shifting attention to oneself could in turn facilitate judgements based on cues from the central figure, without consideration of the contextualising background figures (hence the observed increase in accuracy). Conversely, self-interdependent construals direct attention towards contextual cues and consequently, reduces the accuracy of classification for the central figure's emotion.

4.1.3. Are nominal distinctions sufficient?

At this point, we raise a concern about all the aforementioned studies that demonstrated cultural differences in experiencing contextual effects when interpreting facial expressions. They all have assumed and differentiated individuals from different cultures as analytical versus holistic (Bjornsdottir et al., 2017; Ito et al., 2012; Ito et al., 2013; Stanley et al., 2013). Essentially, the difference between cultures is merely nominal there. For example, if participants were of Japanese origin, it was assumed that they would have collectivist tendencies with holistic thinking styles and an interdependent mindset. Not only does this assumption seem inaccurate given the current state of globalisation (Kim, 2024; Pelham et al., 2022), but it also seems reductionist in nature to categorize individuals into groups based on nationality, without actually measuring those presumed individual differences. After all, contextual effects from body gestures have been observed across both Eastern and Western cultures (Aviezer et al., 2008; Bjornsdottir et al., 2017; Meeren et al., 2005; Van den Stock et al., 2007), which also includes our own findings from Chapter 3. These findings clearly indicate that individuals from both types of culture remain susceptible to contextual cues but to different extents, possibly due to culture-specific thinking styles or, it could even be culture-specific self-construals, which can only be confirmed if they are measured.

In addition, it is important to emphasise the possibility that although Western and Eastern cultures may be separated in thinking styles and self-construals, there can be a considerable amount of variability in the same constructs within these cultures too. One East Asian person might have much less or much more collectivistic tendencies than another East Asian person. In that case, individual differences in those constructs may explain variability in the experience of contextual effects, regardless of which culture people belong to.

4.1.4. The Current Study

Given the influence culture can have, we will first compare the experience of contextual effects on facial expression classification between two nominally distinct cultures: British, “Western” participants and Malaysian, “Asian” participants. These analyses were performed with the expectation that Asian individuals would be more susceptible to contextual cues, compared to the Western individuals (consistent with past research; see above). Past research justifies our expectation, given that Asians are generally considered to be more collectivist (i.e., with holistic thinking and interdependent self-construals) and they have been known to incorporate contextual cues to a relatively greater extent (than Westerners) during emotion classification (Bjornsdottir et al., 2017; Masuda et al., 2008). In contrast, Western participants with more individualistic tendencies would ideally focus only on the target expression, without giving much consideration to contextual information (Bjornsdottir et al., 2017; Ito et al., 2013; Masuda et al., 2008).

Next, we will compare if participants from these two cultures indeed differ in their self-construals and thinking styles. We do these two comparisons so that we can draw parallels between cross-cultural differences in contextual effects and cross-cultural differences in self-construals/thinking styles.

However, to examine the variability in self-construals and thinking styles within cultures, we will pool participants from both cultures and examine the relationship between the magnitude of contextual effects experienced and the scores on individual difference measures of self-construals and thinking styles. The reasoning behind assessing the relationship between thinking styles and contextual influence lies in the divergent ways holistic and analytical thinkers have been impacted by context in previous studies (Bjornsdottir et al., 2017; Ito et al., 2012; Ito et al., 2013; Masuda et al., 2008; Stanley et al., 2013).

Lastly, we will also include variability in classifying isolated expressions as an individual difference measure, purely to test whether we can replicate the findings from Chapter 3, but this time in a cross-cultural sample.

Measure of self-construals. When examining self-construals, the most popular self-report measure is the Self-Construal Scale (SCS; Singelis, 1994), which assesses independent and interdependent construals across two separate subscales (see Section 4.2.2.3 for more details). The SCS has been successfully used in a range of scenarios, such as examining emotional expressivity among immigrants (Van Assche et al., 2024), capturing within-culture differences in self-perception (Kafetsios & Hess, 2013; Park & Guan, 2007), and predicting consumer behaviour in participants (Li et al., 2021) to name a few.

Measures of thinking styles. In the assessment of thinking patterns, one of the most popular self-report has been the Analysis-Holism Scale (AHS; Choi et al., 2007) The AHS, which the current study administered, had been used to not only successfully distinguish between two distinct cultural groups (e.g., Mexicans and Americans; Lechuga et al., 2011) along the dimensions of analytical-holistic thinking, but also to establish differences within a single population (e.g., Korean students studying Oriental Medicine versus Psychology; Choi et al., 2007, Study 4).

Apart from self-report measures, past studies have identified behavioural measures, which allows objective estimations of an individual's thinking style. Two such paradigms are the "Rod and Frame Task" (RFT; Witkin & Goodenough, 1976) and the "Frame-Line Task" (FLT; Kitayama et al., 2003). In the former, participants are instructed to position a rod (that appeared embedded on a frame) to its subjective vertical position while ignoring the orientation of the surrounding frames (oriented away from the objective vertical 0°). Accordingly, participants influenced by the surrounding frame when determining the rod's verticality were referred to as "field dependent" (i.e., aligning with more holistic tendencies). In contrast, those who can judge the rod's verticality without being affected by the frame was considered "field independent" and this is consistent with analytical thinking styles. However, as Lacko et al. (2023) notes, the ideal strategy in the RFT is to always judge verticality without taking into consideration the surrounding frame. Therefore, we required a behavioural task that would evaluate both the ability to make judgements by considering the surrounding visual cues (i.e., context) and to make judgements by ignoring the surrounding cue.

These requirements led us to the Frame Line Task (FLT) devised by Kitayama et al. (2003). The original design of this task consists of two versions, namely the absolute and relative versions. Across both versions, participants were first presented with a "reference" stimulus that contained a vertical line inside a square-shaped frame. In the "absolute" version of the task, participants reproduced the exact length of the vertical line seen in the reference stimulus. In the "relative" version, they reproduced the line to have the same proportion as the reference stimulus (i.e., the proportion of the line's length to the frame's height). Therefore, this FLT was designed to capture at a basic level of processing how context (i.e., the square frame) is either successfully ignored in the absolute version or taken into consideration in the relative version.

In Kitayama et al.’s (2003) study, Americans made more errors in the relative version but were more accurate in the absolute version. Conversely, Japanese made more errors in the absolute version but were more accurate in the relative version. Kitayama et al. (2003) explained their findings in terms of how the FLT tasks mapped on analytical and holistic thinking styles. Americans would be more proficient when judging a single focal line, but would find it difficult to judge proportions (i.e., more errors) owing to their analytical nature. In contrast, Japanese would be more accurate when judging proportions given that the relation between the line and frame need to be considered (i.e., inclined towards holistic thinking). Conversely, they would struggle when simply focusing on the vertical line (i.e., more errors in absolute judgements) owing to their holistic tendencies making it difficult to ignore the context (i.e., the proportion of the line relative to the frame’s height).

Since the conception of the FLT, a significant number of studies have used this task to demonstrate differences in thinking styles between different populations characterised by age (Zhang et al., 2014), clinical conditions (e.g., ASD; Koh & Milne, 2012), culture (e.g., Asians vs Americans in Hedden et al., 2008, and Kitayama et al., 2003; holistic-analytical thinkers within a Chinese population; Teng et al., 2024), and occupation (e.g., thinking styles in farmers, fishermen, herders; Uskul et al., 2008).

However, in the studies cited above, links between FLT performance and analytical-holistic tendencies have been concluded simply based on the measure of errors in reproducing line lengths or proportions. A major drawback of using the originally devised FLT to establish this link is that participants reproduced the line by drawing on paper. This procedure is problematic for two reasons. First, we do not know what the error represents. For example, if Japanese participants are making errors in the absolute task, is it because the context interferes with participants’ judgements of the line or is it because Japanese participants have inherent difficulties with judging the length of lines, independent of the surrounding context? Second, we do not know the source of the error. For example, the source of the measured error in the absolute task could be an error in perceiving line lengths due to interference, or it could be a motor error that hinders the ability to reproduce the same line length (with no change in perception). Given such possibilities, it is difficult to definitely attribute cultural differences observed in the FLT to tendencies to process visual information holistically or analytically.

To control for such alternative possibilities, we modified the FLT, incorporating some principles of psychophysics. In our task, instead of viewing a single line inside a frame and reproducing it, participants were instructed to discriminate between two stimuli, each having a line and a frame. When they discriminate, they would either indicate if the two stimuli have equal line lengths ("absolute" version) or if they have the same line-to-frame proportion ("relative" version). Because the task is purely based on perceptual discrimination, we can rule out the possibility of motor errors. Moreover, as described in the results section, based on participants' discrimination responses, we were able to obtain two different measures of error for each version of the task. For the absolute version, we can measure how much their responses are biased towards perceived proportions, which would occur as a result of incorporating the context. We can also measure how easy or difficult it is for participants to discriminate line lengths. For the relative version, we can measure how much their responses are biased towards line lengths, which occur as a result of ignoring the context. We can also measure how easy or difficult it is for participants to discriminate proportions.

4.2. Methods

4.2.1. Participants

We intended to conduct a 2 × 2 mixed-subjects analysis of variance (ANOVA) for group-level comparisons of contextual effects (e.g., between Western and Asian participants), and a series of correlations to establish relationships between contextual effects and individual-difference measures. Therefore, an a-priori estimation of sample size using G*Power 3.1 (Faul et al., 2007) revealed that 54 participants were required for the ANOVA and 84 participants were required for the correlations to obtain moderate effects (Cohen's f = 0.25 and Pearson's r = 0.3, respectively), with 80% statistical power and a significance criterion alpha = .05.

Accordingly, we recruited 86 participants across two cultural groups (66 females, 20 males), whereby there were 43 Western (M = 21 years, SD = 5 years) and 43 Asian participants (M = 23 years, SD = 4 years). Inclusion criteria for the Western participants were based on their nationality (e.g., British, German, Spanish). However, it is important to note their ethnic backgrounds differed, with the majority identifying as White / Caucasian (n = 21), followed by Asian (n = 17), Black (n = 3) and Arab (n = 2). Our Asian sample was composed of individuals with Asian origins (e.g., Malaysian, Chinese, Indonesian). Western participants were undergraduates from Queen Mary University of London and upon completion of the study were awarded 4 course credits, and entered into a raffle draw to win £10 Amazon vouchers. Asian participants were current students from the University of Nottingham Malaysia, and they received a monetary compensation of RM12 or 2 course credits upon completion of all parts of the study. All participants had normal or corrected-to-normal vision (as per self-reports). Lastly, this study was approved by the Science and

Engineering Research Ethics Committee of the University of Nottingham Malaysia (NNNL200723).

4.2.2. Materials and Apparatus

4.2.2.1. Emotional classification task

The influence of body gestures on facial expressions was investigated using the conventional method of measuring contextual effects on classifying facial expressions; the method that we used in Chapter 3. Here, a single within-subjects variable (context) was manipulated at three levels: facial expressions were presented without a body gesture (no context condition), with an angry body (angry context condition), or with a disgusted body (disgust context condition). Expressions were one of 11 morphed images (i.e., 11 expression intensities) between anger (denoted as −50) and disgust (denoted as +50), morphed through neutral (denoted as 0; see Stimuli and Apparatus in Chapter 3 for more details; Section 3.2.3). The first dependent measure was the proportion of times each expression was classified as “anger”. This proportion was measured separately for each context and expression (i.e., intensity). Second, we also quantified the magnitude of contextual effects by calculating the difference in the proportion of angry responses between a condition with a context (i.e., angry body or disgust body) and the condition without a context (no-context). These magnitudes were also calculated separately for each of the 11 expressions.

All Western participants completed the classification task on a 13.6 inch MacBook Air (M2, 2022) with a screen resolution of 2560 px in width × 1664 px in height. However, the Asian participants completed the task on desktop computers at the University of Nottingham Malaysia which had uniform screen sizes (1600 px in width × 900 px in height). Across both the MacBook Air M2 and the desktop computers, the experiment was implemented through PsyhoPy (v2022.2.2; Pierce et al., 2019). Moreover, to ensure that the visible stimulus size remained identical between the laptop and desktop screens, we adopted the same scaling procedure as described in Chapter 2 (see Section 2.2).

4.2.2.2. Frame-line task (FLT)

To measure the extent to which cognitive styles are biased towards analytical or holistic processing, we employed a modified version of Kitayama et al.'s (2003) FLT. In the "absolute" version of this task, participants compared the absolute length of lines presented within two frames. In the "relative" version of this task, participants compared the lines within the two frames on a different attribute, specifically, the proportion (ratio) of the line to the frame's height.

In contrast to the emotion classification task, the FLT was conducted on the same 13.6 inch MacBook Air (M2, 2022) for both Western and Asian participants. For each task, we generated two types of stimuli, namely the "fixed" stimulus and the "comparison" stimulus. The fixed stimulus for the absolute task could have one of two combinations of line lengths and frame heights as shown in Table 4.1. As for the fixed stimulus in the relative task, it could also be one of two combinations of line lengths and frame heights (Table 4.1), but in both combinations, the line length to frame height ratio was fixed at 0.5:1 (i.e., the proportion of the line's length to the height of the frame was 0.5).

Table 4.1

Unique combinations of line lengths and frame heights for "fixed" and "comparison" stimuli

Combination	Fixed Stimulus (Line Length / Frame Height)		Comparison Stimulus (Line Length / Frame Height)	
	Absolute Task	Relative Task	Absolute Task	Relative Task
1	180 / 257	300 / 600	180 / 360	180 / 360

2	220 / 314	340 / 680	220 / 440	220 / 440

Note. Lengths and heights reported in mm.

The comparison stimulus varied in both versions and in each version, we had two unique starting combinations (of line lengths and frame heights) for the comparisons (see Table 4.1). We added offsets to the line lengths and frame heights of the starting combination to determine the final combinations to present. For line lengths, we added offsets in increments of 30 mm {−120, −90, −60, −30, 0, +30, +60, +90, +120}, resulting in 9 final line lengths. For frame heights, we added offsets to obtain specific proportions of the line's length to the frame's height. This resulted in 8 proportions ranging from 0.3 to 0.7, in intervals of 0.05. This procedure of adding offsets to the line lengths and frame's height (to determine proportions) remained identical between the relative and absolute versions. Table 4.2 provides all the resulting combinations (comparison and fixed stimulus) for the absolute and relative versions of the task.

Table 4.2

All combinations of line lengths and frame heights for "fixed" and "comparison" stimuli

Task Version		Fixed Stimulus			Comparison Stimulus		
	Offset Added to Line Length	Line Length	Frame Height	Prop	Line Length	Frame Height	Prop
Relative	-120	300	600	0.5	60	200	0.3
	-120	340	680	0.5	100	333	0.3
	-90	300	600	0.5	90	257	0.35
	-90	340	680	0.5	130	371	0.35

	-60	300	600	0.5	120	300	0.4
	-60	340	680	0.5	160	400	0.4
	-30	300	600	0.5	150	333	0.45
	-30	340	680	0.5	190	422	0.45
	0	**300**	**600**	**0.5**	**180**	**360**	**0.5**
	0	**340**	**680**	**0.5**	**220**	**440**	**0.5**
	+30	300	600	0.5	210	381	0.55
	+30	340	680	0.5	250	454	0.55
	+60	300	600	0.5	240	400	0.6
	+60	340	680	0.5	280	466	0.6
	+90	300	600	0.5	270	415	0.65
	+90	340	680	0.5	310	476	0.65
	+120	300	600	0.5	300	428	0.7
	+120	340	680	0.5	340	485	0.7
Absolute	-120	180	257	0.7	60	200	0.3
	-120	220	314	0.7	100	333	0.3
	-90	180	257	0.7	90	257	0.35
	-90	220	314	0.7	130	371	0.35
	-60	180	257	0.7	120	300	0.4
	-60	220	314	0.7	160	400	0.4
	-30	180	257	0.7	150	333	0.45
	-30	220	314	0.7	190	422	0.45
	0	**180**	**257**	**0.7**	**180**	**360**	**0.5**
	0	**220**	**314**	**0.7**	**220**	**440**	**0.5**

+30	180	257	0.7	210	381	0.55
+30	220	314	0.7	250	454	0.55
+60	180	257	0.7	240	400	0.6
+60	220	314	0.7	280	466	0.6
+90	180	257	0.7	270	415	0.65
+90	220	314	0.7	310	476	0.65
+120	180	257	0.7	300	428	0.7
+120	220	314	0.7	340	485	0.7

Note. Prop = proportion. The two unique starting combinations (per version of the task) are provided in bold.

Therefore, ultimately, for each version of the task, we generated a series of unique combinations of "fixed" and "comparison" stimuli characterised by distinct line lengths, frame heights and proportions (see Table 4.2 for all combinations). For easy readability, Tables 4.1 and 4.2 reports length and height in millimetres (mm), but these values were converted into screen pixels (px) and mapped onto pixels per mm based on the screen resolution (pixels per mm = 2.8346). Lastly, both the absolute and relative versions of the FLT were implemented using custom codes on MATLAB (MathWorks, version R2022b).

4.2.2.3. Questionnaires

Holistic-analytical thinking styles. We administered the self-report Analysis-Holism Scale (AHS; Choi et al., 2007) to assess the extent to which participants in our study adopted a holistic or analytical pattern of thinking. This 24-item questionnaire assessed four main characteristics associated with thinking styles: 1) causality, 2) locus of attention, 3) attitude towards contradiction, and 4) perception of change. There were six items allocated to each characteristic and response options included a 7-point Likert-type scale (1 = “Strongly disagree” and 7 = “Strongly Agree”). Items 11, 13, 14, 15, 16 and 18 were scored in reverse. Mean scores can range between 1 and 7, with higher scores indicating more holistic tendencies and lower scores indicating more analytical thinking (Masuda et al., 2022; Lechuga et al., 2012). Furthermore, Choi et al. (2007) reports on the convergent validity as the AHS was positively correlated with three other scales that have measures thinking styles in the past, namely: the Attributional Complexity Scale (ACS; Fletcher et al., 1986; $r = .22$, p $< .01$), the Sternberg-Wagner Self-Assessment Inventory on the Global Style (SWSAI; as cited in Choi et al., 2007; $r = .34$, p $< .01$) and the Rahim-Organisational Conflict Inventory II (ROCI-II; Rahim, 1983; $r = .28$, $p < .01$). Additionally, Choi et al. (2007) noted that there were no significant correlations between the overall score of the AHS and the two scales assessing cultural orientation (Individualism and Collectivism Scale; INDCOL; $r = .09$) and self-view (Self-Construal scale; SCS; $r = .09$). In terms of discriminant validity, the authors noted that this absence of correlations indicated that constructs measured within the AHS remained separate and unique from those examined in the INDCOL and SCS.

Self-construals. Participants completed the Self-Construal Scale (Singelis, 1994) which allowed us to assess the extent to which individuals view themselves in reference to others (i.e., interdependent) or themselves (i.e., independent). The 30-item questionnaire evaluated these two types of self-construals using two subscales (each containing 15 statements). Participants were given a 7-point Likert type rating scale (1 = “Strongly disagree” and 7 = “Strongly Agree”). Per individual, scores were separately calculated for each subscale, higher values indicated either a more independent or interdependent self-construal (Kafetsios & Hess, 2013; Kraus & Kitayama, 2019). Past research highlights that the SCS had an internal consistency of .59 for the interdependent subscale and .60 for the independent subscale (Kim et al., 1994).

4.2.3. Procedure

4.2.3.1. Emotional classification task

In this task, participants classified facial expressions when they were presented either alone or accompanied by a body gesture (i.e., signalling anger or disgust). For each intensity (−50, −40, −30, −20, −10, 0, +10, +20, +30, +40, +50), we presented 10 trials, each time with a unique facial identity, resulting in 110 trials per context (i.e., angry body, disgusted body, and no context). This resulted in a total of 330 trials (3 contexts × 11 emotional intensities × 10 trials). Participants classified the facial expression as either angry or disgusted using key presses ('z' for anger, 'm' for disgust). For more specific details, refer to Section 3.2.4.1 in Chapter 3.

4.2.3.2. FLT

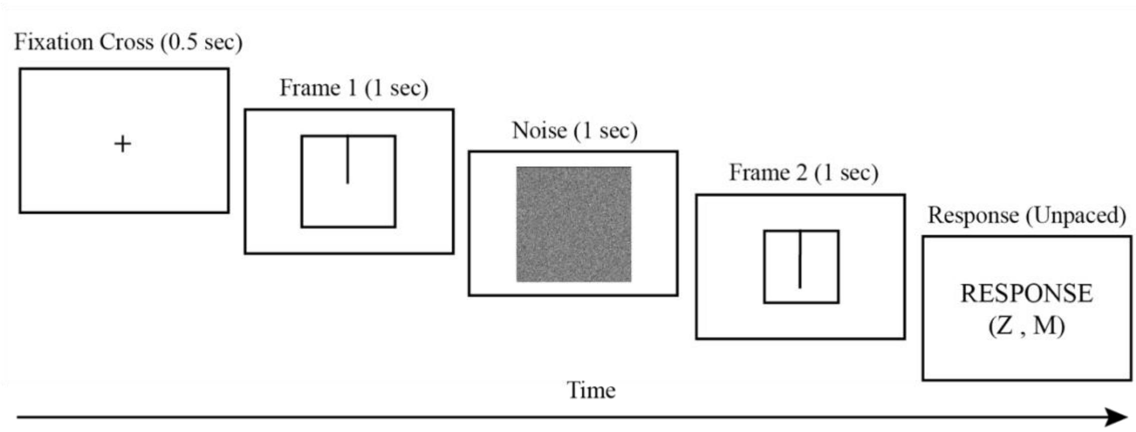
In both versions of our modified FLT (i.e., relative and absolute), each trial began with a fixation cross (0.5s), followed by the presentation of two stimuli (1 sec per stimulus) sequentially (see Figure 4.1). Between each of the two stimuli, a noise stimulus (1 s) was presented with a uniform distribution of grey values between black and white (Figure 4.1). The size of the noise stimulus (width × height) was created so that it matched the frame with the largest dimensions across both the absolute and relative tasks.

In the absolute version, participants were instructed to compare the lengths of the lines in the two stimuli. Accordingly, they indicated which of the two stimuli had a longer line. Conversely, in the relative version, participants were instructed to compare the proportion (i.e., ratio) of the line's length to the frame's height and indicate which stimulus had a higher proportion. A higher proportion indicated that the vertical line length occupied a greater percentage of the frame's height. In both versions, participants made their choices via keypresses, by pressing "Z" to select the first stimulus within a trial, and "M" to select the second stimulus.

For both versions of the task, there were several unique combinations of fixed and comparison stimuli (see Materials and Apparatus above). Each unique combination of fixed and comparison stimuli was presented 10 times, resulting in a total of 90 trials per version (2 unique combinations for fixed items × 9 comparison combinations × 5 trials). Lastly, the two versions of the task were presented in different blocks and the order of these blocks was randomised for each participant.

Figure 4.1

Timeline of a trial in the modified FLT



Note. Z = Stimulus 1 and M = Stimulus 2.

4.2.3.3. Questionnaires

The questionnaires were administered through the online platform Pavlovia (Open Science Tools, Nottingham, UK) and were administered after the emotion classification task and the FLT. The instructions associated with each questionnaire were also provided on Pavlovia.

4.3. Results

4.3.1. Emotion classification between nominally distinct cultures

First, for both cultures, we assessed classification of facial expressions in the three contexts (i.e., angry body gesture, disgusted body gesture, and no context). For each expression intensity, we calculated the proportion of "angry" responses separately for each context condition. These proportions were also separated by culture (see Table 4.3). Next, we conducted a series of independent-samples t-tests to compare the proportions of angry responses between the Asian and Western cohort for the no context condition. Given that the stimuli presented were of Caucasian origins (i.e., Western), past research attests to how individuals tend to be more accurate when judging expressions from their own culture (Li & Han, 2019; Michel et al., 2004). Therefore, it was important to establish whether Westerners and Asians exhibited divergent patterns of classification. At all emotional intensities, except for +10, +20 and +30, both cultural groups demonstrated similar classification rates (see Table 4.4 for statistics). Notably, at these subtle intensities where expressions signalled "disgust", Western participants were more accurate at classifying the emotion. In other words, the mean proportion of angry responses was lower among Western participants than among Asians (see Table 4.3).

Table 4.3

Means and standard deviations for proportion of "angry" responses for the three contexts in both cultural groups

Expression intensity	No context condition		Angry body gesture		Disgust body gesture	
	Asian	Western	Asian	Western	Asian	Western
−50	.737	.788	.819	.921	.547	.449
	(.177)	(.161)	(.215)	(.094)	(.206)	(.299)
−40	.740	.784	.842	.926	.528	.423
	(.158)	(.166)	(.179)	(.109)	(.232)	(.279)
−30	.723	.767	.844	.891	.495	.421
	(.191)	(.184)	(.203)	(.129)	(.225)	(.292)
−20	.691	.649	.847	.872	.565	.349
	(.196)	(.215)	(.149)	(.128)	(.252)	(.273)
−10	.653	.570	.795	.781	.523	.295
	(.281)	(.240)	(.214)	(.245)	(.267)	(.282)
0	.612	.521	.800	.798	.512	.267
	(.282)	(.261)	(.209)	(.242)	(.286)	(.258)
+10	.605	.488	.772	.778	.474	.251
	(.263)	(.223)	(.229)	(.221)	(.256)	(.234)
+20	.453	.309	.658	.744	.321	.177
	(.196)	(.194)	(.214)	(.251)	(.198)	(.152)
+30	.347	.249	.595	.712	.228	.153
	(.196)	(.165)	(.263)	(.270)	(.171)	(.165)
+40	.251	.186	.505	.586	.202	.095
	(.189)	(.196)	(.298)	(.350)	(.167)	(.113)
+50	.221	.149	.505	.558	.147	.086
	(.222)	(.150)	(.315)	(.306)	(.152)	(.125)

Note. Mean reported and standard deviations given in parentheses. The morphing sequence unfolds from intense anger (−50) to intense disgust (+50) through neutral (0).

Table 4.4

Results from independent-samples t-tests for the no-context condition between Asian and Western participants

Expression Intensity	*t* statistic	*p* value	Cohen's *d*
−50	−1.40	.165	−0.302
−40	−1.27	.209	−0.273
−30	−1.09	.277	−0.236
−20	0.94	.349	0.203
−10	1.49	.141	0.320
0	1.55	.125	0.334
+10	2.21	.030*	0.477
+20	3.43	< .001*	0.741
+30	2.50	.014*	0.539
+40	1.57	.121	0.338
+50	1.76	.081	0.380

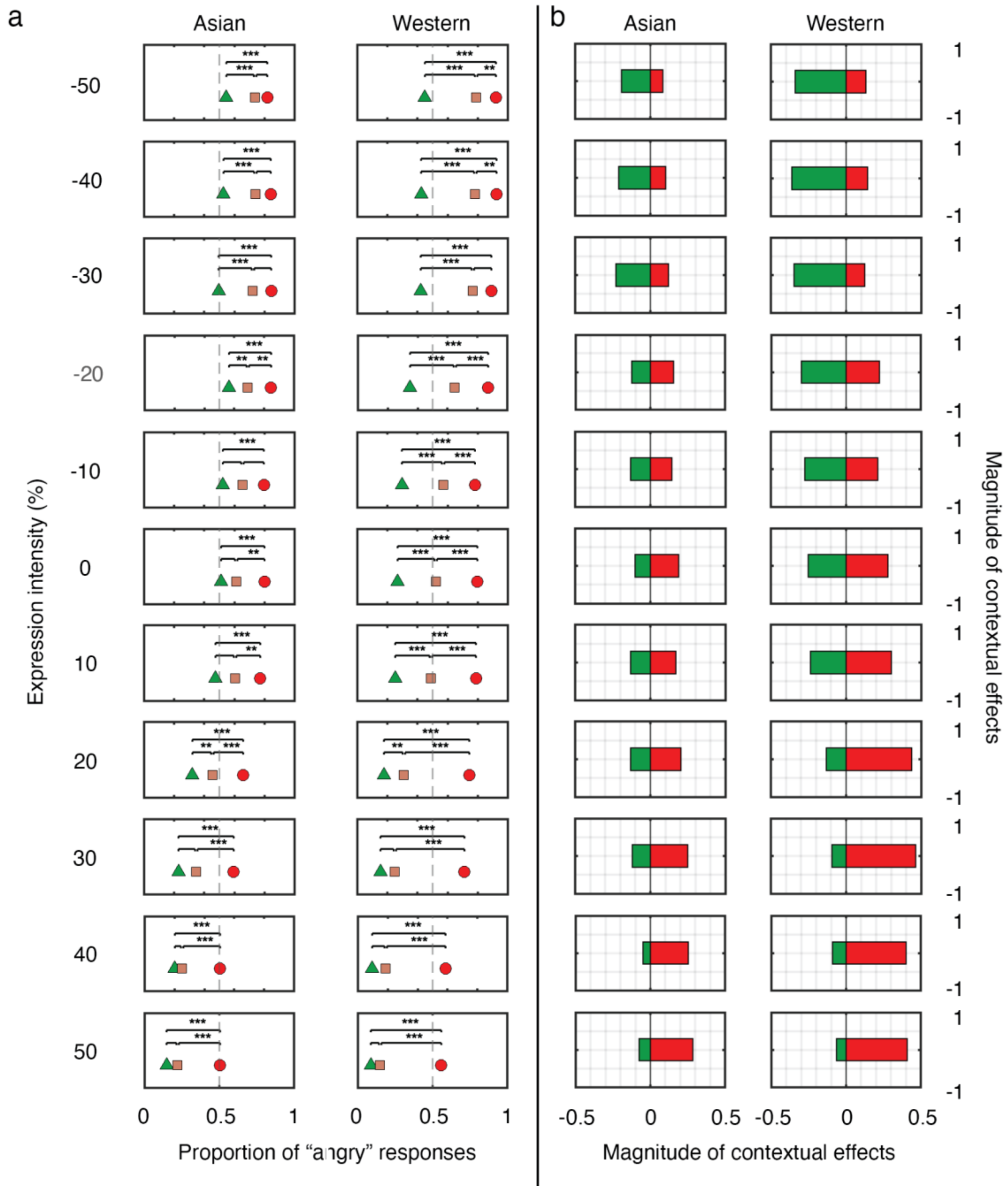
Note. * denotes $p < .05$. The morphing sequence unfolds from intense anger (-50) to intense disgust (+50) through neutral (0). Positive t values and Cohen's d values represent intensity conditions in which Asian participants gave more anger responses than Western participants.

Next, we confirmed whether contextual effects were present in each cultural group, separately. Therefore, for each culture, we conducted a one-way ANOVA per intensity, comparing the proportion of angry responses between the three context conditions (i.e., no-context, angry body gesture, and disgust body gesture).

Contextual effects in Asian participants: All ANOVAs revealed significant main effects of condition (all $p < .001$; effect sizes ranged between Cohen's $d = 0.162$ and Cohen's $d = 0.345$). Furthermore, to identify the direction of effects, Bonferroni-corrected two-tailed paired-samples t-tests were conducted to compare three pairs of conditions within each intensity (i.e., angry-no context, angry-disgust context, and disgust-no context conditions), with an adjusted significance criterion of $\alpha = \frac{0.05}{3} = 0.016$. At all intensities, with the exception of -50, -40, -30 and -10 where anger was signaled, the mean proportion of angry classifications were significantly higher in the angry context condition compared to the no-context condition (all p values < 0.007, Cohen's d values ranging from 0.671 to 1.185), as illustrated in Figure 4.2, Panel a (left column). Next, only at intensities of -50, -40, -30 and +20, we observed significantly lower proportions of angry classifications in the disgust context condition compared to the no-context condition (all p values < 0.009, Cohen's d values ranging from -1.103 to -0.654), as seen in Figure 4.2 (Panel a, left column). Lastly, at all intensities, mean proportion of "angry" classifications were significantly higher in the angry context than the disgust context condition (all p values < 0.001, Cohen's d values ranging from 0.168 to 1.723). Detailed statistics on the ANOVAs conducted are reported in Appendix I (Table I1).

Figure 4.2

Contextual effects in Asian and Western participants



Note. Contextual effects in the two cultural groups. Panel a: Mean proportions of "angry" responses across all participants for each condition; angry body (red circles), no-context (yellow squares) and disgusted body (green triangles). Horizontal lines indicate post-hoc paired samples t-tests conducted, *** = $p < .001$. Panel b: Magnitude of contextual effects from angry and disgust contexts in the two cultural groups. Mean of disgust shifts (green bar) and angry shifts (red bar) at each expression intensity

Contextual effects in Western participants: Similar to the Asian cohort, here all one-way ANOVAs revealed significant main effects for context condition (all $p < 0.001$; effect sizes ranged between 0.382 and 0.593). Moreover, Bonferroni-corrected paired-samples t-tests were conducted for this set of analyses as well, to establish the direction of effects (adjusted significance criterion $\alpha = \frac{0.05}{3} = 0.016$). At all intensities, with the exception of -30, the mean proportions of angry classifications were higher in the angry context condition compared to the no-context condition (all p values < 0.009, Cohen's d values ranging from 0.652 to 2.244); this is illustrated in Figure 4.2 (Panel a, right column). Additionally, except for those intensities where disgust was signaled (i.e., +40, +30, +20, +10), the mean proportion of angry responses were significantly lower in the disgust context condition than in the no-context condition at all remaining intensities (Figure 4.2, Panel a, right column), all p values < 0.009 and Cohen's d values ranging from -1.821 to -0.653. Lastly, angry body contexts elicited significantly higher angry classifications than the disgust body context at all intensities (all p values < 0.001, Cohen's d values ranging from 1.897 to 2.793). Overall, it appears that an angry body led to more angry classifications but a disgusted body elicited less angry classifications. Detailed statistics on the ANOVAs examining contextual effects have been reported in Appendix I (Table I2).

Magnitude of contextual effects in both cultures. Next, we calculated the magnitude of contextual effects arising from angry and disgust body gestures, similar to what we did in Chapter 3 (see Section 3.3.2.2 for more details). Influence of angry body gestures were defined as "angry shifts", where positive values represented larger effects. Influence from disgust body gestures were labelled as "disgust shifts", with more negative values representing greater effects. Figure 4.2 (Panel b) shows the magnitude of contextual effects experienced by each cultural group separately, per intensity.

We compared group-level influences on how the magnitude of contextual influence differed between the two cultures, by conducting a series of independent-samples t-tests, separately, for the mean angry and mean disgust shifts. For angry shifts, the summary of the analyses are reported in Table 4.5. It can be seen that we only observed significant cultural differences for morphs at the extreme ends that signalled disgust (i.e., from +10 to +50) when they were paired with angry body gestures (see Figure 4.3, Panel a). Contrary to what we predicted, we observed that Western participants were more susceptible to the influence from an angry body (i.e., larger positive shifts) in comparison to the Asian cohort (Figure 4.3, Panel a).

Similarly, for disgust shifts (see Table 4.6 for statistics), a comparable pattern can be seen, whereby significant differences between cultures emerged only when angry morphs (i.e., from −50 to −10) were paired with disgusted body gestures (see Figure 4.3, Panel b). Moreover, even with a disgust context, Western participants experienced larger contextual effects. Additionally, for intensities that were more subtle (e.g., +10) or neutral (i.e., 0), Western participants continued to be more influenced by the context than the Asian participants (Figure 4.3, Panels a and b).

Table 4.5

Results from independent-samples t-tests for angry body gestures

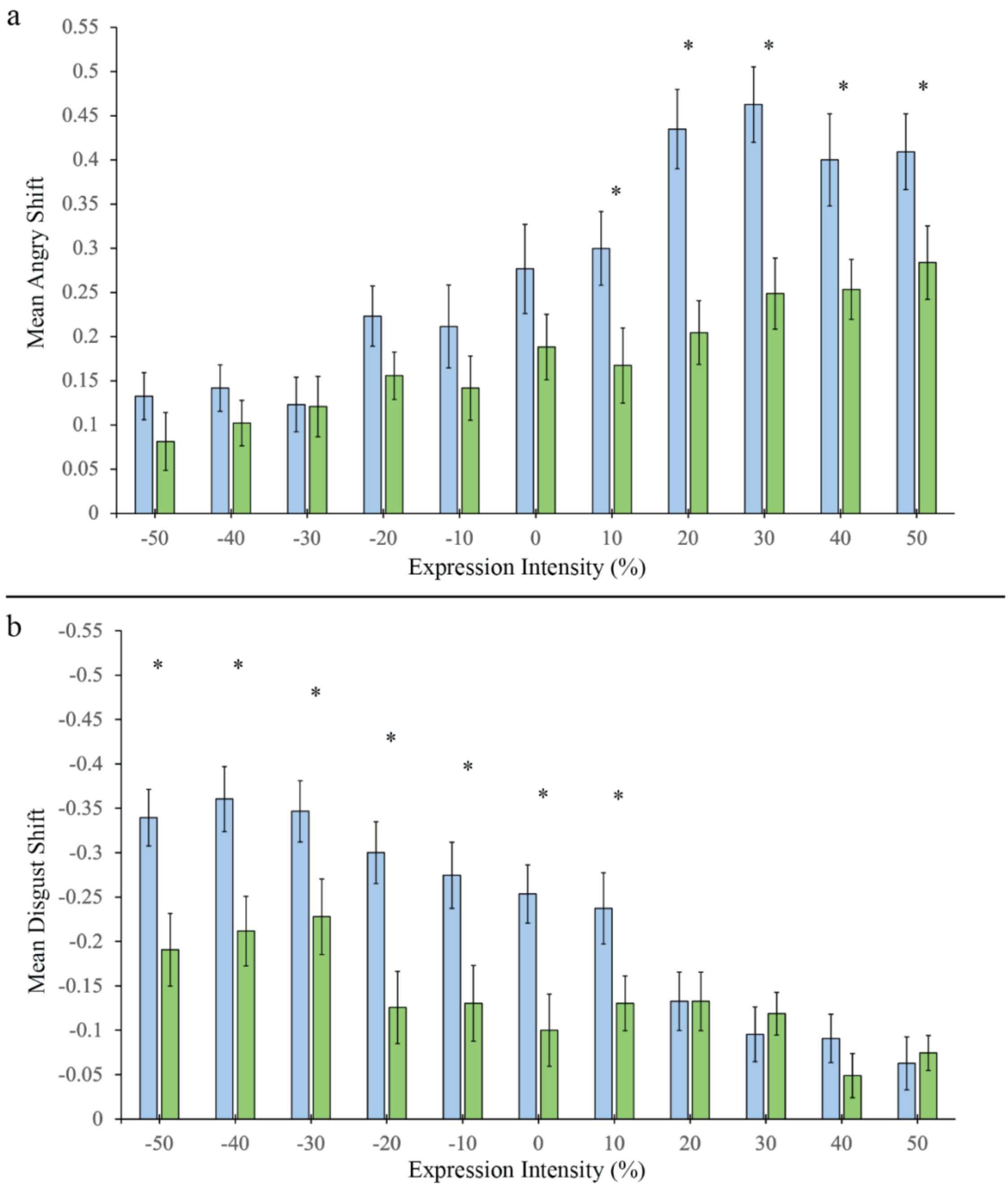
Expression intensity	*t* statistic	*p* value	Cohen's *d*	*M* (*SD*)	
				Asian	Western

−50	−1.20	.235	−0.258	.081 (.217)	.133 (.177)
−40	−1.06	.292	−0.229	.102 (.171)	.142 (.175)
−30	−0.05	.960	−0.011	.121 (.226)	.123 (.205)
−20	−1.54	.128	−0.331	.156 (.178)	.223 (.227)
−10	−1.16	.248	−0.251	.142 (.241)	.212 (.311)
0	−1.40	.166	−0.301	.188 (.245)	.277 (.335)
+10	−2.20	.031*	−0.475	.167 (.282)	.300 (.277)
+20	−3.96	< .001*	−0.855	.205 (.239)	.435 (.297)
+30	−3.60	< .001*	−0.777	.249 (.268)	.463 (.283)
+40	−2.33	.022*	−0.502	.253 (.225)	.400 (.346)
+50	−2.08	.041*	−0.448	.284 (.276)	.409 (.284)

Note. * denotes $p < .05$. Means (M) and standard deviations (SD) refer to angry shifts calculated per intensity. The morphing sequence unfolds from an expression intensity of intense anger (i.e., −50) towards intense disgust (i.e., +50) through neutral (i.e., 0).

Figure 4.3

Comparison of angry and disgust shifts between Western and Asian populations



Note. Blue bars = Western population, Green bars = Asian population. * denotes $p < .05$. Panel A = the comparisons for mean angry shifts (i.e., influence from an angry body gesture) between Western and Asian populations. Panel b shows comparisons for mean disgust shifts (i.e., influence from a disgusted body gesture) between the two populations. Errors bars denote standard error of the mean.

Table 4.6

Results from independent-samples t-tests for disgust body gestures

Expression Intensity	*t* statistic	*p* value	Cohen's *d*	*M* (*SD*)	
				Asian	Western
−50	2.84	.006*	0.613	−.191 (.211)	−.340 (.271)
−40	2.75	.009*	0.592	−.212 (.243)	−.360 (.259)
−30	2.14	.035*	0.461	−.228 (.229)	−.347 (.282)
−20	3.22	.002*	0.694	−.126 (.231)	−.300 (.270)
−10	2.52	.014*	0.543	−.130 (.247)	−.274 (.283)
0	2.90	.005*	0.626	−.100 (.218)	−.253 (.269)
+10	2.09	.040*	0.451	−.130 (.266)	−.237 (.205)
+20	0.00	1.000	0.000	−.133 (.218)	−.133 (.219)
+30	−0.56	.558	-0.127	−.119 (.205)	−.095 (.159)
+40	1.12	.266	0.242	−.049 (.180)	−.091 (.166)
+50	−0.32	.749	-0.074	−.074 (.198)	−.063 (.131)

Note. * denotes $p < .05$. Means and standard deviations refers to disgust shifts calculated per intensity. The morphing sequence unfolds from an expression intensity of intense anger (i.e., − 50) towards intense disgust (i.e., +50) through neutral (i.e., 0)

4.3.2. Thinking Styles and Self-Construals

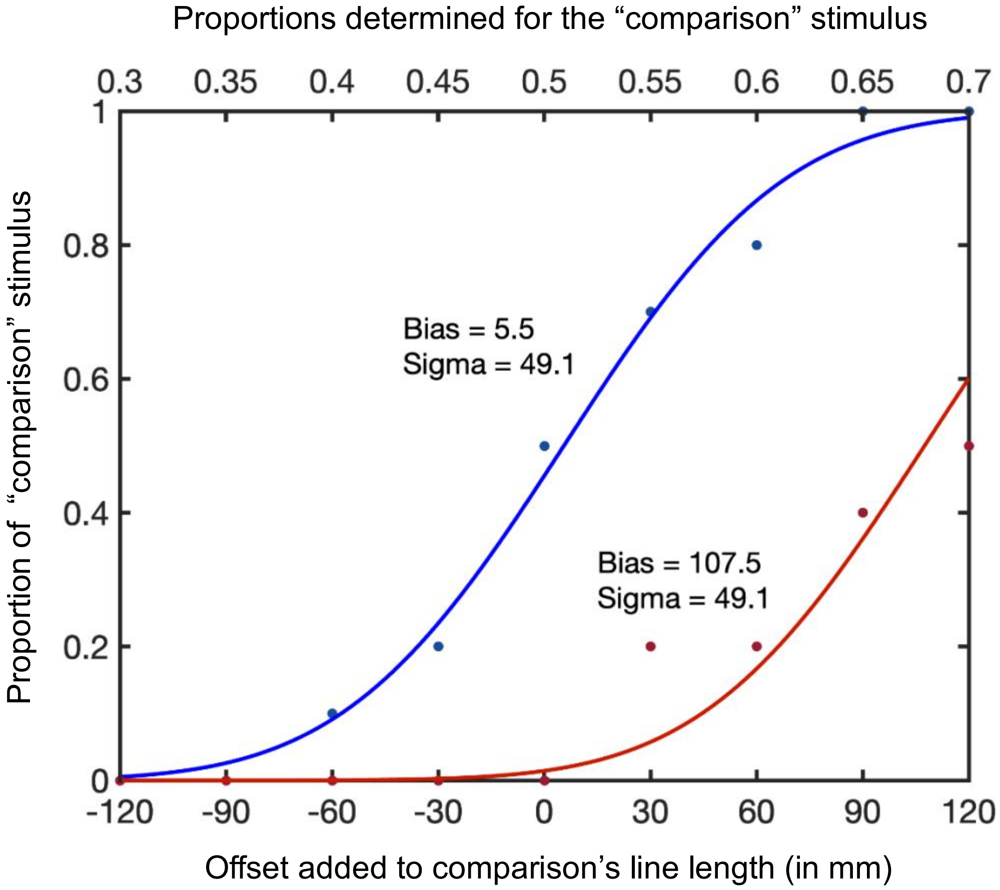
4.3.2.1. Modified FLT

Absolute version. First, we plotted the proportion of times (out of 10 trials) the comparison stimulus was chosen (x-axis), as a function of the offsets added to the line lengths. The proportion of choosing the comparison would increase when participants perceive the comparison line length to be longer than the fixed line length. Subsequently, a cumulative Gaussian function was fitted to this data in Matlab, using the psignifit toolbox (version 2.5.6; see bootstrap-software.org/psignifit/; Wichmann & Hill, 2001). The lower and upper asymptotes of the function were fixed at “0”, and we obtained maximum likelihood estimates of the Point of Subjective Equality (PSE) and the width of the function (sigma; σ).

The PSE represents the offset at which the comparison’s line was perceived to be of equal length to the fixed stimulus’ line length. If participants do not experience any form of bias, the PSE would be at an offset of zero or close to zero if there is noise in the responses. According to the combinations generated (see Table 4.2), the comparison line length systematically increases by adding offsets from −120 to +120. Therefore, the proportion of choosing the comparison should also ideally increase (see blue curve in Figure 4.4). However, we assumed that if there is interference from the context (i.e., the frame) in this absolute version of the task, participants would be more likely to view the line as a component of the frame, and hence, evaluate proportions rather than line lengths. If this happens, their tendency to choose the comparison stimulus in the absolute version would drop. This is because, the fixed and comparison stimulus combinations generated for the absolute version ensured that the fixed proportion always remained greater than the comparison proportion across all combinations, except for the combination where a +120 offset was added to the comparison’s line, which made the proportions of the fixed and comparison stimuli identical. A reduced tendency to choose the comparison would then shift the psychometric function to the right (see red curve in Figure 4.4). As a result, estimates of PSE will take positive values (rather than zero), whereby larger positive values would represent greater interference from context (i.e., frame) in the absolute version. Lastly, estimates of sigma represented participants' ability to discriminate between line lengths and larger sigma values indicated poorer ability.

Figure 4.4

Examples of the psychometric functions with and without interference



Note. Blue curve represents a function where responses were made in the absence of interference from the context. Red curve illustrates a function where judgements were affected by interference from the context.

Relative Task. Once again, we plotted the proportion of times (out of 10 trials) the comparison stimulus was chosen, as a function of the offset added to the comparison's line to determine its length. Similar to the absolute version, we fitted a psychometric function to obtain estimates of PSE and sigma. Here, the PSE represented how much perceiving absolute lengths interfered when estimating proportions between the line and the frame. If there is no interference, the PSE would be at (or close to zero).

Therefore, consistent with the combinations generated (see Table 4.2), the comparison proportion systematically increased from 0.3 to 0.7, in intervals of 0.05 (see Figure 4.4, top x-axis). Accordingly, in the absence of interference, participants' propensity to choose the comparison should ideally increase with increasing comparison proportion (see blue curve in Figure 4.4). In contrast, we expected possible interference in the relative version of the task, if participants made judgements regarding proportions by considering the absolute line lengths. Under these circumstances, their tendency to choose the comparison stimulus would attenuate. This is because, the fixed and comparison combinations generated for the relative version ensured that the fixed line length would always be greater than the comparison line length, except at an offset of +120 where both the fixed and comparison stimuli had identical line lengths (see Table 4.2). Accordingly, when participants' tendency to pick the comparison frame reduces, a rightward shift in the psychometric can be observed (see red curve in Figure 4.4). This would result in positive estimates of PSE (rather than zero), whereby larger positive values represented greater interference from absolute line lengths in the relative version. Lastly, larger estimates of σ represented pronounced difficulty discriminating between different proportions in stimuli.

PSE and culture. To evaluate whether interference effects differed between our Western and Asian cohorts, we subjected the estimates of PSE to a 2 × 2 mixed analysis of variance (ANOVA). Here, the within-subjects factor was the version of the task (i.e., absolute and relative versions), whilst the between-subjects factor was the culture of the participants (UK or Malaysia). Only the main effect of version was significant ($F(1,84) = 82.00$, $p < .001$,

η_p^2 = .270) whereby overall interference was greater in the absolute version (*M* = 47.90, *SD* = 29.56) than the relative version (*M* = 16.90, *SD* = 20.97). No statistically significant results were obtained for the main effect of culture (Asian: *M* = 32.81, *SD* = 33.43; Western: *M* = 32.00, *SD* = 25.70), ($F(1,84) = 0.03$, $p = .854$, $\eta_p^2 = 0.001$) or the interaction between version and culture ($F(1,84) = 0.02$, $p = 0.897$, $\eta_p^2 = 0.000$).

Task difficulty (sigma) and culture. We conducted a separate 2 × 2 mixed ANOVA to assess whether difficulty differed between the two cultures and task versions. The within and between subjects factors remained identical to the analyses conducted above. We failed to observe a main effect of versions ($F(1,84) = 1.26$, $p = .265$, $\eta_p^2 = 0.003$), but we did observe a main effect of culture ($F(1,84) = 4.09$, $p = 0.046$, $\eta_p^2 = 0.036$). Irrespective of the task, Asians in general exhibited less difficulty (*M* = 163.31, *SD* = 61.03), compared to the Western cohort (*M* = 193.81, *SD* = 93.40). Furthermore, it seems that culture may not modulate task difficulty in either the relative or absolute versions of the FLT, given that the interaction effect of version × culture was non-significant ($F(1,84) = 1.55$, $p = 0.217$, $\eta_p^2 = 0.004$).

4.3.2.2. Questionnaires: Thinking Styles and Self-construals

First, we examined whether the scores from our self-report measures, namely, the AHS (Choi et al., 2007) and the SCS (Singelis, 1994) differentiated between the two nominally distinct cultural groups. Therefore, we conducted a series of independent-samples t-tests on the mean AHS total scores and the mean scores from the two SCS subscales (i.e., independent and interdependent).

In contrast to previous research, we did not observe any differences in their thinking styles as quantified by the total AHS scores ($t(84) = 0.90$, $p = 0.382$, Cohen's $d = 0.195$).

Across both Western and Eastern cultures, participants' thinking patterns appear to be learning towards collectivist tendencies (based on the mean total AHS scores; see Table 4.7), when compared to the values from prior research (Brauch & Größler, 2022; Kehmani, 2022).

Similarly, we did not observe any differences between the two cultures for the independent ($t(84) = 1.15$, $p = 0.252$, Cohen's $d = 0.249$) and interdependent ($t(84) = 1.11$, $p = 0.271$, Cohen's $d = 0.195$) subscales of the SCS (Singelis, 1994). The mean values reported in Table 4.7 highlight how across both cultures, individuals exhibited both independent and interdependent self-construals, without one construal explicitly dominating.

Table 4.7

Means and standard deviations for the AHS total score and subscale scores and the SCS subscale scores

Culture	Analysis-Holism Scale					Self-Construal Scale	
	Total	CAU	CON	CHA	ATT	IND	INT
Asian	4.82	5.36	4.77	4.30	4.83	4.68	4.78
	(0.42)	(0.87)	(0.94)	(0.63)	(0.73)	(0.62)	(0.72)
Western	4.73	5.24	4.69	4.35	4.65	4.51	4.60
	(0.42)	(0.79)	(1.04)	(0.60)	(0.90)	(0.78)	(0.79)

Note. The mean values are provided with standard deviations in parentheses. The abbreviations denotes the subscales for each scale. Analysis-Holism subscales: CAU = Causality, CON = Contradiction, CHA = Change and ATT = Attention. Self-construal subscales: IND = Independent and INT = Interdependent.

4.3.3. Individual differences and contextual effects

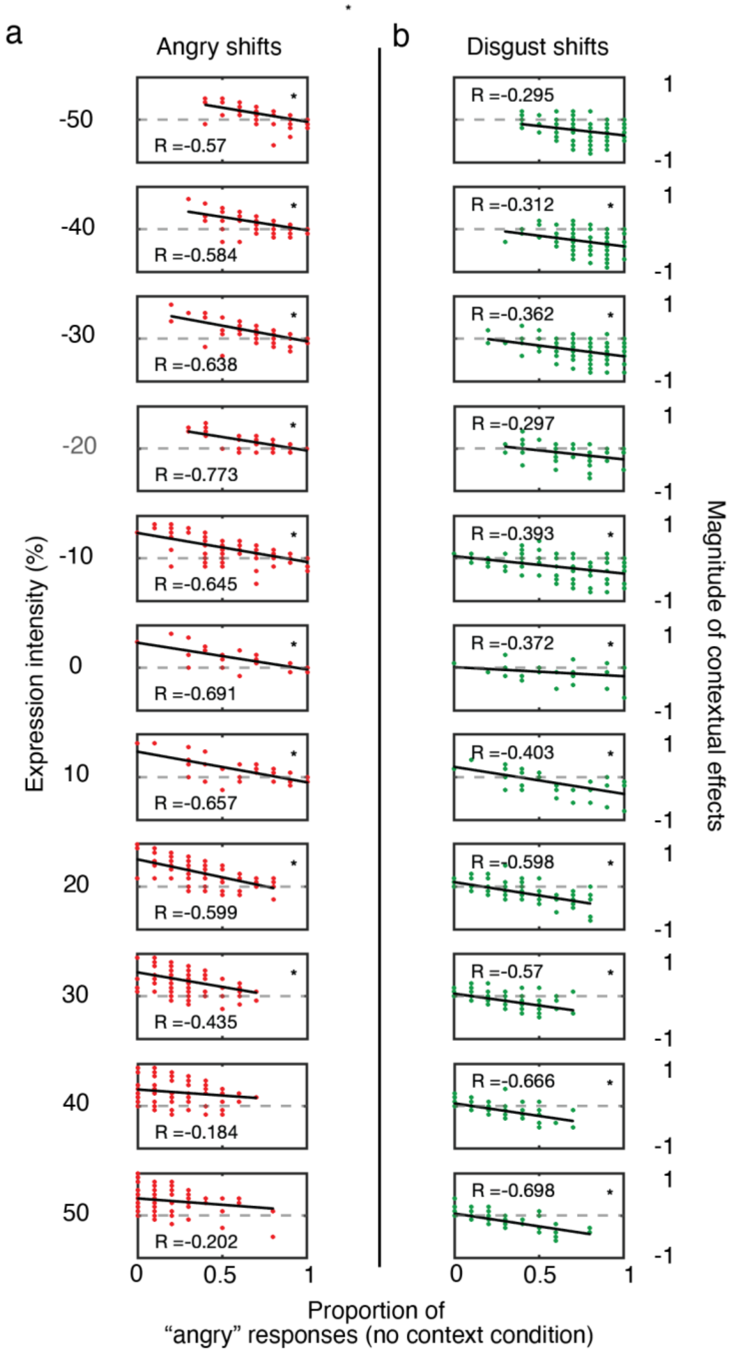
The different tasks and questionnaires allowed us to measure different types of individual differences, which may have influenced the participants' experience of contextual effects. The individual difference measures included: 1) Proportion of "angry" responses in the no-context condition of the emotion classification task; 2) PSEs estimated from the absolute and relative versions of the FLT; 3) estimates of sigma from the absolute and relative versions of the FLT; 4) Total AHS scores; and 5) SCS scores (interdependent and independent subscales). By assessing these different relationships, we aimed to establish if any one of these individual differences would contribute to the magnitude of contextual influence experienced by our participants. For these correlations, we combined the data from both Western and Asian participants ($N = 86$), so that we would capture individual differences across a wide spectrum. Accordingly, we conducted a series of Bonferroni-corrected Pearson's product moment correlations (adjusted significance criterion $\alpha = \frac{0.05}{12} = 0.004$)

First, we investigated whether participants' ability to classify isolated expressions (i.e., no-context) would modulate the strength of contextual influence from body gestures. Therefore, for each intensity, we correlated the proportion of "angry" responses from the no-context condition with angry and disgust shifts, separately. At all intensities (except +40 and +50), we observed that the proportion of "angry" responses were negatively correlated with angry shifts (all $p < 0.001$; r ranged from -0.773 to -0.435; see Figure 4.5, Panel a). It appears that when the face alone was judged more often as "disgusted" (i.e., fewer "angry" classifications), larger angry shifts were observed. Conversely, when the face was judged more often as "angry", the strength of contextual effects attenuated. Similarly, we observed significant negative correlations at all intensities (except -50 and -20) between proportion of angry responses (no-context) and disgust shifts (all $p < 0.004$; r values ranged from

-0.698 to -0.312; see Figure 4.5, Panel b). When participants judged the face alone more often as angry (i.e., higher classifications of “angry”), larger disgust shifts were observed. However, when the face alone was classified more often as disgusted (i.e., fewer “angry” classifications), the magnitude of influence from a disgust body reduced. Detailed statistics related to the correlations above are reported in Appendix J (Table J1).

Figure 4.5

Correlations between angry proportions (no-context) and angry / disgust shifts



Note. Panel a: Correlations between proportion of "angry" responses in the no-context condition and angry shifts. Single asterisk (*) denotes $p < .001$. Panel b: Correlations between proportion of "angry" responses in the no-context condition and disgust shifts. Single asterisk (*) denotes $p < .004$.

Next, analytical and holistic thinking styles were assessed using both the self-report AHS scores (Choi et al., 2007) and PSEs obtained from the FLT. Additionally, estimates of sigma related to task difficulty were included as a variable in the correlations.

Prior to conducting our analyses, we quantified the extent to which interference differed between the absolute and relative versions of the task by calculating the "degree of interference". Accordingly, we obtained a difference between PSE from the absolute task and PSE from the relative task (i.e., PSE absolute version – PSE relative version). Positive values represented greater interference (from proportions) in the absolute version, whereas negative values denoted more interference (from absolute lengths) in the relative version. Subsequently, we correlated Total AHS scores, SCS scores (i.e., independent / interdependent subscales), values for the degree of interference, and estimates of sigma from the FLT with angry and disgust shifts separately. However, no significant relationships at $\alpha < 0.004$ were observed for any given expression (see Tables J2-J12 in Appendix J for full statistics).

4.4. Discussion

In this chapter, we examined whether two nominally distinct cultures (Westerners and Asians) differed in their experience of contextual effects, self-construals, and thinking styles. We also measured the relationships between individual differences in self-construals and thinking styles and the magnitude of contextual effects experienced. We will address these questions while discussing our results in the order in which analyses were conducted in the results section.

4.4.1. Culture and classification of isolated expressions (without a context)

For isolated expressions, Westerners (compared to Asians) classified “disgust” expressions more accurately at subtle intensities (i.e., + 10, +20 and +30), whereas both cultures exhibited comparable classifications for all other emotional intensities. First, our finding suggests that highly conspicuous emotional signals (e.g., anger at −50 / −40 or disgust at +50 / +40) are easily recognized, regardless of cultural background. Second, cultural differences emerge at more subtle intensities, possibly owing to heightened sensitivity towards expressions of one’s own race (i.e., facial expressions presented were of Caucasian identities). In fact, research suggests that individuals are better able to detect lower-intensity emotional expressions on faces from their own race compared to those from other races (Li & Han, 2019). Therefore, we believe this race advantage to be the case in our study too, at least with subtle expressions of disgust, which were more frequently classified as anger by Asian participants.

Nevertheless, with angry expressions (at subtle intensities; e.g., −30 to −10), we did not see a significant race advantage during classification. The absence of a race advantage may be attributed to the unique nature of “anger” as a threat-related cue. Based on the evolutionary perspectives on emotion classification, humans have developed heightened sensitivity to anger due to its survival significance—and possibly other negative emotions as well, enabling faster and more accurate detection compared to positive emotions (LoBue, 2009; Matsumoto et al., 2010; Pinkham et al., 2010).

In relation to our findings, we suspect that two distinct mechanisms may have contributed to Western and Asian participants having comparable rates of classification for angry morphs, regardless of emotional intensity. First, Asian participants may have been influenced by the other-race effect (ORE), where anger detection is heightened when the expresser's racial identity differs from the perceiver's, hence the expresser is perceived as a more threatening out-group member (Ackerman et al., 2006; Krumhuber & Manstead, 2011). Accordingly, for our Asian participants, the influence of this ORE could have plausibly led to facilitation when classifying angry expressions. Second, Western participants likely experienced an own-race advantage (i.e., also facilitation in anger recognition) due to their familiarity with Caucasian facial features (as discussed above). Collectively, these two effects working in opposite directions may have led to comparable levels of classification between the two cultural groups.

Taken together, our cross-cultural comparisons highlights that although some emotions, like anger, may be more universally recognized across intensities, other emotions, such as disgust, exhibit greater variability across cultures. In fact, cultural factors, such as internal representations for a given emotion (Jack et al., 2012) or even the way certain emotions like anger and disgust are expressed can vary between cultures (Fang et al., 2022), this idea will be developed further in the following section.

4.4.2. Contextual effects between two nominally distinct cultures

One aspect of our primary aim was to establish differences in the experience of contextual effects between two cultures. When we compared the magnitudes of contextual effects experienced between the two cultures, we did not replicate the literature. Generally, the literature attests to stronger contextual effects for Easterners than Westerners (Bjornsdottir et al., 2017; Ito et al., 2013, Study 2; Masuda et al., 2008; Stanley et al., 2013), but we did not find the same. Instead, we found that Western participants were influenced more strongly by body gestures (compared to Asian participants) when the emotion signalled by the face was incongruent with the emotion conveyed by the body gesture (e.g., +50 intense disgusted face paired with an angry body). This particular cultural difference cannot be explained by cultural differences in self-construals or thinking styles, as we did not find group-level differences between the two cultures for the measures of these constructs. We explore this lack of differences in detail below.

We quantified thinking styles using two measures, the modified frame-line task (FLT) and the analysis-holism scale (AHS). In the FLT, participants from both cultures demonstrated larger biases in the absolute task than in the relative task. Therefore, when evaluating line lengths in the absolute task, both cultures found it difficult to ignore the proportions (i.e., the influence of context). However, when evaluating proportions in the relative task, they did not find it as difficult to ignore absolute line lengths. In other words, both cultures were good at incorporating the context in the relative task. The analysis of the AHS scores give us a similar finding too. The two cultures did not differ in their AHS scores, and, in fact, the mean AHS score for both cultures were closer to the holistic end of the AHS (see Table 4.7). We also quantified self-construals using Singelis' (1994) Self-Construal Scale, but, again, we did not find any differences between the Western and Asian participants for scores in the independent or interdependent subscales. This finding is similar to a recent finding by Lee et al. (2023) who asked 56 British Caucasians and 56 Chinese Malaysians to answer both the Self-Construal Scale and the Horizontal and Vertical Individualism and Collectivism Scale (HVIC; Triandis & Gelfand, 1998) but found no meaningful differences between the two groups. Collectively, these findings lead us to one obvious possibility that the sample we recruited from both cultures had a majority of holistic thinkers that are comparable in self-construals. In fact, some of the Western participants in our sample were second-generation British Asian individuals (n = 17). Some past studies have shown that Asian Americans differ in thinking styles and/or self-construals from European or Caucasian Americans (Masuda et al., 2012).

If thinking styles and self-construals cannot explain why our Western participants experienced relatively stronger contextual effects, what other factors might explain this difference in susceptibility to contextual cues? One potential explanation is based on divergent cultural norms in “display rules” (i.e., norms that regulate the outward expression of emotions; Matsumoto et al., 1998). Previous research has shown that cultural differences exist in how emotional intensity is judged from facial expressions. Americans, from individualistic cultures, tend to give higher intensity ratings when evaluating overt emotional expressions compared to Asians (Biehl et al., 1997; Matsumoto, 1999). However, this pattern is reversed when assessing internal emotional experiences; Japanese participants rate their internal, subjective feelings more intensely than Americans when viewing the same expressions (Matsumoto et al., 1999). Emotional displays are often exaggerated to assert individuality in Western cultures, potentially leading to rating external expressions with more intensity while downplaying their internal emotional experience (Matsumoto, 1999, 2001). On the other hand, collectivist cultures, such as Japan, emphasize moderation and control of emotional displays (Hutchison & Gerstein, 2017), resulting in higher intensity ratings for internal experiences than for external expressions.

According to these "display rules", it is possible that Western participants assigned greater emotional intensity to the expressions when compared to their Asian counterparts who may have been inclined towards more muted emotional displays and, therefore, perceived the expressions with lesser intensity. As a result, Western participants are likely to experience a greater degree of conflict between the face and body gestures than Asian participants. In fact, even in this chapter, we observed that those who experience greater conflict between the face emotion and body gesture experience stronger contextual effects (Figure 4.5). Individual differences in conflict evaluations between the two cues appear to be a consistent factor contributing to variations in the contextual effects experienced by participants (also see Chapters 3 and 5).

However, although the explanation above appears plausible, it needs to be considered with caution owing to several limitations. First, while Western cultures may encourage exaggerated displays of overt emotional expressions, it is overly simplistic to suggest that these displays are routinely exaggerated to assert individuality. Second, the exaggeration or moderation of emotions may not be exclusive to Western and Asian cultures, respectively; individuals from both cultures are more likely to display emotions strategically, depending on social expectations. For instance, although collectivist cultures such as Japan are traditionally thought to place greater emphasis on emotional restraint, the British (Western) ideal of the "stiff upper lip" similarly encourages emotional restraint, particularly in public settings. Therefore, differences in emotional display norms may reflect variations in the intensity according to a given context, rather than fundamental cultural differences.

Alternatively, it may be more plausible that our findings are related to the specific characteristics of the stimuli presented, rather than solely to cultural display rules. In other words, the familiarity of Western participants with Caucasian identities may have contributed to them experiencing greater contextual effects too. Past evidence report cultural differences for a range of emotion related phenomena. For example, Jack et al. (2012) showed that Western and Eastern participants prioritised different facial features when interpreting Ekman's basic emotions. Chinese participants emphasized changes in gaze as a key component (i.e., eye region) when interpreting facial emotions. Conversely, Western participants gave priority to multiple facial features (e.g., eyebrows and eyes). Additionally, even overt displays of expressions (e.g., for anger and disgust) in terms of the action units deployed can be distinct between Asian and Western participants such as in Fang et al. (2012). Taken together, the studies above suggest that cultural factors can influence how facial expressions are internally represented and interpreted across two distinct cultural groups.

Therefore, in our study, the alignment of Caucasian stimuli with Western participants' cultural expectations (for angry / disgust expressions) possibly enhanced their perception of emotional intensity and classification accuracy, as observed in the no-context condition. Studies investigating recognition accuracies for facial expressions across groups with varying ethnicities and cultural exposure attest to validity of the above explanation. For instance, Elfenbein and Ambady (2003) demonstrated that individuals were more accurate at recognizing facial expressions displayed by members of cultural groups to which they have had greater exposure (i.e., more familiarity), regardless of their own ethnic background. Therefore, it remains plausible that when the stimuli presented aligns with cultural expectations shaped by prior exposure, this alignment could have resulted in greater experience of conflict between the face and body gesture, thus leading to stronger contextual effects in our Western participants. In contrast, the lack of alignment between Asian participants' expectations for angry / disgust expressions and the (Caucasian) target stimuli likely diminished their sensitivity and recognition accuracy (e.g., for subtle intensities; see

Section 4.3.1). Consequently, the perceived conflict between the face and body gesture would also reduce, thus leading to smaller contextual effects (compared to Westerners).

Lastly, we demonstrated that, at the group level, Western participants experienced greater contextual effects compared to Asian participants. Notably, this is one of the first instances where behavioural data show this pattern, suggesting that factors beyond those conventionally used to explain cultural differences (e.g., analytical vs holistic processing) may play a role.

4.4.3. Individual differences in thinking styles and self-construals

The lack of group-level differences between our Western and Asian participants in thinking styles and self-construals does not necessarily mean that these constructs are not related to the experience of contextual effects. Therefore, we pooled data from both cultures and analysed the relationship between the individual differences in thinking styles and self-construals and the magnitude of contextual effects experienced. However, we did not find evidence that individual differences in our two measured constructs modulated the strength of contextual effects.

Our findings appear in contrast to prior studies that attributed variations in the experience of contextual effects to an individuals' thinking styles (Bjornsdottir et al., 2017, Study 2; Ito et al., 2013; Masuda et al., 2008; Stanley et al., 2013) or self-construals (Kafetsios & Hess, 2013). However, these earlier studies often relied on broad generalizations about cultural identity (e.g., Westerners as analytical, Easterners as holistic) to explain differences in contextual effects, without incorporating qualitative comparisons. Therefore, in the current study, upon making qualitative comparisons between objective measures of contextual influence and thinking styles or self-construals, we failed to observe any significant relationships, thus calling into question the validity of conclusions drawn by past research.

In fact, broad assumptions, such as Westerners being individualistic, analytical with higher independent self-construals, and therefore must experience smaller contextual effects in visual perception remains flawed. For example, the Namibian Himba population – a highly collectivist society – exhibited a strong local bias (i.e., associated with analytical thinking) on the Navon task compared to native British participants (Davidoff et al., 2008). Thus, such a finding contradicts the expectation that collectivist ideals align with holistic thinking, typically resulting in a stronger global bias in the Navon task. Furthermore, McKone et al. (2010) also emphasized that direct links between collectivist-individualist ideals and behavioural differences in visual perception are at best, limited.

Similarly, the link between holistic-analytical thinking and self-construals also appears questionable. McKone et al. (2010) reported that, although Easterners processed visual information more holistically compared to Westerners, this difference did not correspond to differences in self-construals between the two cultural groups. Further support from Na et al. (2012) also highlights that there are no observable relationships between thinking styles and self-views. Taken together, it appears that weak associations persist between: 1) cultural orientations (i.e., individualism-collectivism) versus thinking styles and 2) thinking styles versus self-view. Hence, it is plausible that neither thinking styles nor self-view can independently or collectively modulate the experience of contextual effects. Hence, we raise the possibility that cultural differences in contextual effects previously reported may need to be explained by constructs beyond thinking styles and self-construals.

4.4.4. Limitations and future directions

A notable limitation of the current study is the ethnic composition of our Western cohort. All participants had nationalities considered Western, however, we did have a substantial number of participants who had Asian ethnic backgrounds (*n* = 17). This issue raises the possibility that their ethnic origins may have contributed to the absence of cultural differences in terms of thinking styles and self-construals. In fact, past studies report that dominant culture-specific traits can persist even in those individuals considered "second generation" (e.g., Asian British individuals with Asian parents). For instance, McKone et al. (2010, Study 2) reported that second-generation Asian Australians, despite being born and raised in a Western country, exhibited a global bias in the Navon task similar to East Asians, albeit to a lesser degree. Therefore, future research can benefit from recruiting participants belonging to single ethnic group (e.g., White, Caucasian) to determine whether culture-specific differences emerge across our two constructs of thinking styles and self-construals. That being said, cultural differences may not be observable even in two extreme populations. For example, Lee et al. (2023) did not observe meaningful differences in self-construals contributing to the variability in the self-face advantage, across Chinese Malaysians and British Caucasians. Additionally, to ensure a comprehensive analysis, future research could investigate whether our measured constructs would contribute to the influence of body gestures when classifying facial expressions that are considered easily discriminable (Chapter 1).

4.4.5. Conclusion

The current study primarily aimed to investigate whether thinking styles and self-construals influence the strength of contextual effects. Additionally, we examined how the contextual influence from body gestures differed between two cultural groups (i.e., Asians and Westerners). First, we did not find individual-level differences relating contextual effects to any of our cross-cultural measures (i.e., AHS scores, SCS scores and biases / sigma from FLT). This absence of relationships can be possibly attributed to the weak associations between our measured constructs and their ability to elicit variations in behavioural patterns where emotion classification is concerned (McKone et al., 2010; Na et al., 2010).

Nevertheless, we reported novel evidence that Western participants experienced stronger contextual effects than Asian participants, contrary to previous findings (Bjornsdottir et al., 2017; Ito et al., 2013, Study 2; Masuda et al., 2008). It is plausible that our Western participants detected the conflict between the face and body gesture to a greater extent (compared to our Asian participants), thereby leading to pronounced contextual effects in the Western cohort. This experience of varied levels of conflict in the two cultural groups may have resulted from differences in cultural display rules or the interplay of cultural identity between the perceiver and target stimuli (e.g., Western participants judging familiar Caucasian stimuli versus Asians judging unfamiliar Caucasian stimuli). In any case, beyond contextual effects, using our modified Frame-Line Task (FLT), we demonstrated that both Western and Asian participants appeared to naturally integrate and are influenced by contextual cues.

Lastly, the current work (similar to the previous chapters) add to the growing body of research assessing factors influencing the magnitude of contextual effects when interpreting facial expressions. Specifically, we show here that constructs, such as cultural orientation, thinking patterns or self-construals, do not drive contextual effects. Rather the most robust factor of individual difference influencing contextual effects tends to be participants' judgement (i.e., interpretation) of the isolated expression, across both this chapter and the previous one. We consistently show that level of disparity detected between the face alone and body gesture drives the strength of contextual effects. In other words, when participants experience greater conflict between the face (e.g., classified as angry) and body gesture (e.g., disgusted), then contextual effects tend to be stronger. Conversely, contextual influence attenuates when participants' detect greater agreement between the face (e.g., classified as disgust) and body (e.g., disgust).

Chapter 5. Individual differences in gaze deployment and contextual effects in face-emotion perception

5.1. Introduction

In Chapters 2 to 4 of this thesis, we examined various types of individual differences that may potentially influence the experience of contextual effects. These include participants' ability to classify emotions from isolated expressions (aka inherent biases; Chapters 2-4), clinical traits (Chapters 2-4), thinking styles (Chapter 4) and self-construals (Chapter 4). From these investigated types of individual differences, thus far only participants' inherent biases appear to influence the strength of contextual effects experienced when perceiving as well as classifying facial expressions.

As we discuss below in detail, the effects of a context are not limited to how the face is classified, which is a decisional response. Context also appears to modulate how viewers deploy overt attention, both within the face (Aviezer et al., 2008, Study 3), as well as between the face and its context (Kret et al., 2013; Nelson & Mondloch, 2017; Noh & Isaacowitz, 2013). Parallel changes in classification decisions and gaze deployment give rise to the possibility that the two effects are related, and as some researchers have speculated in the past, changes in gaze deployment may be one of the driving factors underlying changes in classification due to context. Moreover, the presence of clear individual differences in the experience of contextual effects on classification as demonstrated in Chapters 2 to 4, provided an opportunity to systematically explore this relationship between classification and gaze deployment, which remains the focus of this chapter. We reasoned that if the two effects are related, individual differences in gaze deployment should account for a significant amount of variability in the experience of contextual effects.

5.1.2. Overt attention and contextual effects

Attention can be considered as a cognitive process that facilitates parsimonious and efficient allocation of neuronal processing resources to selectively process specific cues/signals from the environment (Desimone & Duncan, 1995). There are two main types of attention, namely, overt and covert attention. The former refers to attending important spatial locations through targeted eye-movements such as fixations (Geisler & Cormack, 2011; Pasqualette & Kulke, 2024), which serve as a measure of overt attention. In contrast, the latter refers to capturing information at the periphery, typically in the absence of eye movements. There are several past studies informing us that deployment of overt attention (i.e., gaze) within the face highly depends on the emotion expressed by the face (Schurgin et al., 2014; Calvo et al., 2018). Some examples of emotion-specific gaze allocation include fixating predominantly in the eye region when identifying angry expressions (Calvo et al., 2018; Schurgin et al., 2014) or fixating on the mouth region when identifying happy expressions (Calvo et al., 2018; Eisenbarth & Alpers, 2011; Schurgin et al., 2014).

Interestingly, gaze deployment within the face is also affected by the emotional congruency between the face and its context. What is more interesting is that changes in gaze deployment resulting from context are also accompanied by changes in classification. Aviezer et al. (2008, Study 3) were one of the first to link gaze behaviour on the face to its context. In their study, gaze movements were monitored as participants classified facial expressions from congruent face-body composites (e.g., angry face-angry body gesture) and incongruent composites (e.g., angry face-disgusted body). In the case of congruent composites, participants' gaze patterns followed the characteristic scanning patterns associated with the target expression. For instance, when an angry face appeared with an angry body gesture, more fixations were deployed to the eye region–a pattern consistent with prior findings for isolated angry expressions (Calvo et al., 2018; Schurgin et al., 2014). However, when the target expression appeared on an incongruent body context, participants' scanning patterns shifted to reflect the scanning strategy typically associated with the emotion conveyed by the body gesture. For instance, when an angry expression was paired with a disgusted body gesture, participants deployed an equal number of fixations between the mouth and eye regions. This scanning pattern aligns with the characteristic strategy for processing *disgust* expressions (Wells et al., 2016) and not the predominant fixation on the eye region typically observed with angry expressions (Calvo et al., 2018; Schurgin et al., 2014).

Aviezer et al. (2008, Study 3) quite convincingly showed that the emotional congruency between the face and the body determines how gaze is deployed within the face, when facial expressions are the target of classification. However, they provided no information about allocations of gaze to the context, which almost implies that the context is processed covertly, or peripherally, when the target of classification is the face. Later studies suggest that this might not be the case, and that gaze is distributed between the face and the context. This is an important finding because it reveals that the context is actively sampled by viewers through overt attention even when the target of classification is just the face. Moreover, when faces appear with a semantically meaningful spatial context, the allocation of overt attention to the face and the context appears to be sensitive to the degree of emotional incongruency between the two as well. However, the literature has produced mixed evidence with regards to the consequence (i.e., direction of effects) of this sensitivity.

When the context of a face is emotionally incongruent with the face, it is quite clear that the classification of the face shifts in the direction of the body's emotion. However, the effect that incongruence has on the deployment of gaze between the face and the body is quite controversial. There is some evidence showing that the allocation of overt attention to the context is enhanced when the expression and its context signal incongruent emotions (e.g., happy face – angry context). For instance, Kret et al. (2013, Study 1) aimed to broadly establish how facial expressions and body gestures are processed when presented together as composites. Their participants judged expressions of happiness, anger or fear that were paired with body gestures signaling one of the same three emotions. Only with happy expressions did Kret et al. (2013) observe incongruent body gestures eliciting a higher proportion of fixations on the body compared to congruent body gestures. Moreover, their analysis of congruent composites revealed no significant effects on body fixations, across any of the target expressions (i.e., happy, angry, and fearful). In terms of face fixations, only angry expressions in congruent composites elicited higher proportion of fixations on the face compared to when angry faces were paired with incongruent body gestures. No other congruency-related effects were observed.

Kret et al.'s (2013) findings have been supported to a certain extent with other gaze metrics and expressions as well. For example, Noh and Isaacowitz (2013) showed that overt attention is initially drawn to the body when the face and body signal incongruent emotions. First fixations more frequently landed on the body than the face (i.e., eyes and mouth), when the emotions of the two cues were incongruent (for angry expressions), but when the two cues were congruent, first fixations were more frequent on the face. However, Noh & Isaacowitz (2013) observed the reverse pattern with disgusted expressions. First fixations landed on the face compared to the context for incongruent composites but with congruent composites, more first fixations landed on the context than the face. Interestingly, these gaze changes were accompanied by typical contextual effects. In other words, accuracy of emotion recognition was facilitated when participants judged facial expressions in a congruent context (e.g., angry face-angry body) compared to a neutral context. In contrast, participants' recognition was impaired (i.e., less accurate) when classifying expressions embedded on incongruent composites (e.g., angry face-disgust body). Their findings remain consistent with the past literature (Aviezer et al., 2008; Kret et al., 2013; Meeren et al., 2005; Mondloch, 2012; Wang & Zhang, 2017; Xu et al., 2017).

On the other hand, the typical contextual effects described above, especially with incongruent composites, can be accompanied by gaze behaviour indicative of the face being prioritized. For example, Nelson and Mondloch (2017) report an experiment where participants were instructed to explicitly ignore the body context and categorize facial expressions. In general, for all their target expressions (sad, angry and fearful), participants (adults and children) fixated more on the face than the body. However, for angry and fearful faces, participants fixated on the face more often (than the body) in incongruent trials (e.g., angry face-sad body) compared to congruent trials (e.g., angry face-angry body). Noh and Isaacowitz (2013) replicated identical results with angry and disgust expressions. In their study, when both these expressions were paired with incongruent contexts, overall participants spent more time on the face (i.e., eyes and / or mouth) compared to the context. However, with congruent contexts, only for angry expressions (not disgust) did the face receive longer fixation durations than the context. Collectively, the evidence points to how participants engage in more extensive active sampling of the face not only when assessing emotions in general, but especially when faced with conflicting (incongruent) emotional signals between the expression and its context. Moreover, their gaze behaviour is accompanied by the well-replicated contextual effects observed in past literature (Aviezer et al., 2008; Kret et al., 2013; Meeren et al., 2005; Mondloch, 2012; Noh & Isaacowitz, 2013; Wang & Zhang, 2017; Xu et al., 2017).

5.1.3. Individual differences in overt attention

As discussed so far, evidence linking changes in classification resulting from face-context congruency to changes in gaze deployment resulting from the same is mixed. It is also difficult to make clear comparisons between past studies since they used different emotions as their expressions (and context) and sometimes, they also differed in the metrics of gaze measurements (e.g., fixation duration, number of fixations). This has warranted a more systematic examination of the relationship between classification and gaze deployment, and we believe that individual differences in the experience of contextual effects on classification offer a good opportunity to do that. In fact, Masuda et al.'s (2012) findings comparing of Asians and Westerners further encourages this approach of examination. In their study, Asians experienced stronger contextual effects than Westerners when judging the emotional intensity of a central figure surrounded by other figures (the context). Asians also fixated in the context more frequently and for a longer duration than Westerners. This led them to conclude that the strength of contextual effects experienced when judging emotional expressions is dependent on the extent to which overt attention is allocated to the context.

In addition to examining gaze metrics and classification patterns, we aimed to replicate our previous findings that demonstrated a relationship between the magnitude of contextual effects and participants' inherent biases when perceiving (Chapter 3) and classifying isolated expressions (Chapters 3-4). As mentioned earlier, across all our chapters thus far, participants' inherent biases (for isolated expressions) have consistently emerged as the sole factor reliably accounting for variability in the magnitude of contextual effects observed.

5.1.4. Current study

To systematically examine the relationship between contextual effects on classification and gaze behaviour, we measured deployment in gaze while participants classified facial expressions that appeared with or without a body context, using the same conventional experimental method used in Chapters 3 and 4. Three different gaze metrics were obtained in our study, namely, number of fixations, fixation durations and proportion of time spent in different regions of interest (face and the body). The first two measures allow comparisons with prior research findings (Aviezer et al., 2008; Kret et al., 2013; Masuda et al., 2008, Study 1; Noh & Isaacowitz, 2013; Masuda et al., 2013). Regarding the third, we believe that proportion of time maybe a more appropriate measure when assessing attentional priority, rather than number and/or duration of fixations. Consider an example with two participants viewing a face-body composite. Where participant 1 spends 5 seconds (s) fixating on the face during a 10 s trial (50%), participant 2 also spends 5 s on the face but during a 20 s-long trial (25%). In this case, although fixation durations on a specific region of interest (e.g., the face) were comparable between the two participants, participant 1 has clearly prioritized the face more than participant 2, relative to the body context. Therefore, although metrics like fixation durations and number of fixations provide absolute measures of overt attention, they do not clearly inform biases in allocating overt attention between the face and the body. So, proportion of time spent serves as a more normalised measure of attentional allocation, that takes into account individual differences in viewing strategies (Murphy & Isaacowtiz, 2010). That being said, first we examined if gaze metrics and classification responses differed between conditions where (angry or disgusted) faces were classified with or without the presence of (angry or disgusted) body gestures. Second, we correlated changes gaze metrics resulting from context with changes in classification resulting from context.

5.2. Methods

5.2.1. Participants

We aimed to conduct a one-way analysis of variance (ANOVA), a series of 2 × 2 ANOVAs and correlations to examine the relationship between classification responses and gaze metrics (i.e., number of fixations, fixation duration, proportion of time spent). An a-priori estimation of sample size using G*Power 3.1 (Faul et al., 2007) revealed that 28 participants were required for the one-way ANOVA and 24 participants were needed for the 2 × 2 ANOVA, while 84 participants were required for a correlation analysis to obtain moderate effects (Cohen's $f = 0.25$ and Pearson's $r = 0.3$, respectively) with 80% statistical power. Accordingly, we recruited 84 participants (62 females, 22 males) with an age range of 18-30 years ($M = 22$ years, $SD = 2$ years). Our participants were either current undergraduate or postgraduate students from the University of Nottingham Malaysia. Furthermore, if participants belonged to the School of Psychology, they received 1 course credit upon completion of the study, but if they were non-psychology students, a monetary compensation of RM 8 was given. All participants had normal or corrected-to-normal vision (as per self-reports). This study had received ethics approval from the Science and Engineering Research Ethics Committee of the University of Nottingham Malaysia (NNNL210224).

5.2.2. Materials and Apparatus

5.2.2.1. Emotion classification task

We adopted the conventional method (i.e., presenting a single stimulus) to examine the influence of body gestures when classifying facial expressions. The same paradigm was implemented in Chapters 3 and 4 as well. Accordingly, we had a single within-subjects variable (i.e., body context) which was manipulated at three levels: no body gesture (i.e., no-context condition), angry body gesture (i.e., angry body condition) and disgusted body gesture (i.e., disgust body condition). In each condition, we presented facial expressions that conveyed different intensities (11 in total) of anger and disgust. In conditions with a context, the same expressions were paired with body gestures. To obtain facial expressions, we generated morphed sequences of expressions that unfolded from extreme anger (i.e., denoted −50) to extreme disgust (i.e., denoted as +50), going through neutral (i.e., denoted as 0). The "Stimuli and Apparatus" in Chapter 3 (Section 3.2.3) provides more details regarding the generation of the face-body combinations.

The experiment was conducted on a desktop computer with a resolution of 1920 px in width × 1080 px in height with a refresh rate of 60 Hz. The distance from the screen to the participant was controlled by the use of a chin rest placed at a distance of 60 cm from the screen. All stimuli (i.e., faces alone, face-body composites) were embedded on a white square of equal width and height (500 px). Furthermore, the stimuli appeared against a grey background. Lastly, after the presentation of the target stimulus (which could just be a face or a face paired with a body gesture), a noise stimulus appeared with identical dimensions (500 px × 500 px) and on-screen position (i.e., center), as a way of minimising possible carry-over effects due to sequential trials. This noise stimulus was characterised by a uniform distribution of grey values between black and white. Lastly, this experiment was implemented using custom codes written using MATLAB (MathWorks, version R2022b).

5.2.2.2. Measuring gaze metrics

The *EyeLink Portable Duo* was used to monitor and sample gaze movements. We used this eye-tracker with a sampling rate of 2000 Hz (i.e., 2000 samples per second) to record gaze behaviour from both eyes (i.e., binocular) during the emotion classification task. The eye-tracking device was mounted on a tripod and positioned directly below the display screen (i.e., desktop; see above for details), at a distance of 55 cm from the eyes. The recording of gaze behaviours on the EyeLink Portable Duo takes place via a real-time operation system (QNX) on a dedicated host PC (Lenovo ThinkPad).

5.2.3. Procedure

5.2.3.1. Calibration and validation procedures for eye-tracking

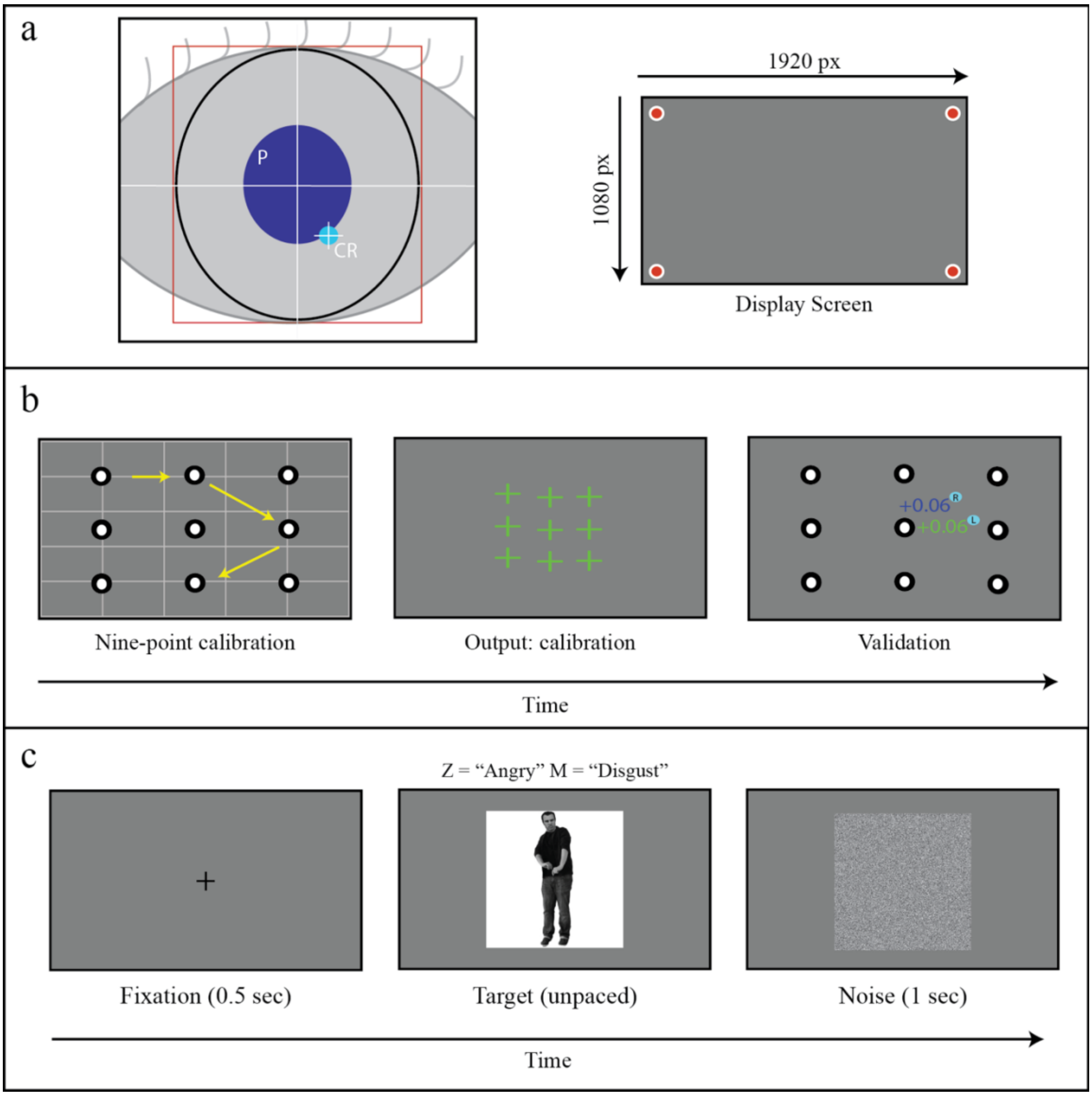
The Portable Duo tracks two main properties of the eye as illustrated in Figure 5.1 (panel a, left image), namely, the pupil (larger blue circle and the corneal reflection (smaller light blue circle). Therefore, once the participant was seated, we needed to ensure that these two properties were accurately detected by the eye-tracker. To do this, we adjusted the "threshold" values for the pupil and cornea as given in the EyeLink software. These threshold values can be increased or decreased to adjust the size of the area captured, for example, ensuring that the pupil is fully filled in blue, without any additional blue in the iris regions (Figure 5.1, panel a, left image). Then, participants were asked to fixate on the four corners of the screen (Figure 5.1, panel a, right image), to ensure that eye-tracker was capturing the eye even at these four extreme locations.

Next, EyeLink's standard nine-point calibration procedure was initiated, where white circles with black borders appeared against a grey background. Participants were instructed to fixate on the white circle, as it appeared in a randomized location on the screen (Figure 5.1, panel b, left rectangle). Additionally, they were asked to mimic the natural movement of their eyes (without being too fast), when they fixated on one circle to the next. EyeLink illustrates the results of the calibration as a grid of green crosshairs, denoting each of the nine spatial locations calibrated (Figure 5.1, panel b, middle rectangle). A symmetrical pattern of crosshairs with uniform distances between each crosshair indicated that the participant was seated at an appropriate distance from the eye-tracker. Therefore, we ensured that this grid of green crosshairs depicted a symmetrical pattern for each participant, else we repeated the calibration procedure.

Once the calibration was completed, a “validation” was conducted using the identical nine-point calibration paradigm (Figure 5.1 panel b, right rectangle). At the end of the validation, we obtained the degree of error pertaining to gaze accuracy for each eye. Furthermore, based on average degree of error computed (from both the calibration and validation phases), EyeLink software would indicate if the validation conducted was GOOD (average error: $< 1.0°$), FAIR (average error: between 1.0° and 1.5°) or POOR (average error: $> 1.5°$). Each participant only progressed to the emotion classification task if the validation’s outcome was classified as “GOOD”. This procedure for calibration and validation was conducted before the start of each of the two experimental blocks of trials in the emotion classification task.

Figure 5.1

Procedure for eye-tracking and emotion classification task



Note. Panel a (left image): How a single eye appears on the EyeLink software, when the pupil (P; larger blue circle) and corneal reflection (CR; light blue circle) are correctly tracked by the Portable Duo. Panel a (right image): Participants were asked to fixate on the four corners of the screen to ensure that the eyes were tracked at all extreme distances. Panel b (left rectangle): Nine-point calibration was conducted, the circular targets appeared in a random sequence (yellow arrows) across nine spatial locations. Participants were asked to fixate on the single target that appears in a sequential manner. Panel b (middle rectangle): Results from the validation was presented as a grid of nine green crosshairs. As recommended by EyeLink, these crosshairs need to appear as a symmetrical grid with uniform distances between each crosshair (e.g., no overlapping crosshairs). Panel b (right rectangle): The results from the validation phases whereby degree of error was expected to be less than 1 degree for both eyes. Panel c: Timeline of emotion classification task.

5.2.3.2. Emotion classification task

The details and characterization of trials remained identical to a large extent between the previous adaption of this task in Chapters 3 and 4 (please refer to Sections 3.2.4.1 and 4.2.3.1 for more details). To summarize, we presented facial expressions that appeared either alone (i.e., no-context condition) or paired with angry / disgusted body gestures (i.e., with context conditions). Facial expressions could have one of 11 emotional intensities (i.e., −50, −40, −30, −20, −10, 0, 10, 20, 30, 40, 50, 10) and 10 trials were presented per intensity (with unique facial identities), resulting in 110 trials per context (i.e., angry body, disgusted body and no-context). Overall, participants completed 330 trials in total ($3 \text{ contexts } \times 11 \text{ emotional intensities } \times 10 \text{ trials per intensity}$). Moreover, the experiment was conducted in two experimental blocks (165 trials per block). As Figure 5.1 (panel c) illustrates the timeline, each trial began with a black fixation cross (1 second), followed by the target stimulus that remained on the screen until a response was given. Accordingly, participants classified a face as angry by pressing “Z” or as disgust by pressing “M”. Lastly, a given trial ended with the presentation of a noise stimulus for 1 second (Figure 5.1, panel c).

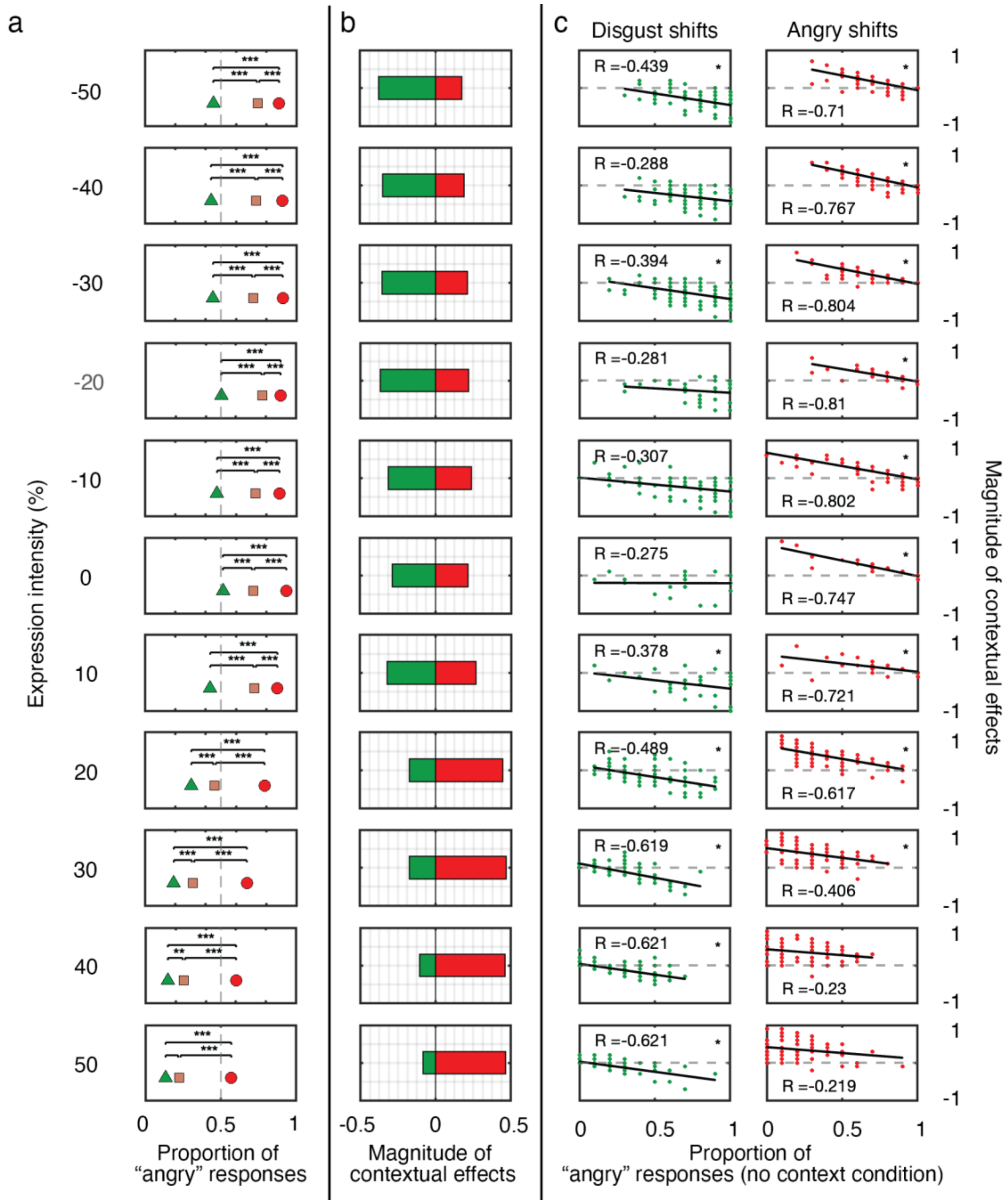
5.3. Results

5.3.1. Effect of context of emotion classification

First, we examined the influence of body gestures on the classification of facial expressions. Therefore, for every intensity, we calculated the proportion of "angry" classifications separately in the three context conditions (i.e., angry body gesture, disgust body gesture, no-context). Subsequently, we examined whether the proportion of angry responses differed between the three contexts (at each intensity) in a series of one-way Analysis of Variance (ANOVA), to investigate how the body gesture influenced the classification of facial expressions. A significant main effect of context was observed at every intensity (all $p < 0.001$; effect sizes ranged between 0.245 and 0.535; see Appendix K, Table K1). Next, Bonferroni-corrected two tailed paired-samples *t*-tests were conducted to identify the direction of these effects (with an adjusted significance criterion of $\alpha = \frac{0.05}{3} = 0.016$) and this entailed comparing three pairs of conditions per intensity (i.e., angry vs no-context, angry vs disgust, and disgust vs no-context conditions). At all intensities, the mean proportion of angry responses was significantly higher when the facial expression appeared with an angry body gesture, compared to if there was no context (all p values < 0.001, Cohen's d values ranging from 0.612 to 1.177) or if the body gesture signalled disgust (all p values $< .001$, Cohen's *d* values ranging from 1.387 to 2.583), as illustrated in Figure 5.2 (panel a). Additionally, with the exception of the +50 intensity, the mean proportion of angry responses in the disgust body condition was significantly lower than no-context condition, (all $p < 0.001$; effect sizes ranged between -8.96 and -0.93; Figure 5.2, panel a). In brief, angry body gestures consistently elicited more angry responses, whereas, disgusted bodies elicited fewer angry classifications (i.e., more disgust classifications).

Figure 5.2

Contextual effects measured in the emotional classification task



Note. Contextual effects from the emotion classification task: a) Mean proportions of "angry" responses across all participants for each condition; angry body (red circles), no-context (yellow squares) and disgusted body (green triangles). Horizontal lines indicate post-hoc paired samples t-tests conducted, *** = $p < .001$, b) Mean of disgust shifts (green bar) and angry shifts (red bar) at each expression intensity, c) Participants' proportion of "angry" responses in the no-context condition (x-axis) correlated against disgust shifts (left panel; green circles) and angry shifts (right panel; red circles) in the y-axis, * = $p < .0025$.

Magnitude of contextual effects. Next, we estimated the magnitude of contextual influence from angry and disgusted body gestures, similar to that in Chapters 3 and 4 (see Section 3.3.2.2 for more details on how magnitudes were calculated). The magnitude of influence arising from angry bodies were defined as "angry shifts" and positive values denoted larger effects. Conversely, "disgust shifts" represented the magnitude of contextual influence from disgust body gestures and here, negative values represented greater effects. Figure 5.2 (panel b) shows the magnitude of contextual effects experienced across our cohort. The estimates of the magnitude will be used in our assessment of individual differences below.

Classification of isolated expressions and contextual effects: Prior to discussing our gaze metrics, we first replicated our analyses from Chapters 3 and 4 to examine if participants' ability to classify isolated expressions (i.e., no-context) would influence the strength of contextual effects from body gestures. Therefore, per intensity, we correlated the proportion of "angry" responses from the no-context condition with angry and disgust shifts, separately. At all intensities (with the exception of +40 and +50), the proportion of "angry" responses were negative correlated with the magnitude of contextual influence from angry body gestures (all p values < 0.001, r values ranged between −0.810 and −0.406; see Figure 5.2, panel c, right column). When the face alone was judged more often as "disgusted" (i.e., fewer angry classification), participants were more influenced by an angry body gesture (i.e., larger angry shifts); conversely, when angry classifications increased, the influence from an angry body attenuated. Similarly, we observed that proportion angry responses were negatively correlated with disgust shifts (all p values < .001, r values ranged between -0.621 and -0.378; see Figure 5.2, panel c, left column), at all intensities with the exception of -40, -20, -10 and 0). Here, when participants' proportion of "angry" classification increased for an isolated expression, they were more influenced by a disgusted body gesture (i.e., larger disgust shifts). In contrast, when the face alone was judged as "disgusted" (i.e., fewer "angry" classifications), then the influence from a disgusted body gesture reduced. Detailed statistics related to the correlations above are reported in Appendix K (Table K2).

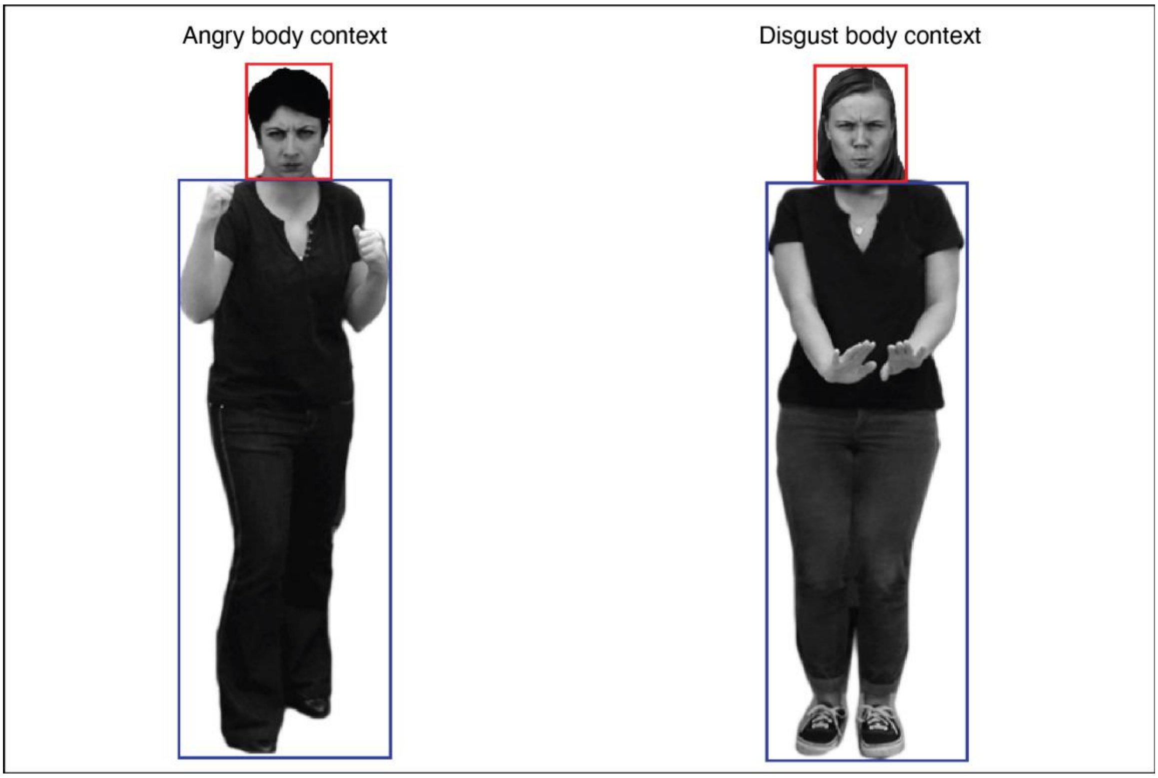
5.3.2. Effect of context on gaze behaviour

Two regions of interest (ROI) were defined per target stimulus: the face and the body gesture. The face ROI encompassed the area from the highest point of the head to mid-neck, while the body ROI extended from the mid-neck region to the bottom-most part of the shoes typically worn by the actors (see Figure 5.3 for examples). These ROIs were identified for each target stimulus that we presented. For each participant and target stimulus, we obtained three gaze metrics: 1) the average number of fixations, denoting the total number of fixations that landed within a given ROI, 2) the average fixation duration (msec), which represented the total amount of time participants dwelled in a given ROI and, 3) average proportion of time spent in each ROI relative to the total duration of the time spent looking at a given stimulus (i.e., until the target terminated with a response). Notably, for all three gaze metrics, our measurements were obtained from the onset of the target stimulus until a response was given (i.e., target offset).

First, we conducted a series of 2×2 repeated measure analysis of variance (ANOVA) for each gaze metric, to examine how attention has been deployed to our two ROIs (i.e., face and body). Per intensity, we compared whether and how the mean of gaze metrics measured differed between the two ROIs when the body gesture signaled anger versus disgust. Therefore, the 2 × 2 repeated measures ANOVAs conducted always had two within-subjects factors, namely, the ROI (i.e., face, body) and the context (i.e., angry body gesture, disgust body gesture). The results from these analyses are presented below (separately) for each gaze measure.

Figure 5.3

Examples stimuli with ROIs



Note. Red rectangles denote face ROIs and blue rectangles denote body ROI.

Number of fixations. There were significant main effects of ROI at every intensity (all p values < 0.05; effect sizes ranged between .064 and .13; see Table 5.1). We observed that the body ROI received significantly higher number of fixations than the face ROI, when collapsing across the two context conditions (i.e., angry body, disgust body; Table 5.2). Furthermore, at each intensity (with the exception of +30, +40, +50), main effects of context were also observed (all p values < 0.05; effect sizes ranged between .065 and .337; Table 5.1). When mean fixations were collapsed across context (i.e., face fixations + body fixations per condition), it can be seen that composites with disgusted body gestures overall received more fixations, compared to composites with angry body gestures (Table 5.2). Lastly, the interaction effect of ROI × Context was only significant at the intensities of −30, −40, +30 and +40, (p values < .05, effect sizes ranged between .072 and .149). To identify the direction of effects, post-hoc paired-samples t-tests were conducted, which entailed 4 comparison combinations examining differences in average fixations between ROI × Context, (adjusted significance criterion of $\alpha = \frac{0.05}{4} = 0.0125$). Only one comparison yielded a consistent direction of effects, whereby the body ROI received a higher number of fixations compared to the face ROI in the disgust body condition, at intensities of −30, −20, −40 and +40 (Figure 5.4). Full statistics related to the post-hoc results with fixations are provided in Appendix K (Table K3).

Table 5.1

Number of fixations: Results from 2 × 2 repeated measures ANOVA

Morph	2 × 2 ANOVA								
	Main effect (ROI)			Main Effect (Context)			ROI * Context		
	F	p	η_p^2	F	p	η_p^2	F	p	η_p^2
−50	12.42	<.001*	0.13	10.40	.002*	0.11	1.18	.280	0.01
−40	8.62	.004*	0.09	23.35	<.001*	0.22	2.49	.118	0.03
−30	11.13	.001*	0.12	42.24	<.001*	0.34	14.50	<.001*	0.15
−20	7.80	.007*	0.09	23.15	<.001*	0.22	6.42	.013*	0.07
−10	6.57	.012*	0.07	5.76	.019*	0.07	0.05	.820	6.252×10^{-4}
0	6.75	.011*	0.08	5.75	.019*	0.07	1.15	.282	0.01
10	7.93	.006*	0.09	12.68	<.001*	0.13	2.64	.108	0.03
20	7.38	.008*	0.08	11.42	.001*	0.12	0.20	.660	0.00
30	5.69	.019*	0.06	0.34	.564	0.00	13.13	<.001*	0.14
40	7.29	.008*	0.08	1.01	.318	0.01	7.65	.007*	0.08
50	7.12	.009*	0.08	1.66	.201	0.02	0.19	.668	0.00

Note. Single asterisk (*) denotes p < .05.

Table 5.2

Number of fixations: Means and standard deviations for ROIs and context

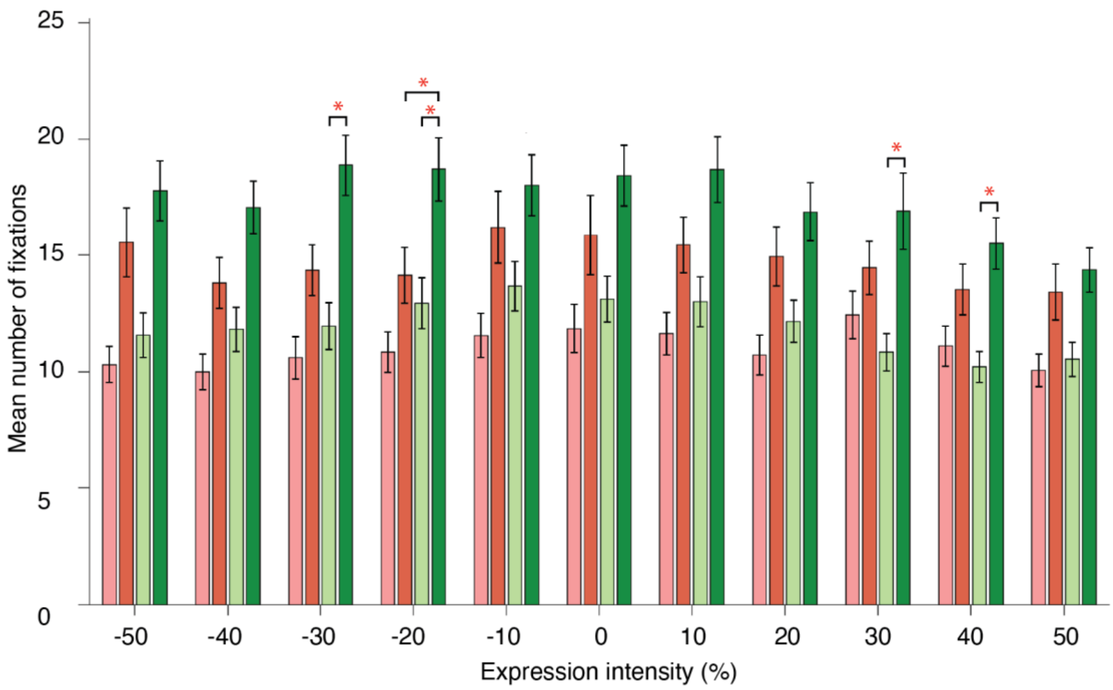
Morph	Face	Body	Face ROI	Body ROI	AN context	DI context

	AN	DI	AN	DI				
−50	10.31	11.56	15.54	17.66	10.93	16.66	12.92	14.66
	(7.08)	(8.73)	(13.63)	(11.84)	(7.95)	(12.78)	(11.14)	(10.83)
−40	10.00	11.81	13.81	17.06	10.91	15.43	11.90	14.44
	(6.99)	(8.67)	(9.99)	(10.28)	(7.90)	(10.24)	(8.80)	(9.84)
−30	10.59	11.96	14.35	18.88	11.28	16.61	12.47	15.42
	(8.24)	(9.20)	(10.01)	(11.86)	(8.74)	(11.18)	(9.34)	(11.14)
−20	10.84	12.94	14.13	18.70	11.89	16.41	12.48	15.82
	(7.94)	(9.932)	(10.95)	(12.44)	(9.02)	(11.90)	(9.67)	(11.58)
−10	11.54	13.66	16.20	18.01	12.60	17.10	13.87	15.83
	(8.72)	(9.76)	(14.22)	(12.04)	(9.29)	(13.16)	(11.99)	(11.14)
0	11.85	13.10	15.86	18.42	12.48	17.14	13.86	15.76
	(9.41)	(9.02)	(15.63)	(12.04)	(9.21)	(13.97)	(13.02)	(10.93)
10	11.63	13.0	15.44	18.69	12.31	17.06	13.53	15.84
	(8.37)	(9.72)	(11.01)	(13.03)	(9.07)	(12.13)	(9.93)	(11.81)
20	10.71	12.15	14.95	16.86	11.43	15.91	12.83	14.51
	(7.73)	(8.27)	(11.74)	(11.42)	(8.02)	(11.58)	(10.13)	(10.22)
30	12.44	10.83	14.45	16.89	11.63	15.67	13.44	13.86
	(9.34)	(7.27)	(10.45)	(15.03)	(8.38)	(12.96)	(9.93)	(12.16)
40	11.09	10.20	13.52	15.50	10.64	14.51	12.31	12.85
	(7.96)	(6.05)	(10.03)	(10.20)	(7.06)	(10.13)	(9.11)	(8.77)
50	10.06	10.53	13.41	14.36	10.29	13.89	11.73	12.45
	(6.31)	(6.70)	(10.91)	(8.68)	(6.49)	(9.84)	(9.04)	(7.96)

Note. Average number of fixations are provided. The standard deviations are given in parentheses. Face ROI and Body ROI columns denote mean fixations collapsed across the two context conditions. AN (angry) and DI (disgust) context denotes mean fixations collapsed across the two ROIs for each context.

Figure 5.4

Mean number of fixations: Interaction Context × ROI



Note. Light red bars = Angry Face ROI, Dark red bars = Angry Body ROI, Light green bars = Disgust Face ROI, Dark green bars = Disgust Body ROI. Single red asterisk (*) denotes $p <$ .0125 (adjusted significance criterion of $\alpha = \frac{0.05}{4}$). Only post-hoc comparisons following significant interactions between ROI × Context has been presented. Error bars denote standard error of the mean.

Fixation Duration. Similar to the analyses above, we also conducted a series of 2 × 2 repeated measures ANOVAs with ROI (i.e., face, body) and context (i.e., angry body gesture, disgust body gesture) as within subject factors, to compare differences in average fixation duration. All ANOVAs (for every intensity) revealed significant main effects for ROI at an alpha level of 0.05 (all p values < 0.001, effect sizes ranged between 0.393 and 0.630; Table 5.3). We observed that the face ROI was fixated for longer compared to the body ROI at all intensities, irrespective of the body context (see Table 5.4 for means). Next, a significant main effect of context was only observed at intensities of −10 and +40 (p values < .008, effect sizes between .081 and .088). At the −10 intensity, a disgusted body gesture was fixated on longer than an angry body gesture (Table 5.4). Conversely, an angry body gesture elicited longer fixation durations than a disgusted body gesture at +40 intensity (Table 5.4). Lastly, as seen in Figure 5.5, the interaction between ROI × context was only significant for intensities of −40, −30 and +20, (all p values < 0.031, effect sizes between 0.055 and 0.060). Our post-hoc analyses (adjusted significance criterion of $\alpha = \frac{0.05}{4} = 0.0125$) revealed that for both angry and disgusted body contexts, the face was fixated for longer compared to the body (at all three intensities; Figure 5.5). Full statistics related to the post-hoc results are provided in Appendix K (Table K4).

Table 5.3

Fixation Duration (msec): Results from 2 × 2 repeated measures ANOVA

Morph	2 × 2 ANOVA								
	Main effect (ROI)			Main Effect (Context)			ROI * Context		
	F	p	η_p^2	F	p	η_p^2	F	p	η_p^2
−50	100.45	<.001*	0.55	3.02	0.086	0.04	0.74	0.392	0.01
−40	67.62	<.001*	0.45	1.68	0.199	0.02	5.07	0.027*	0.06*
−30	79.18	<.001*	0.49	1.33	0.252	0.02	5.32	0.024*	0.06*
−20	87.95	<.001*	0.51	0.65	0.424	0.01	0.25	0.619	0.00
−10	119.28	<.001*	0.59	7.99	0.006*	0.09	0.51	0.478	0.01
0	128.45	<.001*	0.61	0.02	0.902	1.855×10^{-4}	1.36	0.247	0.02
10	141.39	<.001*	0.63	0.22	0.638	0.00	0.96	0.329	0.01
20	92.60	<.001*	0.53	0.13	0.719	0.00	4.79	0.031*	0.06*
30	116.94	<.001*	0.59	21.36	<.001	0.21	3.163×10^{-4}	0.986	3.811×10^{-6}
40	133.98	<.001*	0.62	7.29	0.008*	0.08	0.38	0.539	0.01
50	53.63	<.001*	0.39	1.45	0.233	0.02	0.87	0.353	0.01

Note. Single asterisk (*) denotes p < .05.

Table 5.4

Fixation Duration (msec): Means and standard deviations for ROIs and context

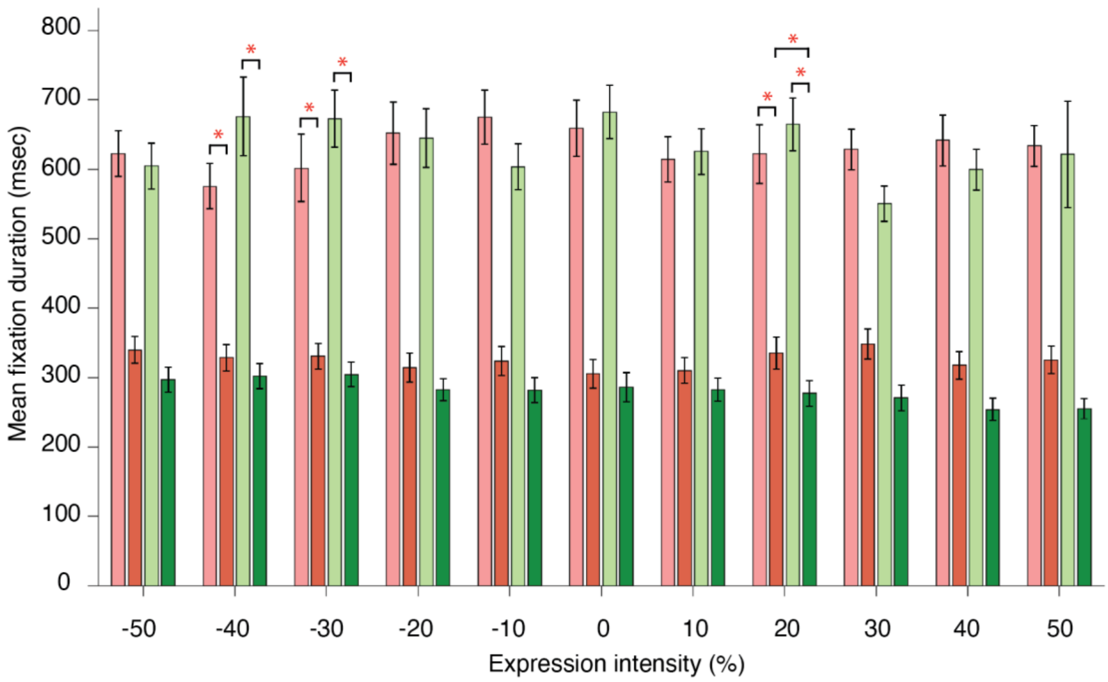
Morph	Face		Body		Face ROI	Body ROI	AN context	DI context
	AN	DI	AN	DI				
−50	622.51	604.80	339.86	297.46	613.65	318.66	481.19	451.13
	300.86	300.11	175.05	164.09	299.71	170.48	283.38	286.18
−40	575.70	675.71	328.60	302.30	625.70	315.45	452.15	489.00
	298.00	518.50	173.10	166.20	424.58	169.69	272.74	427.10
−30	601.42	672.47	330.81	304.64	636.94	317.72	466.11	488.56
	445.77	377.58	167.45	160.39	413.39	163.99	362.10	343.03
−20	651.53	644.87	314.53	282.88	648.20	298.70	483.03	463.87
	408.98	384.52	193.05	143.45	395.76	170.30	360.85	341.56
−10	675.02	603.72	323.73	282.11	639.37	302.92	463.73	518.54
	357.75	300.03	191.03	163.10	331.10	178.31	287.39	384.48
0	658.69	682.37	305.63	286.23	670.53	295.93	482.16	484.30
	369.55	350.44	187.15	191.06	359.24	188.80	341.51	344.45
10	614.36	625.79	310.41	282.62	620.08	296.51	462.38	454.21
	294.50	300.27	169.22	152.32	296.56	161.11	283.85	293.19
20	622.16	664.46	335.68	277.48	643.31	306.58	478.92	470.97
	386.24	344.74	210.96	165.77	365.59	191.38	341.91	332.24
30	628.42	550.50	348.37	271.14	589.46	309.75	488.39	410.82
	267.45	235.98	196.09	168.03	254.47	186.13	272.74	247.66

40	641.54	599.57	317.80	253.77	620.55	285.78	479.67	426.67
	332.60	268.60	182.63	151.14	302.12	170.18	312.92	278.00
50	633.52	621.30	325.56	255.26	627.41	290.41	479.54	438.28
	266.91	702.15	182.20	136.32	529.60	164.25	275.24	536.62

Note. The average fixation duration (in msec) has been provided and immediately below are the values for standard deviations. Face ROI and Body ROI columns denote average fixation durations collapsed across the two context conditions. AN (angry) and DI (disgust) denotes mean fixation durations collapsed across the two ROIs.

Figure 5.5

Mean fixation duration: Interaction Context × ROI



Note. Light red bars = Angry Face ROI, Dark red bars = Angry Body ROI, Light green bars = Disgust Face ROI, Dark green bars = Disgust Body ROI. Single red asterisk (*) denotes $p <$ .0125 (adjusted significance criterion of $\alpha = \frac{0.05}{4}$). Only post-hoc comparisons following significant interactions between ROI × Context has been presented. Error bars denote standard error of the mean.

Proportion of time spent per ROI: Lastly, we subjected our final gaze metric to 2 × 2 repeated measures ANOVAs to compare differences in the proportion of time spent between the two ROIs (i.e., face, body) across the two context conditions. At all intensities, with the exception of −40 and −30, there were main effects of ROI at an alpha level of 0.05 (all *p* values < 0.027, effect sizes ranged between 0.060 and 0.100; Table 5.5). Our participants prioritised the face (i.e., higher proportion of time spent), compared to the body gesture (see Table 5.6 for means). We only observed a main effect of context at an intensity of −20, ($F(1,83) = 6.608$, $p = 0.012$, $\eta_p^2 = 0.074$). Here, when average proportion of time spent is collapsed across context, our participants allocated more attention towards stimuli with disgust body contexts rather than angry body contexts (Table 5.6). Lastly, no significant interaction effects were seen between ROI × context (all *p* values > 0.138) at all intensities (Table 5.5) and thus additional post-hoc comparisons were not conducted.

Table 5.5

Proportion of time spent per ROI: Results from 2 × 2 repeated measures ANOVA

Morph	2 × 2 ANOVA								
	Main effect (ROI)			Main Effect (Context)			ROI * Context		
	F	p	η_p^2	F	p	η_p^2	F	p	η_p^2
−50	6.62	0.012*	0.07	0.06	0.809	7.043×10^{-4}	1.07	0.304	0.01
−40	2.78	0.099	0.03	1.21	0.274	0.01	1.45	0.233	0.02

−30	1.95	0.166	0.02	1.62	0.206	0.02	0.00	0.959	3.257 $\times10^{-5}$
−20	5.08	0.027*	0.06	6.61	0.012*	0.07	0.59	0.445	0.01
−10	6.19	0.015*	0.07	1.32	0.253	0.02	2.25	0.138	0.03
0	8.82	0.004*	0.10	0.98	0.325	0.01	0.09	0.769	0.00
10	6.32	0.014*	0.07	0.07	0.797	8.039 $\times10^{-4}$	0.91	0.342	0.01
20	5.77	0.019*	0.07	3.29	0.073	0.04	1.75	0.190	0.02
30	5.49	0.021*	0.06	8.354 x 10^-4	0.995	4.230 $\times10^{-7}$	0.00	0.950	4.783 $\times10^{-5}$
40	6.94	0.010*	0.08	0.49	0.488	0.01	1.00	0.321	0.01
50	6.62	0.012*	0.07	0.06	0.809	7.043 $\times10^{-7}$	1.07	0.304	0.01

Note. Single asterisk (*) denotes p < .05.

Table 5.6

Proportion of time spent per ROI: Means and standard deviations for ROIs and context

Morph	Face		Body		Face ROI	Body ROI	AN Context	DI Context
	AN	DI	AN	DI				
−50	45.26 (26.25)	44.06 (24.72)	31.57 (23.06)	33.08 (23.41)	43.19 (25.67)	35.43 (23.78)	39.08 (25.10)	39.55 (24.99)

−40	42.97	45.35	35.96	34.87	44.16	35.41	39.47	40.11
	(27.00)	(26.70)	(25.98)	(24.99)	(26.80)	(25.42)	(26.65)	(26.31)
−30	41.83	42.65	35.37	36.05	42.24	35.71	38.60	39.35
	(24.19)	(24.49)	(23.30)	(23.16)	(24.27)	(23.16)	(23.90)	(23.99)
−20	43.20	45.81	33.01	33.50	44.51	33.25	38.10	39.66
	(25.57)	(25.78)	(25.27)	(24.02)	(25.63)	(24.58)	(25.86)	(25.60)
−10	43.51	46.77	33.44	32.01	45.14	32.72	38.47	39.39
	(26.52)	(26.07)	(24.75)	(24.38)	(26.27)	(24.50)	(26.07)	(26.23)
0	46.11	47.30	32.51	32.74	46.71	32.62	39.31	40.02
	(26.46)	(23.73)	(23.60)	(23.71)	(25.07)	(23.58)	(25.91)	(24.75)
10	45.98	44.62	32.30	33.98	45.30	33.14	39.14	39.30
	(26.26)	(26.37)	(22.46)	(24.27)	(26.25)	(23.33)	(25.31)	(25.83)
20	44.19	47.31	33.57	32.64	45.75	33.10	38.88	39.97
	(28.81)	(25.88)	(26.39)	(24.77)	(27.35)	(25.52)	(28.05)	(26.31)
30	44.62	44.71	33.21	33.11	44.66	33.16	38.91	38.91
	(25.33)	(26.43)	(22.87)	(25.09)	(25.81)	(23.93)	(24.73)	(26.34)
40	46.47	44.76	31.94	32.78	45.61	32.36	39.21	38.77
	(27.68)	(25.10)	(25.12)	(23.22)	(26.35)	(24.12)	(27.34)	(24.84)
50	45.26	44.06	31.57	33.08	44.66	32.33	38.41	38.57
	(26.25)	(24.72)	(23.06)	(23.41)	(25.43)	(23.18)	(25.57)	(24.63)

Note. The average proportion of time spent has been provided and standard deviations are in parentheses. Face ROI and Body ROI columns denote average proportion of time collapsed across the two context conditions. AN (angry) and DI (disgust) denotes average proportion of time spent collapsed across the two ROIs.

5.3.3. Individual differences and contextual effects

We conducted a series of (20) correlations (adjusted significance criterion of $\alpha = \frac{0.05}{20}$ = 0.0025) to examine individual differences, attentional deployment and emotion classification. The individual difference measures included the values denoting: 1) whether attentional priority was attributed to the face and / or body ROI in each gaze metric 2) how attentional allocation shifted between the ROIs due to context.

Attentional priority and magnitude of contextual effects: First, we calculated measures of difference between the face ROI and body ROI per gaze measure (i.e., number of fixations, fixation duration and proportion of time spent). In other words, for each measure, we estimated which ROI was given priority in each context condition (i.e., angry body, disgust body). For example, we obtained the difference in the number of fixations between the face ROI and body ROI (i.e., $\text{Face ROI}^{\text{fixation\_number}} - \text{Body ROI}^{\text{fixation\_number}}$). The calculated values were separated according to the context condition and denoted as $\text{priority}^{\text{fix\_AN}}$ (difference in fixations in angry context) and $\text{priority}^{\text{fix\_DI}}$ (difference in fixations in disgust context). Similarly, we obtained identical estimates for fixation duration and proportion of time spent. These values were defined as $\text{priority}^{\text{dur\_AN}}$ (difference in fixation duration in angry context), $\text{priority}^{\text{dur\_DI}}$ (difference in fixation duration in disgust context), $\text{priority}^{\text{prop\_AN}}$ (difference in proportion of time spent in angry context) and $\text{priority}^{\text{prop\_DI}}$ (difference in proportion of time spent in angry context). For all the calculated values representing attentional priority, positive values denoted higher allocation of overt attention towards the face ROI.

Subsequently, we examined whether each of these six metrics characterising individual differences in attentional priority were correlated with: 1) magnitude of influence from an angry context and 2) magnitude of influence from a disgusted context. These correlations will allow us to examine whether attentional priority to either the face ROI or body ROI is related to the strength of contextual effects. For example, Masuda et al. (2012) reported that the number of fixations and the duration fixated on the background context can lead to pronounced facilitation with congruent face-context pairings and enhanced impairment with incongruent face-context pairings when judging facial expressions. Therefore, by correlating our metrics for attentional priority (i.e., $priority^{fix\_AN}$, $priority^{fix\_DI}$, $priority^{dur\_AN}$, $priority^{dur\_DI}$, $priority^{prop\_AN}$, $priority^{prop\_DI}$) with the magnitude of contextual influence (i.e., angry / disgust body), we assessed whether selective attention to one ROI (i.e., face and / or body) could possibly modulate participants' susceptibility to contextual information. We only observed one significant correlation across all the analyses conducted whereby at a +40 intensity, angry shifts were negatively correlated with $priority^{fix\_DI}$ ($r = -3.410$, $p = 0.002$). However, beyond this correlation, we failed to observe any significant relationships between attentional deployment and contextual effects at the adjusted alpha criterion of .0025 (for detailed statistics please refer to Appendix L, Tables L1 – L3). Therefore, in general, participants' strategies in overt attention did not explain variability in contextual effects.

Changes in attentional shifts and classification due to context. However, we also aimed to address the question whether changes in gaze metrics resulting from the context can lead to changes in classification owing to the context as well. Accordingly, we quantified the degree to which participants' classification of facial expressions differed between angry and disgust contexts–a measure we define as "classification shift". Therefore, across all participants, we calculated classification shifts by obtaining the difference between the proportion of "angry" responses in the angry and disgust context conditions (i.e., angry body context – disgust body context). Positive values for classification shifts denote higher proportion of "angry" classifications when faces were judged with an angry context. Conversely, negative values denote lower proportion of "angry" classifications when the face was judged with disgusted body contexts.

Similar to classification shifts, we also quantified the degree to which attentional allocation shifted between the angry and disgust context conditions. This measure termed "attentional shift" was calculated for each ROI, namely, attentional shift^{face} and attentional shift$^{body.}$ We calculated these attentional shifts by obtaining the difference in the gaze metric between angry and disgusted contexts (e.g., attentional shift^{face} = $\text{Angry Context}^{\text{fixation\_number}} - \text{Disgust Context}^{\text{fixation\_number}}$). The calculated values were separated according to the gaze metric (i.e., number of fixations, FIX; fixations duration, DUR; proportion of time spent, PROP) and is denoted as: attentional shift^{face_FIX}, attentional shift^{body_FIX}, attentional shift^{face_DUR}, attentional shift^{body_DUR}, attentional shift^{face_PROP}, attentional shift^{body_PROP}. For all the calculated values representing attentional shifts, positive values denoted higher allocation of overt attention towards the face ROI.

Lastly, to examine whether changes in attentional allocation (owing to context) leads to variability in classification, we correlated each of these 6 metrics (i.e., attentional shift^{face_FIX}, attentional shift^{body_FIX}, attentional shift^{face_DUR}, attentional shift^{body_DUR}, attentional shift^{face_PROP}, attentional shift^{body_PROP}) with classification shifts that were previously calculated (see above). However, we did not observe any significant relationships between attentional and classification shifts owing to context at the level of $p < \alpha$ (for full statistics see Appendix L, Table L4).

5.4. Discussion

In this chapter, we examined whether individual differences in the allocation of overt attention can be related to variability in contextual effects. Hence, we assessed the relationship between three different gaze metrics (i.e., number of fixations, fixation durations and proportion of time spent) and contextual effects experienced by our participants from angry / disgusted body gestures. The following discussion section will discuss our main findings in the order in which the analyses were conducted.

First, consistent with the findings from Chapters 3 and 4, the present cohort of participants also exhibited contextual effects when classifying facial expressions. Specifically, body gestures were capable of biasing judgements in the direction of the context emotion at a group-level, thus replicating past findings (Aviezer et al., 2008; Kret, Stekelenburg, et al., 2013; Meeren et al., 2005; Mondloch, 2012; Wang et al., 2017; Xu et al., 2017). Crucially, we observed considerable variability in the magnitude of contextual effects participants experienced at the individual-level, which once again appears to be related to participants' inherent bias when classifying isolated expressions (similar to Chapters 3-4). Refer to Chapter 3 (Section 3.4.3) for detailed discussion. In any case, it remains plausible that participants' inherent biases may potentially guide how attention may be preferentially allocated towards either the face and / or body context, thereby justifying our examination of the relationship between gaze behaviour and contextual effects.

5.4.1. Gaze behaviour on the face and the body

Number of fixations. Participants deployed a higher number of fixations towards the body ROI than the face, irrespective of context. This aligned with previous findings from Kret et al. (2013) and Noh and Isaacowitz (2013), who also report increased attention (i.e., longer fixation duration and higher fixations) to contextual cues over facial expressions. Interestingly, disgust body gestures received more fixations and longer fixation duration (only at −10 intensity) compared to angry body gestures. This finding remains in contrast to much of the literature attesting to an "anger-bias", whereby individuals remain particularly sensitive to the detection of anger, given its relevance as a threat signal (Gilbert et al., 2010; Kret et al., 2013; Valk et al., 2015). For example, in Kret et al. (2013, Studies 1-3), any instance where angry body gestures were presented, they attracted the attentional focus of participants, as revealed by longer fixation durations. Given this, we are inclined to attribute our finding to stimulus characteristics. A paired samples *t*-test comparing classification accuracies for the presented stimuli (from our validation study in Chapter 3) revealed that angry body gestures (M = .947) were more accurately classified compared to disgusted body gestures (M = .347). In other words, angry body gestures were significantly more diagnostic of the intended emotion. Therefore, it remains plausible that the higher number of fixations and longer duration (only at −10 intensity) reflects greater difficulty in interpreting emotional cues from disgusted body gestures compared to angry gestures.

Fixation Duration and Proportion of time spent. When considering fixation durations, we found that participants consistently fixated longer on the face than on the body context and this pattern held true for both angry and disgust body gestures. Similarly, for the proportion of time spent, our participants allocated a greater percentage of time to the face ROI compared to the body ROI, across all emotional intensities (intense and subtle mid-sequence morphs) and this pattern was also uniform for angry / disgust body gestures.

First, our findings highlight an asymmetry between the number of fixations and fixation duration. The body received more fixations overall; however, the face received longer fixation durations indicative of more sustained processing. Participants' fixation behaviour reflects a strategy wherein body gestures elicited broader scanning (rather than selective priority) characterised by shorter fixations, likely reflecting inhibitory mechanisms to remain consistent with task instructions (Galley et al., 2015). After all, participants were asked to classify the emotion conveyed by the facial expression, without being given any explicit instructions regarding the context (i.e., it was not the primary target cue). In any case, this asymmetry between number and duration of fixations also implies that the former metric may not directly reflect attentional priority or selective processing of the emotional signals from body gestures, in contrast to past studies (Kret et al., 2013; Noh & Isaacowitz).

Furthermore, both our metrics of fixation duration and proportion of time spent support this sustained processing of the face cue rather than the body, in line with task instructions. We replicated previous findings where greater fixation duration and time spent were on the face ROI than body gestures, in both naturalistic viewing conditions (i.e., no explicit instructions to ignore context; Shields et al., 2012) and when participants were explicitly instructed to ignore the context (Nelson & Mondloch, 2017). This prioritization of the face ROI is consistent with theoretical frameworks where participants prioritize and fixate longer on stimulus locations deemed more informative and accordingly, the gaze behaviour facilitates the gathering of more task relevant information (Renninger et al., 2007). Therefore, in our case, by deploying attention towards the face ROI, participants could actively interpret the emotional expression as expected from the emotion classification task.

Additionally, we assert that fixation duration and proportion of time spent delineate different aspects of overt attentional deployment. This assertion is based on the notion that fixation duration, like fixation number, may not clearly indicate whether one visual cue was prioritised over the other. It mainly speaks for depth of visual processing or gaze behaviour elicited consistent with task demands (e.g., attend to face more when classifying an expression). Proportion of time spent, by contrast, highlights the distribution of overt attention across different ROIs, relative to the total time spent on the task (i.e., when judging the emotion from facial expressions). Therefore, we believe it is a better metric to understand which cue is prioritised in a task of facial expression classification.

5.4.2. Individual differences in overt attention and contextual effects

Attentional priority and contextual effects. One of our primary aims was to explore whether overt attention influences the strength of influence from body gestures when classifying facial expressions. However, in our study, variations in the deployment of overt attention (for all three gaze metrics) did not impact the magnitude of contextual effects. This observation can be primarily attributed to our participants' sustained engagement in processing the facial expression (i.e., longer fixation durations) rather than the body, and prioritization of the face ROI over the body ROI (i.e., higher proportion of time spent), regardless of the expression and the context presented. Overall, although our individual participants differed in the magnitude of contextual effects they experienced, that variability does not appear to be related to variability in the deployment of gaze between the face and the body gesture.

In Masuda et al.'s (2012) study, participants who fixated more on the context experienced larger contextual effects (i.e., those from an Eastern culture) than participants who fixated less frequently on the context (i.e., those from a Western culture). We studied this relationship more systematically at the individual level, but failed to observe a similar relationship as Masuda et al.'s (2012). Taken together, our findings imply that contextual effects from body gestures seem to occur independently of overt attentional deployment. In fact, although early studies report characteristic eye movements that highlight task-dependent patterns of attentional deployment (Yarbus; DeAngelus & Pelz, 2009), more recent research attested to a decoupling between eye movements and participants' behavioural patterns in a given task (Greene et al., 2012). In the latter study, Greene et al. (2012) tracked participants' gaze behaviour (e.g., fixation number, fixation duration, saccades) while they viewed pictures under 4 different task conditions (e.g., memorize the picture, determine the decade the picture was taken). Using their measured gaze metrics, scan paths were generated for each stimulus, and trained individuals were tasked with predicting the specific task associated with each scan path. In general, their trained classifiers performed at chance levels, indicating that it was difficult to identify characteristic scanning paths specific to a given task. Thus, the findings lead to the conclusion that gaze behaviour alone may not provide sufficient information to reliably infer the specific behavioural task undertaken. Therefore, the lack of a relationship between overt attention and emotion classification in our study is not altogether surprising.

Attentional shifts and classification due to context. As previously noted, at a group-level, we did observe how the context biased participants' classification in the direction of the body's emotion. Accordingly, we then examined whether such classification patterns would be accompanied by specific patterns of gaze allocation. However, our findings indicate that, overall, classification patterns identified in this study were not systematically related to variations in attentional shifts driven by the body contexts, across all three gaze metrics. Thus, our results only align with prior research in demonstrating robust contextual effects on emotion classification (Aviezer et al., 2008; Masuda et al., 2012; Noh & Isaacowitz, 2013; Nelson & Mondloch, 2017) and not the changes in gaze that accompanied these contextual effects. Notably, with the exception of Masuda et al. (2012), previous studies have not systematically linked emotion classification data with gaze metrics, often relying instead on independent inferences drawn from separate analyses of gaze and classification behaviour. Therefore, contrary to past conclusions, when we explicitly make links between changes in gaze allocation and classification (owing to context), no significant relationships emerge. Accordingly, we once again reaffirm that gaze allocation operates independently of contextual effects, consistent with the observations from Greene et al. (2012).

5.4.3. Limitations and Future directions

There are several limitations to highlight in the current study. First, the disgusted body gestures presented were not entirely diagnostic of the intended emotion, particularly when compared to the angry body gestures. The weaker communicative value of disgusted bodies may have influenced our findings for the gaze metrics, especially, the calculation of attentional shifts (i.e., between angry and disgust context conditions for each gaze measure). To address this limitation, future research need to carefully ascertain the communicative value of the body gesture, given that ideally the context needs to remain unambiguous to participants. Accordingly, when body gestures clearly communicate the intended emotion, it may reveal potential asymmetrical effects in attentional allocation. Specifically, whether attention is preferentially directed towards angry body gestures, as suggested by prior studies (Gilbert et al., 2010; Kret et al., 2013; Valk et al., 2015), compared to other emotional body gestures. Furthermore, the findings of the present study are limited to expressions considered confusable (i.e., angry-disgust) and existing evidence suggests that attentional capture may vary based on the specific emotion (Becker et al., 2011; Torrence et al., 2017). Expanding this line of research to include a broader range of emotional expressions, encompassing both confusable (e.g., angry-disgust) and easily discriminable pairs (e.g., angry-happy) of emotions would be valuable. It would allow us to identify whether relationships between attentional capture and contextual effects emerge for other expressions but also clarify whether these effects (or their absence) remains emotion-specific or generalizable to all emotions.

5.4.4. Conclusion

In summary, we primarily aimed to examine whether individual differences in the deployment of overt attention could explain variations in the strength of contextual effects. To this end, we failed to observe any relationship between attention deployment and patterns of emotion classification in different contexts. However, consistent with our findings from past Chapters (3-4), inherent biases in the classification of isolated expressions appears to be the only measure of individual difference that relates to the magnitude of contextual effects even in the current study. Additionally, our findings add to the existing research (Shields et al., 2012; Noh & Isaacowitz, 2013), that across a range of emotional intensities (not only intense expressions), the face appears to be prioritised when assessing face-body composites during a task where the facial expression being classified.

Chapter 6. General Discussion

This chapter will summarize the main findings from the thesis. Across four empirical chapters, we examined two broad themes, namely contextual effects and individual differences. More specifically, we examined: 1) in Chapters 2 and 3, whether contextual influences (i.e., body gestures in our case) elicited genuine shifts in perception when judging facial expressions, and 2) what factors of individual differences could account for the variability in the strength of contextual effects experienced by participants. Accordingly, we investigated five perceiver-related individual differences, namely, severity of clinical traits (Chapters 2-3), judgement of isolated expressions (Chapters 2-5), thinking styles (Chapter 4), self-construals (Chapter 4) and the allocation of overt attention (Chapter 5).

6.1. Summary of main findings

We first assessed whether body contexts would bias the *perception* of facial expressions considered to be easily discriminable (i.e., angry, happy; Chapter 2) or confusable (i.e., angry, disgusted; Chapter 3). To do this, we quantified differences in the strength of contextual effects experienced by our participants across two distinct paradigms. One paradigm captured genuine shifts in perception when participants judged facial expressions (i.e., COCM; Chapters 2-3), whereas the other allowed both perceptual and non-perceptual influences to contribute to participants' classification of emotional expressions (i.e., "conventional" paradigm with single stimuli presentation; Chapter 3). We only observed contextual effects when participants classified angry-disgusted facial expressions in the conventional paradigm, akin to past studies (Aviezer et al., 2008; Kret et al., 2013, Study 1; Lecker et al., 2020; Meeren et al., 2005; Wenzler et al., 2016, Study 1). However, with

COCM, we failed to see body contexts significantly shifting participants' perception of both easily discriminable (Chapter 2) and confusable emotions (Chapter 3). As Morgan et al. (2015) conveys, when we use COCM to measure perceptual biases, it largely minimises the contribution of non-perceptual factors such as criterion shifts and response biases. Therefore, if a bias is obtained through the COCM, we can be more confident that it is indeed perceptual in nature. Accordingly, our findings together lead us to claim that body gestures do not change the perception of facial expressions, alternatively, they may act upon decisional processes (Teufel et al., 2019).

In terms of individual differences, we examined whether severity of symptoms in four clinical traits (i.e., autism, depression, alexithymia and anxiety) modulated the magnitude of contextual effects when perceiving (Chapters 2-3) and classifying facial expressions (Chapter 3). We expected individuals with more severe symptoms for a given trait to exhibit greater reliance on body gestures (Eack et al., 2015; Ferguson et al., 2021; Leppänen et al., 2004; Montebarocci et al., 2011). However, we failed to observe any relationships between the scores for our clinical traits and contextual effects observed in both the COCM (Chapter 2-3) or the conventional paradigm (Chapter 3). In other words, increasing severity of clinical symptoms did not lead to a systematic reliance on the body contexts, irrespective of whether participants judged easily discriminable (Chapter 2) or confusable emotions (Chapter 3). Our findings may result from the subclinical nature of our cohort. It is possible that relationships between clinical traits and susceptibility to context may only emerge once the symptoms experienced by individuals make them eligible for a clinical diagnosis (Brewer et al., 2017).

Beyond clinical traits, we report a novel finding whereby individual differences in participants' ability to perceive isolated expressions influenced the magnitude of contextual effects (Chapter 3, COCM). This relationship was predicated on the emotional disparity between the perceived emotion of the isolated (objectively) neutral expression and body's emotion. Accordingly, strongest contextual effects were observed when there was greater disparity between the face alone and body gesture (e.g., neutral faces perceived as disgusted and the body signaling anger), thus leading to larger "attractive" shifts in biases (e.g., neutral faces paired with angry bodies perceived angrier than when presented alone). When disparity attenuated (i.e., more agreement was perceived between face-body cues), the contextual effects not only reduced but also switched directions and elicited "repulsive" shifts. In other words, perception of facial expressions was biased away from the body's emotion. The "attractive" shifts we observed are consistent with past research (Aviezer et al., 2008; Gao et al., 2022; Meeren et al., 2005; Van den Stock et al., 2007; Wu & Ying, 2023), although the "repulsive" shifts have not been reported previously.

Additionally, we observed qualitatively similar relationships in the conventional paradigm (Chapter 3). Not only did our participants vary significantly in how they classified isolated expressions but greater emotional disparity between the isolated expressions (e.g., classified as disgust) and body gestures (e.g., angry) elicited stronger "attractive" contextual shifts. Conversely, with reducing disparity (i.e., more agreement between the face alone and body's emotion), contextual effects weakened. However, unlike with COCM, we did not observe any "repulsive" shifts. Taken together, emotional disparity between isolated expressions and body gestures emerged as a critical determinant influencing the strength of contextual influence on perception and classification of confusable emotions (i.e., angry-disgust).

As mentioned earlier, in Chapter 3, we successfully replicated contextual effects (at a group level) in an Asian sample using the conventional paradigm, consistent with studies involving Western participants (Aviezer et al., 2008; Bjornsdottir et al., 2017; Meeren et al., 2005; Van den Stock et al., 2007). Past findings suggest that Asians typically experience stronger contextual effects than Westerners (Bjornsdottir et al., 2017; Stanley et al., 2013) owing to cultural differences in thinking styles (i.e., holistic, analytical; Bjornsdottir et al., 2017; Ito et al., 2012; Ito et al., 2013; Stanley et al., 2013) and self-views (i.e., independent; Kafetsios and Hess, 2013). Therefore, in Chapter 4, we examined whether individual differences in two culturally shaped constructs (i.e., thinking styles / self-view) could explain variability in contextual effects, across a sample of British “Westerners” and Asian participants. Accordingly, we obtained both self-report (Analysis-Holism Scale, AHS; Self-Construal Scale, SCS) and behavioural (Frame-Line Task, FLT) measures for the two constructs. No significant relationships emerged between our cross-cultural constructs (i.e., AHS scores, SCS scores, or biases/sigma from FLT) and contextual effects measured using the conventional paradigm. Nevertheless, surprisingly, our Western participants exhibited stronger contextual effects than Asians (at a group level), diverging from past research (Bjornsdottir et al., 2017; Ito et al., 2013; Masuda et al., 2008). This finding may stem from Western participants increased sensitivity in detecting greater conflict between face and body cues from our Caucasian stimuli (compared to Asians) and will be discussed in relation to theoretical implications below.

In any case, even in Chapter 4, individual differences in participants’ ability to classify isolated expressions and the resulting emotional disparity between face-body cues influenced the magnitude of contextual effects. Accordingly, it remains plausible that variability in susceptibility to contextual effects may be reflected in how participants allocate overt attention selectively to either the body or face. Therefore, in Chapter 5, we investigated whether individual differences in strategies for overt attentional allocation could explain variations in participants’ experience of contextual effects. We tracked participants’ gaze behaviour, as they classified facial expressions in the conventional paradigm. Subsequently, we assessed whether gaze metrics (i.e., number of fixations, fixation duration, proportion of time spent were related to the magnitude of contextual effects. To a large extent, we failed to observe any relationships between any of our gaze metrics and the influence from body gestures when classifying facial expressions.

6.2. Theoretical implications

Across four empirical chapters, in the five distinct factors of individual differences we explored (i.e., clinical traits, judgement of isolated expressions, thinking styles, self-views, overt attention), only individual differences in participants' interpretation of isolated facial expressions consistently accounted for the strength of contextual effects. Therefore, our findings collectively lead us to claim that emotional "conflict" between the face and the context appear to be a key factor in driving contextual effects across individuals. In the following sections, we will first attempt to discuss our behavioural findings with regard to existing theories in the literature. Given some limitations of those theories, we propose a new theory that can explain both our findings and those of the literature.

6.2.1. Dimensional theories

We already described in detail (see Section 1.3.3) how these theories attempt to capture emotions in multi-dimensional spaces (2-dimensions), most popularly characterising emotions based on valence and arousal (Russell, 1980, 2003). Specifically, regarding contextual effects, dimensional theories predict that highest contextual effects may be experienced when the two target emotions are identical in terms of valence and arousal (Mondloch et al., 2013). To an extent, maybe our findings at the group level can be explained by these theories. For instance, in Chapter 2 with easily discriminable expressions, the lack of global shift in perception can be attributed to our target emotions differing in both valence and arousal–while anger communicates high arousal with negative valence, comparatively happy has lower arousal with positive valence. Therefore, as dimensional accounts predict and consistent with our findings, contextual effects would be absent in circumstances where emotion pairs (i.e., anger-happiness) differ in both dimensions of valence and arousal (Mondloch et al., 2013). Now, regarding confusable emotions in Chapters 3 to 5 (i.e., anger-disgust), contextual effects should persist given that both these emotions tend to communicate high arousal with negative valence, consistent with past studies (Aviezer et al., 2008; Lecker et al., 2020). This appears to not be the case in our findings from both the COCM and conventional paradigm.

That being said, the contextual effects observed using the conventional paradigm (i.e., classification) does support dimensional accounts to a certain extent. The strongest contextual effects were observed for the morphs at extreme-ends (Chapters 3-5), where incongruency was signalled with the highest clarity (e.g., +50 disgusted expression paired with an angry body). Accordingly, participants significantly classified these morphs in the direction of the body context, consistent with dimensional accounts that predict strongest contextual effects when the face and body conveyed similar arousal and valence (Aviezer et al., 2008; Lecker et al., 2020; Mondloch et al., 2013). Notably, although anger and disgust are identical in terms of valence-arousal, additional complexity arises considering how emotional intensity of our target emotions differed across the morphing sequence. For those morphs mid-sequence morphs (towards the neutral expressions), we generally observed weaker contextual effects for both angry and disgusted body contexts. One possibility could be that as expressions became more ambiguous (i.e., subtle), valence and arousal may have attenuated in a linear manner (Kuppens et al., 2016). Accordingly, when the emotional intensity of the morphs became more subtle, the face-body pairings may no longer map as clearly onto valence-arousal dimensions, thus reducing the magnitude of contextual effects. However, the postulations made about the mid-sequence (ambiguous) morphs remain difficult to validate, given limited prior research and insufficient evidence to the claim that linear relationships exist between valence and arousal at least for our morphed sequences (Fiorentini & Viviani, 2009).

Next, it becomes even more challenging to explain (based on dimensional theories), the individual differences relating conflict between face-body cues to the strength of contextual effects. Our findings seem to suggest that an asymmetry exists between the valence-arousal of the objective face-body composite (e.g., angry face-disgust body) and the individual's subjective assessments of these dimensions. Notably, our relationships at the individual level highlight that participants' internal assessment of the face alone (e.g., –50 angry expression classified as disgust) can diverge from objective signal of the emotional expression (e.g., –50 angry expression). Past research has primarily demonstrated that participants' assessments of valence and arousal can vary when evaluating objectively subtle expressions (Fiorentini & Viviani, 2009) or intense expressions (Sutton et al., 2019). Therefore, dimensional theories struggle to account for variability where internal representations for facial expressions are concerned, particularly in the context of conflict between face-body cues and individual variability.

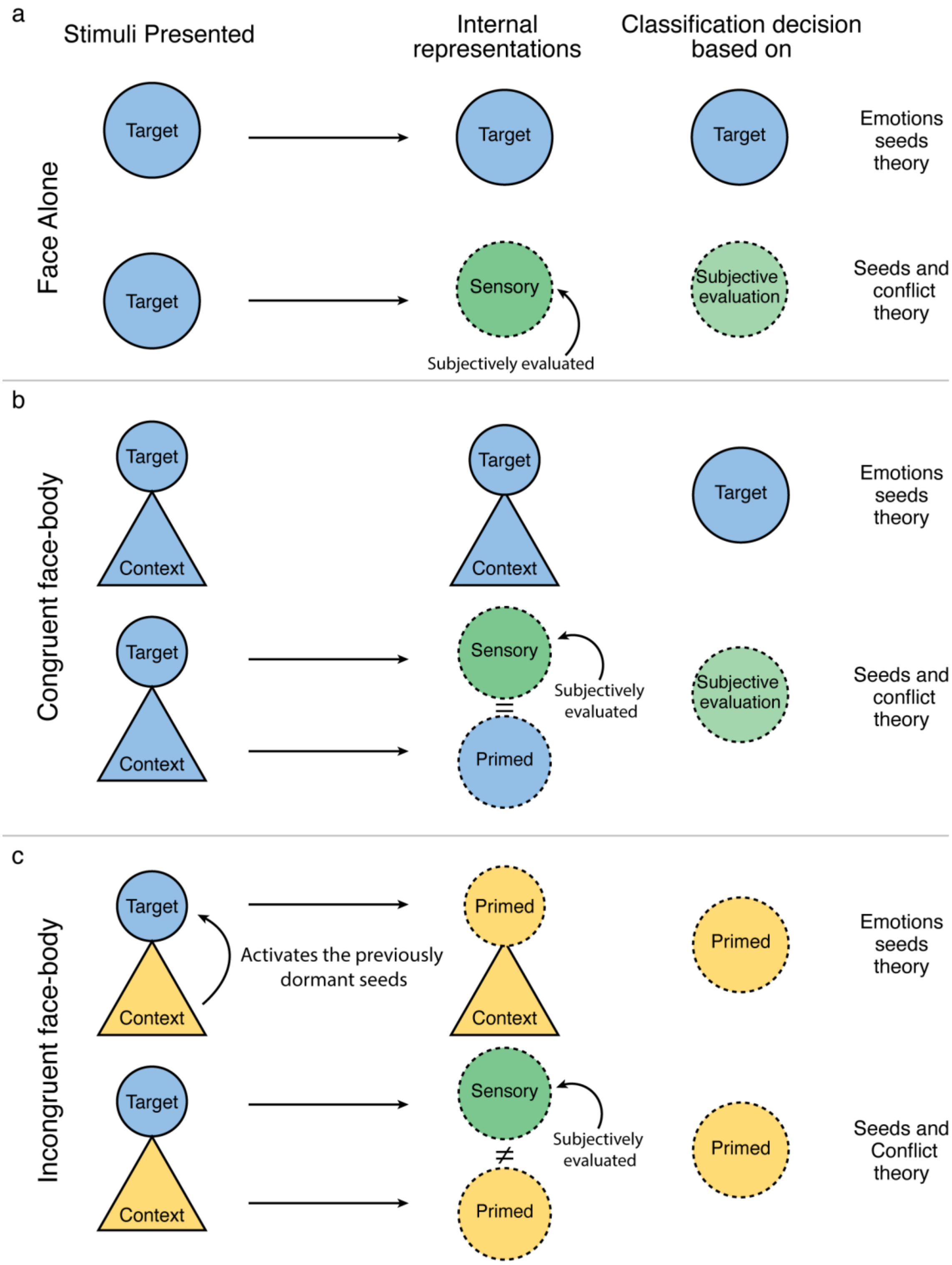
6.2.2. Emotion "seeds" theory

Next, we turn to the "emotion seeds" theory (Aviezer et al., 2008) that was conceptualised to capture contextual effects when classifying expressions, especially for emotions considered confusable (i.e., anger-disgust; Aviezer et al., 2008; Aviezer et al., 2012, Study 3; Lecker et al., 2020). Dimensional theories propose that stronger contextual effects arise from similarity in valence-arousal attributions between target emotions; however, in the emotion seeds theory, physical similarity in terms of facial features (e.g., anger-disgust; Susskind et al., 2007) drives contextual effects. This theory was explained in detail under

Section 1.7.1. Briefly, perception of emotions depends on whether an expression has distinct diagnostic physical characteristics or shares common features with another emotion (denoted as *emotion seeds*). Whilst these seeds remain dormant when judging isolated expressions (Figure 6.1, face alone condition), they can become active in a fitting context. If the context (e.g., disgust body) activates seeds for an expression (e.g., disgust face) that shares overlapping seeds with the target expression (e.g., angry face), then these seeds could override perception of the target emotion (Figure 6.1, incongruent face-body condition). Accordingly, confusable emotions (anger and disgust; Aviezer et al., 2008; Susskind et al., 2007) would exhibit stronger contextual effects compared to discriminable emotions (Van den Stock et al., 2007). However, there is no clear reason why dominant activity in emotion seeds should shift classification in the direction of the activated expression (or the context for that matter), as these seeds are common to both the presented and activated expressions.

Figure 6.1

Comparison of emotions "seeds" theory and our proposed "seeds and conflict" theory



Note. Any shapes with solid lines represents an *objective* stimulus and shapes with dotted lines denotes representations triggered owing to either the face or context.

This emotional seeds theory can explain some of our findings but not all. At a glance, our group-level findings from the conventional paradigm can be explained by Aviezer et al.'s (2008) hypothesis, wherein contextual effects may stem from shared facial features between two emotions. Participants systematically changed their category of judgements in the direction of body's emotion across all intensities (Chapter 3-5), consistent with past studies (Aviezer et al., 2008; Karaaslan et al., 2020; Lecker et al., 2020). More importantly, the strength of contextual influence varied along the morphing sequence. In general, with disgust body gestures, contextual effects were smallest for extreme disgust expressions (+50%) and increased as intensities became less disgusted and approached neutral (0%). The strength of the contextual effects became larger as the expressions approached extreme anger (−50%). At +50%, the context is congruent with the presented expression and therefore will not activate any alternative expressions that share emotions seeds with the presented expression. When the context becomes increasingly incongruent (i.e., more neutral and angrier thereafter), the quantity of shared seeds activated and the likelihood of the context activating an alternative expression increase. Therefore, dominance of shared seeds will increase and contextual effects will also be stronger (Figure 6.1, incongruent face-body condition). A similar explanation can be given for the effects of the angry context– contextual effects generally increased as expressions changed from –50% to +50%, in parallel to an increase in shared seeds along the same direction in the continuum of morphed faces.

Much like with dimensional theories, once again, our findings regarding individual difference remains incompatible with a theory based on physical similarity. Shared facial features cannot account for how our participants clearly had their own unique representations for a given expression (irrespective of the objective signal).

6.2.3. Seeds and conflict theory

Therefore, to explain our findings regarding individual differences and those in the literature, we propose a revision of the emotion seeds hypothesis, which we call the "seeds and conflict theory". Our theory makes two key assertions. First, physiological features may not be sufficient when judging emotions from facial expressions. For instance, in our conventional method, for any given target expression, the quantity of shared seeds available between the presented expression and the alternate expression activated by a context is assumed to be comparable across all observers, but clearly there were differences in the magnitude of contextual effects experienced. Second, objective facial features can be assessed against an individual's internal representation, leading to varied classification of expressions within a population that may not always match the objective emotion signalled by the stimuli.

To explain our theory, we first begin with an internal representation triggered by the sensory input (i.e., facial expression presented) which we label as the "sensory representation". In contrast, a representation of the expression activated by the context is referred to as a "primed representation". Additionally, we refer to the cue (e.g., facial expression) undergoing an interpretation as the "target" and other cues as the "context". We propose that the sensory representation of a target undergoes an evaluation, in which it is compared against the observer's expectations or stored templates of various emotions. For instance, an angry expression that is presented may produce an angry sensory representation. However, this representation may be evaluated as more closely resembling the observer's internal template for disgust, rather than aligning with the objectively presented emotion. When a target (e.g., a face) is presented alone, this evaluation guides classification (i.e., the final decision) by default (Figure 6.1, face alone condition).

The process changes when a context (e.g., a body gesture) is presented given that this context will now activate a primed representation (Figure 6.1, congruent and incongruent conditions). When there is some conflict between the sensory and primed representations—as would ideally be the case when a face and body gesture display incongruent emotions—seeds shared between the two representations are weighted in the direction of the primed representation (Figure 6.1, incongruent condition). We assume that this occurs because the primed representation appears to be more congruent with the body's emotion than the sensory representation, reducing the certainty of the sensory representation (i.e., making it an unreliable signal). In this case, the primed representation would proceed with the evaluation and guide classification (Figure 6.1, incongruent condition). In principle, our theoretical assumption of conflict resolution is similar to how multisensory cues are integrated within a Bayesian framework, where the weightage given to a cue reduces with increasing uncertainty (e.g., Alais & Burr, 2019; Zaki, 2013).

What is crucial for the conflict resolution aspect of our theory is the presence of brain mechanisms that are sensitive to the congruency in emotion between a target and the contextual cue(s) surrounding it in space. In the build-up of forming a sensory representation of a target and assigning an emotion label to it, congruency in emotion between the target and context are detected, monitored and resolved at various stages of the emotion processing hierarchy, ranging from early perceptual to late decision-making stages. There is ample support for these stages based on a wider range of ERP components identified to be involved in each of those stages (Diéguez-Risco et al., 2015; Gu et al., 2013; Xue et al., 2016; Xu et al., 2015). Although representations of the target and context, as well as the detection of congruency between them, may occur at perceptual or post-perceptual stages, our findings across our three experiments suggest that conflict resolution that guides the final classification of the target is most likely to happen at post-perceptual stages.

6.3. How can our theory explain current and past findings?

In the following section, we apply our proposed theory to the results from the current thesis and existing literature.

Conflict between isolated expressions and context. First, we propose that the classification of the facial expression without a body gesture represents the participants' self-generated evaluation of the emotion depicted in the sensory representation of the target (Figure 6.1; face alone condition). Therefore, irrespective of the objective emotion signalled by the target face, we observed at all intensities individuals interpreting the expression in a varied manner (e.g., an intense angry target face may be interpreted as less angry; i.e., fewer angry classifications), indicative of individual differences in participants' interpretations of the target face (Chapters 3-5). Next, when the target face is accompanied by a body gesture, the primed expression elicited would be in line with the context emotion (e.g., an angry body gesture primes an angry expression). According to our theory, the extent to which shared seeds are activated in the primed expression (due to context) would be determined by the disparity between the evaluation of the sensory representation (i.e., the template to which the sensory representation is matched) and the objective context emotion (e.g., disgust). For instance, if a participant evaluated the sensory representation (of the face) as angry but the body gesture signalled disgust, the resulting discrepancy would lead to the activation of shared seeds in the primed expression and judgements of classifications weighted in the direction of the primed expression (Figure 6.1; incongruent condition). In other words, the resulting uncertainty surrounding the sensory representation (of the face) increases reliance on the primed representation.

Under these circumstances, we surmise that the extent of the conflict between the sensory and primed expressions drives the magnitude of influence exerted by the body gesture, in line with our observations at every emotional intensity. Conversely, when there is agreement between the sensory representations (e.g., evaluated as an angry face) and primed representations (e.g., angry expression from an angry body gesture), then greater certainty is accorded to the former. The subsequent lack of conflict between the two representations would elicit classifications weighted in the direction of the original evaluation of the target face (Figure 6.1; congruent condition) and accordingly this translates to a diminished influence from the body gesture. Taken together, we propose that across our emotional intensities, the classification patterns reported resulted from this interplay between conflict resolution and the influence of body gestures. In this manner, we can explain the individual differences in classification observed within a given emotional intensity.

Discriminable expressions. The concepts of our seeds and conflict theory outlined above can also be applied to paradigms involving easily discriminable emotions, such as happiness and fear. For instance, Van den Stock et al. (2007) examined the influence of fearful and happy body gestures on a range of expressions that were morphed along a continuum from intense fear to intense happiness. They reported larger contextual influence for the expressions in the middle of their sequence compared to the extreme ends. A possible interpretation of this finding is that these ambiguous morphs mid-sequence triggered the greatest activation of “shared seeds”. Accordingly, this increased activation could have resulted in more conflict between the sensory representation and the primed expression elicited by the body gesture. However, given that Van den Stock et al. (2007) only reported group-level effects, we can only speculate that the majority of individual level interpretations of the target face conflicted to a large extent with the primed expression, resulting in pronounced contextual effects. Lastly, these results by Van den Stock et al. (2007) likely stemmed from the manner in which the facial expressions were morphed. The mid-sequence "neutral" expressions were not objectively neutral per se, rather they shared features from both happy and fearful expressions, contributing to greater ambiguity. Therefore, this ambiguity could lead to the activation of more shared seeds (akin to confusable emotions) and ultimately elicit larger contextual effects.

Bi-directional contextual effects. In circumstances where the body gesture becomes the target, participants' primed expressions would be triggered by the face which now acts as the context (Lecker et al., 2020). So, in any scenario where participants detect two cues, the target (e.g., body gesture) triggers a sensory representation followed by the self-generated evaluation of it and then the context (e.g., face) triggers the primed expression. Moreover, any conflict between the resulting sensory and primed expressions would lead to classifications attributed in the direction of the latter (i.e., emotion of non-target cue). More importantly, the theory explains behavioural results in the literature as well. For example, in Aviezer et al. (2008), most participants classified disgusted faces accurately (65.6%). Therefore, pairing these expressions with angry body gestures is likely to create greater conflict between the sensory representations and contextually primed expressions for most participants. As a result, classifications tend to be biased toward the primed expression, thereby reflecting the influence of the contextual emotion—an interpretation consistent with their findings.

Age and culture. Our theory also explains why some populations with difficulties in emotion perception experience larger contextual effects (e.g., older adults, Richter et al., 2011; ASD participants, Brewer et al., 2007). Older adults' difficulties with classification suggest that their evaluation of the sensory representations do not reliably match the emotion depicted by the objective stimulus. Under such circumstances, we could expect a greater discrepancy or conflict between the inaccurate evaluation of the target (i.e., face) and the primed expressions elicited by contextual cues. In line with our theory, this heightened conflict would result in greater weightage being accorded to the primed representation, thereby eliciting a stronger contextual influence on emotion classification. Therefore, the poorer the classification of expressions, the greater the conflict experienced when contexts are presented.

Furthermore, cultural differences have been observed in the extent to which contextual cues influence judgements of emotion from faces (Ko et al., 2011b; Masuda et al., 2008b; Matsumoto et al., 2012). Our findings from Chapter 4 remain contradictory to past research in that the Western cohort experienced stronger contextual effects, compared to Asians. However, our seeds and conflict theory can account for this finding. Since Westerners had heightened familiarity with the Caucasian stimuli presented, it is likely they would have enhanced sensitivity to the emotional conflict between the sensory and primed expressions and, therefore, experience larger contextual effects compared to our Asian cohort.

6.4. Limitations and future directions

However, the seeds and conflict theory does have some limitations. First, although our theory can explain the presence of bi-directional effects, it does not explain their asymmetry– specifically, why the face is more influenced by contextual cues than the reverse (Kret et al., 2013; Lecker et al., 2020). It was assumed that shared emotion seeds would be activated uniformly regardless of direction and thus resulting in similar magnitudes of influence in both directions. However, this may not be the case. It remains plausible that there may be more shared seeds between the body and facial expressions when the face is the target, rather than when the body is the target—leading to stronger contextual effects from body to face than from face to body. Second, our theory does not take into account sensory representations nor the self-generated evaluations for the emotions conveyed by the body gestures, even when the body serves as the context. It remains plausible that, as with facial expressions, individuals have internal templates for body emotions that vary independently of the objective signal. In other words, the evaluation of the sensory representation for a given body context can also vary based on the participants' subjective evaluation irrespective of the emotion objectively conveyed.

Moreover, the experiments undertaken across the current thesis do have some limitations too. In Chapter 1, we only established whether participants' perception of easily discriminable expressions shifted due to body contexts, using COCM. However, a more comprehensive investigation implementing the conventional paradigm with identical stimuli is needed for qualitative comparison, similar to Chapter 3 with confusable expressions (both COCM and conventional methods were used). Additionally, while the Caucasian stimuli presented in the current work were validated using an Asian sample, the potential influence of other-race-effects remains undeniable based on past research (Elfenbein & Ambady, 2002). This is particularly relevant to the findings in Chapter 4, where Western participants exhibited stronger contextual effects than Asian participants. Future research could benefit from exploring how individual differences in contextual effects are shaped by the racial identities of the stimuli presented (i.e., expressor's race) and the participant (i.e., perceiver's race). Moreover, when examining individual differences, particularly clinical traits, we recognize that observable reliance on contextual cues may primarily emerge in clinically diagnosed individuals. While limited evidence supports this claim (Brewer et al., 2017), a more rigorous investigation of contextual effects in clinical populations is still required.

Lastly, across all the experiments conducted (Chapters 2-5), while we aimed to recruit a sufficient sample size based on a priori power analyses using G*Power (Faul et al., 2007), the possibility that some analyses were underpowered cannot be entirely ruled out. That being said, even when applying more stringent estimation methods (e.g., using MorePower 6.0; Campbell & Thompson, 2012), the maximum recommended sample size remained consistent at 84 participants (Chapters 2-5). Nevertheless, it is important to acknowledge that these calculations were based on moderate estimates such as with medium effect sizes and 80% statistical power. Therefore, especially when conducting correlations, our sample sizes may not be sufficient to capture subtle effects—specifically for those correlations relating sub-clinical traits with contextual effects (Chapters 2-3). Thus, it remains possible that some analyses were underpowered. Future research employing larger samples and more conservative power estimates would be beneficial in further validating our findings.

6.5. Conclusion

This thesis contributes to the growing body of research attesting to the importance of contextual cues (e.g., body contexts) when classifying facial expressions. Specifically, we used robust experimental methods to establish that these contextual effects are not perceptual in nature, but rather a product of post-perceptual decisional processes. Moreover, we identified key perceiver-related factors of individual differences that did not contribute to participants' susceptibility to contextual cues in subclinical populations. Importantly, in one of the first instances, we report that the resulting disparity between participants' judgement of isolated expressions and the emotion conveyed by a context drives the strength of contextual effects when classifying facial expressions. The current work provides a foundation for future research to determine whether our findings can be generalised to all types of contexts (i.e., perceiver-related versus expresser related cues) or remain specific to body contexts that we studied.

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Appendix A

Happy and Angry Body Identity Data (Chapter 2)

Table A1

Subset of validated "Happy" body identities from the Bochum Emotional Stimulus Set (BESST) used in Chapter 2 (HA-AN emotions)

BESST code	Gender	*N*	Target Emotion	Classification Accuracy (*M*)	Misclassification as second target emotion ("Angry")	Most misclassified non-target emotion	Misclassified rate as non-target emotion
026wF	Female	83	Happy	0.903	0.012	Neutral	0.072
033wF	Female	83	Happy	0.903	0	Neutral	0.084
058wF	Female	83	Happy	0.843	0.144	Angry	0.144
015wF	Female	83	Happy	0.831	0.048	Neutral	0.096
031wF	Female	83	Happy	0.831	0.096	Angry	0.096
028mF	Male	83	Happy	0.939	0.036	Angry	0.036
053mF	Male	83	Happy	0.915	0.048	Angry	0.048
068mF	Male	83	Happy	0.903	0.072	Angry	0.072

082mF	Male	83	Happy	0.807	0.084	Angry	0.084
						Neutral	0.084
060mF	Male	83	Happy	0.795	0.168	Angry	0.168

Note. All body gestures were chosen from the frontal subset of BESST stimuli. The simple case letter in the BESST code represents gender (w = Female). The uppercase letter in the BESST code represents emotion (F = Happy, W = Angry). Mean classification accuracy (*M*) denotes the proportion of choosing the target emotion correctly. For each *gender*, identities are presented in a descending order according to the accuracy of classification as the target emotion. Mean misclassification rate (second target emotion) denotes the proportion of confusing the target emotion (happy) with the second target emotion (angry). Chance performance was .25. *N* indicates the number of judgements per identity.

Table A2

Subset of validated "Angry" body identities expressing from the Bochum Emotional Stimulus Set (BESST) used in Chapter 2 (HA-AN emotions)

BESST code	Gender	*N*	Target Emotion	Classification Accuracy (*M*)	Misclassification as second target emotion ("Happy")	Most misclassified non-target emotion	Misclassified rate as non-target emotion
032wW	Female	83	Angry	0.903	0.012	Neutral	0.072
048wW	Female	83	Angry	0.891	0.048	Happy	0.048
045wW	Female	83	Angry	0.855	0.084	Happy	0.084
036wW	Female	83	Angry	0.807	0.144	Happy	0.144
031wW	Female	83	Angry	0.783	0.156	Happy	0.156
070wW	Male	83	Angry	0.915	0.024	Sad	0.036
084mW	Male	83	Angry	0.867	0.024	Neutral	0.096
078wW	Male	83	Angry	0.867	0.012	Neutral	0.084
010mW	Male	83	Angry	0.831	0.048	Neutral	0.096
068mW	Male	83	Angry	0.783	0.024	Neutral	0.168

Note. All body gestures were chosen from the frontal subset of BESST stimuli. The simple case letter in the BESST code represents gender (w = Female). The uppercase letter in the BESST code represents emotion (F = Happy, W = Angry). Mean classification accuracy (*M*) denotes the proportion of choosing the target emotion correctly. For each *gender*, identities are presented in a descending order according to the accuracy of classification as the target emotion. Mean misclassification rate (second target emotion) denotes the proportion of confusing the target emotion (angry) with the second target emotion (happy). Chance performance was .25. *N* indicates the number of judgements per identity.

Appendix B

Statistics from Correlations conducted for Discriminable Expressions (Chapter 2)

Table B1

Means, standard deviations and Pearson's correlations for Chapter

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. NC_Sigma	16.504	4.098	–								
2. NC_Bias	3.209	3.277	0.034 (0.759)	–							
3. Happy shift	0.500	2.778	-0.021 (0.852)	-0.105 (0.342)	–						
4. Angry shift	-0.134	2.648	-0.079 (0.478)	-0.251 (0.021)	0.371* (< 0.001)	–					
5. AQ	20.179	7.701	0.121 (0.272)	0.0007 (0.995)	-0.183 (0.095)	-0.042 (0.702)	–				
6. BDI-II	16.167	9.915	0.154 (0.161)	-0.033 (0.768)	-0.088 (0.428)	-0.167 (0.130)	-0.337* (0.002)	–			
7. TAS	50.679	11.517	0.309 (0.004)	-0.008 (0.942)	-0.011 (0.918)	-0.082 (0.456)	0.434* (< 0.001)	0.442* (< 0.001)	–		
8. STAI-S	41.869	12.869	0.090 (0.413)	-0.046 (0.681)	-0.083 (0.451)	-0.203 (0.064)	0.314* (< 0.001)	0.671* (< 0.001)	0.390* (< 0.001)	–	
9. STAI-T	46.452	11.880	0.106 (0.336)	-0.123 (0.265)	-0.093 (0.399)	-0.126 (0.252)	0.485* (< 0.001)	0.759* (< 0.001)	0.528* (< 0.001)	0.777* (< 0.001)	–

Note. *M* and *SD* represent the means and standard deviations for each variable. Values for Pearson's correlations (*r*) are provided and the *p* values are given within paratheses, * $p < 0.0020$. NC = no context, AQ = Autism Quotient, BDI-II = Beck's Depression Inventory II, TAS = Toronto Alexithymia Scale, STAI-T = Spielberger State-State Anxiety Inventory (State anxiety subscale), STAI-T = Spielberger State-Trait Anxiety Inventory (Trait anxiety subscale).

Appendix C

Angry and Disgusted Body Identity Data (Chapter 3)

Table C1

Subset of validated "Angry" body gestures from the Bochum Emotional Stimulus Set (BESST) used in Chapter 3 (AN-DI emotions)

BESST code	Gender	*N*	Target Emotion	Classification Accuracy (*M*)	Misclassification as second target emotion ("Disgusted")	Most misclassified non-target emotion	Misclassified rate as non-target emotion
008wW	Female	21	Angry	1	-	-	-
017wW	Female	21	Angry	1	-	-	-
009wW	Female	21	Angry	0.952	-	Sad	0.047
015wW	Female	21	Angry	0.904	-	Neutral	0.047
						Surprise	0.047
020wW	Female	21	Angry	0.904	-	Surprise	0.047
						Sad	0.047
028mW	Male	21	Angry	1	-	-	-
042mW	Male	21	Angry	1	-	-	-

070mW	Male	21	Angry	0.952	-	Surprise	0.047
053mW	Male	21	Angry	0.904	-	Neutral	0.095
064mW	Male	21	Angry	0.857	-	Neutral	0.095

Note. All body gestures were chosen from the frontal subset of BESST stimuli. The simple case letter in the BESST code represents gender (w = Female, m = Male). The uppercase letter in the BESST code represents emotion (W = Anger, E = Disgust). For each *target emotion*, identities are presented in a descending order according to the accuracy of classification. Mean classification accuracy (*M*) denotes the proportion of choosing the target emotion correctly. Mean misclassification rate (second target emotion) denotes the proportion of confusing the target emotion (Angry) with the second target emotion presented (Disgusted).

Table C2

Subset of validated "Disgusted" body gestures from the Bochum Emotional Stimulus Set (BESST) used in Chapter 3 (AN-DI emotions)

BESST code	Gender	*N*	Target Emotion	Classification Accuracy (*M*)	Misclassification as second target emotion ("Angry")	Most misclassified non-target emotion	Misclassified rate as non-target emotion
027wE	Female	21	Disgust	0.380	-	Fear	0.571
009wE	Female	21	Disgust	0.333	-	Fear	0.523
035wE	Female	21	Disgust	0.333	-	Fear	0.621
038wE	Female	21	Disgust	0.333	-	Fear	0.428
031wE	Female	21	Disgust	0.190	-	Fear	0.619
053mE	Male	21	Disgust	0.571	.047	Fear	0.190
021mE	Male	21	Disgust	0.523	-	Fear	0.333
040mE	Male	21	Disgust	0.333	.047	Fear	0.380
028mE	Male	21	Disgust	0.285	.047	Fear	0.476
074mE	Male	21	Disgust	0.190	.047	Surprise	0.333

Note. All body gestures were chosen from the frontal subset of BESST stimuli. The simple case letter in the BESST code represents gender (w = Female, m = Male). The uppercase letter in the BESST code represents emotion (W = Anger, E = Disgust). For each *target emotion*, identities are presented in a descending order according to the accuracy of classification. Mean classification accuracy (*M*) denotes the proportion of choosing the target emotion correctly. Mean misclassification rate (second target emotion) denotes the proportion of confusing the target emotion (Disgusted) with the second target emotion presented (Angry).

Appendix D

Angry and Disgusted Face Identity Data (Chapter 3)

Table D1

Subset of validated "Angry" face identities from the Karolinska Directed Emotional Faces database used in Chapter 3 (AN-DI emotions)

KDEF ID	Gender	*N*	Target Emotion	Classification Accuracy (*M*)	Misclassification as second target emotion ("Disgusted")	Most misclassified non-target emotion	Misclassified rate as non-target emotion
AF23	Female	21	Angry	0.857	0.048	Surprise, Sad	0.048, 0.048
AF16	Female	21	Angry	0.810	-	Sad, Fear	0.048, 0.143
AF07	Female	21	Angry	0.762	0.095	Neutral, Sad, Fear	0.048, 0.048, 0.048
AF09	Female	21	Angry	0.667	0.143	Surprise, Sad, Fear	0.095, 0.048, 0.048
AF02	Female	21	Angry	0.286	0.238	Surprise	0.238
AM09	Male	21	Angry	1	-	-	-
AM14	Male	21	Angry	0.714	-	Neutral	0.143

AM28	Male	21	Angry	0.714	0.190	Sad	0.095
AM18	Male	21	Angry	0.667	0.286	Neutral	0.048
AM31	Male	21	Angry	0.619	0.143	Neutral, Surprise, Sad, Fear	0.048, 0.048, 0.048, 0.048

Note. All face identities were obtained from Karolinska Directed Emotional Faces database (Lundqvist et al., 1998). For each *target emotion*, identities (per gender) are presented in a descending order according to the accuracy of classification. Mean classification accuracy (*M*) denotes the proportion of choosing the target emotion correctly. Mean misclassification rate (second target emotion) denotes the proportion of confusing the target emotion (Angry) with the second target emotion presented (Disgusted).

Table D2

Subset of validated "Disgusted" face identities from the Karolinska Directed Emotional Faces database used in Chapter 3 (AN-DI emotions)

KDEF ID	Gender	*N*	Target Emotion	Classification Accuracy (*M*)	Misclassification as second target emotion ("Angry")	Most misclassified non-target emotion	Misclassified rate as non-target emotion
AF16	Female	21	Disgust	0.762	0.190	Fear	0.048
AF09	Female	21	Disgust	0.714	0.190	Surprise, Fear	0.048, 0.048
AF02	Female	21	Disgust	0.667	0.048	Surprise	0.143
AF07	Female	21	Disgust	0.571	0.143	Surprise, Sad, Fear	0.048, 0.143, 0.095
AF23	Female	21	Disgust	0.524	0.381	Neutral, Surprise	0.048, 0.048
AM18	Male	21	Disgust	0.762	0.190	Surprise	0.048
AM28	Male	21	Disgust	0.762	0.095	Sad, Fear	0.048, 0.095
AM14	Male	21	Disgust	0.714	0.190	Sad	0.095
AM31	Male	21	Disgust	0.714	0.190	Surprise, Sad	0.048, 0.048
AM09	Male	21	Disgust	0.619	0.048	Surprise, Sad	0.143, 0.143

Note. All face identities were obtained from Karolinska Directed Emotional Faces database (Lundqvist et al., 1998). For each *target emotion*, identities (per gender) are presented in a descending order according to the accuracy of classification. Mean classification accuracy (*M*) denotes the proportion of choosing the target emotion correctly. Mean misclassification rate (second target emotion) denotes the proportion of confusing the target emotion (Disgust) with the second target emotion presented (Anger).

Appendix E

Statistics from Correlations conducted for Confusable Expressions (Chapter 3)

Table E1

Means, standard deviations and Pearson's correlations for experiment 2

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. NC_Sigma	13.641	4.841	–								
2. NC_Bias	2.280	1.923	0.072 (0.516)	–							
3. Angry shift	-0.013	2.115	0.100 (0.367)	- 0.680* (< 0.001)	–						
4. Disgust shift	0.207	2.479	0.097 (0.382)	-0.699* (< 0.001)	0.711* (< 0.001)	–					
5. AQ	21.893	7.311	-0.056 (0.614)	-0.139 (0.207)	0.074 (0.501)	0.173 (0.115)	–				
6. BDI-II	15.536	9.393	0.072 (0.516)	-0.133 (0.226)	-0.018 (0.870)	0.138 (0.212)	0.321 (0.003)	–			
7. TAS	51.357	9.909	0.253 (0.020)	-0.103 (0.351)	0.097 (0.379)	0.214 (0.051)	0.428* (< 0.001)	0.547* (< 0.001)	–		
8. STAI-S	43.369	13.397	0.161 (0.142)	-0.042 (0.704)	-0.031 (0.781)	0.021 (0.380)	0.286 (0.008)	0.734* (< 0.001)	0.498* (< 0.001)	–	

9. STAI-T	49.083	11.397	0.035 (0.751)	-0.083 (0.452)	-0.089 (0.419)	0.097 (0.380)	0.428 (< 0.001)	0.800* (< 0.001)	0.513* (< 0.001)	0.703* (< 0.001)	–

Note. *M* and *SD* represent the means and standard deviations for each variable. Values for Pearson's correlations (*r*) are provided and the *p* values are given within paratheses, * $p < 0.0020$. NC = no context, AQ = Autism Quotient, BDI-II = Beck's Depression Inventory II, TAS = Toronto Alexithymia Scale, STAI-T = Spielberger State-State Anxiety Inventory (State anxiety subscale), STAI-T = Spielberger State-Trait Anxiety Inventory (Trait anxiety subscale).

Appendix F

One-samples *t*-tests conducted for conventional paradigm (Chapter 3)

Table F1

Results from one sample t-tests conducted for the no context condition against chance level performance (.50)

Morph Percentage (%)	*t* statistic	*p* value	Cohen's *d*	*M*	*SD*
-50%	12.148	< .001	1.325	.738	.180
-40%	11.359	< .001	1.239	.717	.180
-30%	9.233	< .001	1.007	.704	.202
-20%	6.472	< .001	.706	.664	.233
-10%	3.878	< .001	.423	.626	.298
0%	3.331	.001	.363	.611	.305
10%	2.767	.007	.302	.582	.272
20%	-6.559	< .001	-.716	.369	.183
30%	-9.129	< .001	-.996	.290	.210
40%	-10.785	< .001	-1.177	.244	.218

50%	-11.931	< .001	-1.302	.210	.233

Note. Means (*M*) and standard deviations (*SD*) reported refer to the proportion of times target expressions were classified as “angry” in the condition without a body gesture (i.e., face alone).

Table F2

Results from one sample t-tests conducted for the angry context condition against chance level performance (.50)

Morph Percentage (%)	*t* statistic	*p* value	Cohen's *d*	*M*	*SD*
-50%	19.893	< .001	2.171	.875	.173
-40%	20.693	< .001	2.258	.868	.163
-30%	19.890	< .001	2.170	.873	.172
-20%	15.886	< .001	1.733	.839	.196
-10%	12.756	< .001	1.392	.817	.228
0%	10.429	<.001	1.138	.782	.248
10%	11.027	<.001	1.203	.795	.245
20%	8.514	< .001	.929	.723	.240
30%	5.311	< .001	.579	.663	.281
40%	3.319	< .001	.362	.613	.312
50%	2.232	< .001	.028	.583	.342

Note. Means (*M*) and standard deviations (*SD*) reported refer to the proportion of times target expressions were classified as “angry” in the condition where the face was paired with an angry body gesture.

Table F3

Results from one sample t-tests conducted for the disgust condition against chance level performance (.50)

Morph Percentage (%)	*t* statistic	*p* value	Cohen's *d*	*M*	*SD*
-50%	-2.536	.013	-.277	.437	.299
-40%	-2.585	.011	-.282	.436	.228
-30%	-3.087	.003	-.337	.420	.237
-20%	-4.447	< .001	-.485	.370	.267
-10%	-3.757	< .001	-.410	.377	.299
0%	-3.244	.002	-.354	.383	.330
10%	-5.597	<.001	-.611	.326	.285
20%	-12.784	< .001	-1.395	.230	.194
30%	-16.463	< .001	-1.796	.151	.194
40%	-16.574	< .001	-1.808	.160	.188
50%	-17.932	< .001	-1.957	.144	.182

Note. Means (*M*) and standard deviations (*SD*) reported refer to the proportion of times target expressions were classified as "angry" in the condition where the face was paired with a disgusted body gesture.

Appendix G

Statistics for One-way ANOVAs for the Conventional Method (Chapter 3)

Table G1

Results from one-way repeated measures ANOVA using the conventional paradigm on confusable expressions (AN-DI)

Morph (%)	*F*	η_p^2	Post hoc *t*-tests *t* (*Cohen's d*)			*M* (*SD*)		
			AN-DI	AN-NC	NC-DI	AN	DI	NC
-50%	110.929*	.471	14.558* (2.246)	2.549* (.702)	-10.008* (-1.544)	0.875 (0.173)	0.437 (0.228)	0.738 (0.180)
-40%	111.110*	.472	14.688* (2.266)	5.129* (.793)	-9.549* (-1.473)	0.868 (0.163)	0.436 (0.228)	0.717 (0.175)
-30%	104.167*	.456	14.283* (2.204)	5.337* (.824)	-8.945* (-1.380)	0.873 (0.172)	0.420 (0.237)	0.704 (0.202)
-20%	86.349*	.410	13.003* (2.006)	4.851* (.749)	-8.151* (-1.258)	0.839 (0.196)	0.370 (0.267)	0.664 (0.233)
-10%	53.123*	.299	10.277* (1.586)	4.456* (.688)	-5.821* (-.898)	0.817 (0.228)	0.377 (0.299)	0.626 (0.298)

0%	38.365*	.236	8.731* (1.347)	3.753* (.579)	-4.978* (-.768)	0.782 (0.248)	0.383 (0.330)	0.611 (0.305)
10%	64.579*	.342	11.349* (1.751)	5.156* (.796)	-6.193* (-.956)	0.795 (0.245)	0.326 (0.285)	0.582 (0.272)
20%	126.635*	.504	15.436* (2.382)	11.073* (1.709)	-4.362* (-.673)	0.723 (0.240)	0.230 (0.194)	0.369 (0.183)
30%	109.520*	.468	14.313* (2.208)	10.418* (1.608)	-3.894* (-.601)	0.663 (0.281)	0.151 (0.194)	0.290 (0.210)
40%	81.313*	.395	11.990* (1.850)	9.756* (1.505)	-2.234 (-.345)	0.613 (0.312)	0.160 (0.188)	0.244 (0.218)
50%	70.785*	.362	11.027* (1.702)	9.384* (1.448)	-1.644 (-.254)	0.583 (0.342)	0.144 (0.182)	0.210 (0.223)

Note. AN = Angry context, DI = Disgust context and NC = No context, face alone. * = $p < .001$. Adjusted p value for the Bonferroni corrected post-hoc paired samples t-tests, $\alpha = \frac{0.05}{3} = 0.01$. Mean ($M$) values indicate the proportion of classifying target expressions as "angry" in the three experimental conditions (i.e., angry body, disgust body and face alone). SD = standard deviation.

Appendix H

The series of tables below indicate correlations conducted per emotional intensity between the proportion of "angry" responses (no context condition), anger / disgust shifts and clinical traits. [a] denotes correlations where $\alpha = \frac{0.05}{12} = 0.004$. * = $p < \alpha$. The p values are provided in paratheses.

Table H1

-50% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.738	.180	–						
2. Anger shift	.137	.157	[a] -.479* (<.001)	–					
3. Disgust shift	-.301	.250	[a] -.475* (<.001)	.017 (.881)	–				
4. AQ	21.893	7.311	-.015 (.173)	.003 (.975)	.119 (.282)	–			
5. BDI-II	15.536	9.393	-.020 (.856)	-.020 (.856)	.066 (.554)	.321 (.003)	–		
6. TAS	51.357	9.909	-.160 (.146)	-.0008 (.994)	.056 (.615)	.428* (<.001)	.547* (<.001)	–	

7. STAI-T	49.083	11.397	-.027 (.808)	.013 (.906)	.114 (.302)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H2

-40% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.717	.175	–						
2. Anger shift	.151	.181	[a] -.580* (<.001)	–					
3. Disgust shift	-.281	.244	[a] -.448* (<.001)	.008 (.945)	–				
4. AQ	21.893	7.311	-.164 (.137)	.065 (.555)	.216 (.048)	–			
5. BDI-II	15.536	9.393	-.132 (.230)	.039 (.725)	.037 (.738)	.321 (.003)*	–		
6. TAS	51.357	9.909	-.119 (.281)	.184 (.094)	.028 (.804)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	-.196 (.074)	.066 (.552)	.192 (.081)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H3

-30% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.704	.202	–						
2. Anger shift	.169	.198	[a] -.631* (<.001)	–					
3. Disgust shift	-.283	.262	[a] -.504* (<.001)	.031 (.779)	–				
4. AQ	21.893	7.311	-.217 (.048)	.079 (.477)	.233 (.033)	–			
5. BDI-II	15.536	9.393	-.009 (.933)	-.083 (.456)	-.046 (.679)	.321 (.003)*	–		
6. TAS	51.357	9.909	-.170 (.123)	-.061 (.583)	.081 (.465)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	.011 (.922)	-.049 (.661)	.019 (.862)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H4

-20% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	0.664	0.233	–						
2. Anger shift	0.175	0.23	[a] -.642* (<.001)	–					
3. Disgust shift	-0.294	0.247	[a] -.380* (<.001)	.056 (.615)	–				
4. AQ	21.893	7.311	-.124 (.261)	-.096 (.384)	.267 (.014)	–			
5. BDI-II	15.536	9.393	-.184 (.095)	.118 (.286)	.190 (.083)	.321 (.003)*	–		
6. TAS	51.357	9.909	-.108 (.327)	-.084 (.446)	.041 (.708)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	-.070 (.528)	.020 (.856)	.150 (.174)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H5

-10% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.626	.298	–						
2. Anger shift	.190	.264	[a] -.679* (<.001)	–					
3. Disgust shift	-.249	.242	[a] -.402* (<.001)	.145 (.187)	–				
4. AQ	21.893	7.311	-.014 (.898)	-.101 (.361)	.111 (.315)	–			
5. BDI-II	15.536	9.393	-.099 (.369)	.041 (.708)	.104 (.347)	.321 (.003)*	–		
6. TAS	51.357	9.909	-.090 (.413)	-.004 (.970)	.136 (.217)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	-.018 (.868)	.007 (.952)	.119 (.282)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H6

0% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.611	.305	–						
2. Anger shift	.171	.252	[a] -.618* (<.001)	–					
3. Disgust shift	-.227	.264	[a] -.335* (.002)	.158 (.151)	–				
4. AQ	21.893	7.311	-.005 (.965)	-.195 (.076)	.060 (.590)	–			
5. BDI-II	15.536	9.393	.040 (.720)	.152 (.166)	-.067 (.546)	.321 (.003)*	–		
6. TAS	51.357	9.909	-.038 (.731)	-.120 (.278)	.055 (.617)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	.057 (.604)	-.140 (.205)	.020 (.860)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H7

10% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.582	.272	–						
2. Anger shift	.213	.289	[a] -.620* (<.001)	–					
3. Disgust shift	-.256	.241	[a] -.389* (<.001)	.104 (.346)	–				
4. AQ	21.893	7.311	-.028 (.799)	-.160 (.146)	.105 (.340)	–			
5. BDI-II	15.536	9.393	.-.036 (.743)	-.096 (.387)	-.068 (.541)	.321 (.003)*	–		
6. TAS	51.357	9.909	-.041 (.714)	-.173 (.116)	.018 (.874)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	.008 (.941)	-.101 (.358)	-.045 (.685)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H8

20% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.369	.183	–						
2. Anger shift	.354	.281	[a] -.536* (<.001)	–					
3. Disgust shift	-.139	.219	[a] -.548* (<.001)	.027 (.809)	–				
4. AQ	21.893	7.311	-.113 (.305)	-.168 (.126)	.004 (.970)	–			
5. BDI-II	15.536	9.393	.-.020 (.859)	-.069 (.531)	-.076 (.493)	.321 (.003)*	–		
6. TAS	51.357	9.909	.097 (.382)	-.159 (.148)	-.061 (.584)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	.012 (.916)	-.074 (.502)	-.109 (.323)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H9

30% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.290	.210	–						
2. Anger shift	.373	.287	[a] -.393* (<.001)	–					
3. Disgust shift	-.139	.190	[a] -.534* (<.001)	-.009 (.936)	–				
4. AQ	21.893	7.311	.027 (.809)	-.167 (.128)	.074 (.503)	–			
5. BDI-II	15.536	9.393	-.046 (.677)	-.049 (.661)	.050 (.649)	.321 (.003)*	–		
6. TAS	51.357	9.909	.043 (.070)	-.145 (.189)	.151 (.171)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	.006 (.958)	-.066 (.551)	-.008 (.939)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H10

40% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.244	.218	–						
2. Anger shift	.369	.298	[a]-.297* (.006)	–					
3. Disgust shift	-.085	.203	[a] -.600* (<.001)	.106 (.338)	–				
4. AQ	21.893	7.311	.114 (.303)	-.218 (.046)	-.079 (.478)	–			
5. BDI-II	15.536	9.393	-.026 (.811)	-.098 (.376)	.068 (.540)	.321 (.003)*	–		
6. TAS	51.357	9.909	.105 (.342)	-.064 (.563)	.049 (.655)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	.013 (.906)	-.156 (.157)	.069 (.534)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Table H11

50% morph intensity

Variable	*M*	*SD*	1	2	3	4	5	6	7
1. No context	.210	.223	–						
2. Anger shift	.374	.328	-.274* (.012)	–					
3. Disgust shift	-.065	.168	-.599* (<.001)	.012 (.912)	–				
4. AQ	21.893	7.311	.083 (.455)	-.182 (.098)	.029 (.797)	–			
5. BDI-II	15.536	9.393	.026 (.816)	-.126 (.253)	-.127 (.250)	.321 (.003)*	–		
6. TAS	51.357	9.909	.159 (.149)	-.093 (.401)	-.082 (.459)	.428* (<.001)	.547* (<.001)	–	
7. STAI-T	49.083	11.397	.012 (.914)	-.086 (.439)	-.062 (.576)	.428* (<.001)	.800* (< .001)	.513* (< .001)	–

Appendix I

Statistics for One-way ANOVAs for the Conventional Method (Chapter 4)

Table I1

Results from one-way repeated measures ANOVA using the conventional paradigm for Asian participants

Morph (%)	*F*	η_p^2	Post hoc *t*-tests *t* (*Cohen's d*)		
			AN-DI	AN-NC	NC-DI
−50%	20.915*	0.249	6.300* (1.359)	1.885 (0.406)	-4.416* (-0.952)
−40%	29.846*	0.321	7.575* (1.634)	2.469 (0.532)	-5.106* (-1.101)
−30%	31.586*	0.334	7.826* (1.688)	2.713 (0.585)	-5.113* (-1.103)
−20%	20.622*	0.247	6.410* (1.382)	3.549* (0.765)	-2.861 (-0.617)
−10%	12.173*	0.162	4.933* (1.064)	2.572 (0.555)	-2.361 (-0.509)

0%	13.494*	0.176	5.116* (1.103)	3.342* (0.721)	-1.774 (-0.383)
10%	15.374*	0.196	5.531* (1.193)	3.111* (0.671)	-2.420 (-0.522)
20%	30.170*	0.324	7.709* (1.663)	4.679* (1.009)	-3.031* (-0.654)
30%	33.237*	0.345	7.988* (1.723)	5.409* (1.167)	-2.578 (-0.556)
40%	22.312*	0.262	6.222* (1.342)	5.217* (1.125)	-1.005 (-0.217)
50%	26.813*	0.299	6.939* (1.496)	5.497* (1.185)	-1.442 (-0.311)

Note. AN = Angry context, DI = Disgust context and NC = No context, face alone. * = $p < .001$. Adjusted p value for the Bonferroni corrected post-hoc paired samples t-tests, $\alpha = \frac{0.05}{3} = 0.01$.

Table I2

Results from one-way repeated measures ANOVA using the conventional paradigm for Western participants

Morph (%)	*F*	η_p^2	Post hoc *t*-tests *t* (*Cohen's d*)		
			AN-DI	AN-NC	NC-DI
−50%	61.74*	0.495	10.772* (2.323)	3.025* (0.652)	-7.748* (-1.671)
−40%	73.596*	0.539	11.767* (2.538)	3.323* (0.717)	-8.444* (-1.821)
−30%	56.569*	0.473	10.258* (2.212)	2.691 (0.580)	-7.566* (-1.632)
−20%	64.831*	0.507	11.346* (2.447)	4.841* (1.044)	-6.505* (-1.403)
−10%	38.885*	0.382	8.794* (1.897)	3.829* (0.826)	-4.965* (-1.071)
0%	47.071*	0.428	9.700* (2.092)	5.063* (1.092)	-4.637* (-1.000)
10%	61.015*	0.492	11.022*	6.155*	-4.867

			(2.377)	(1.327)	(-1.050)
20%	91.825*	0.593	12.953*	9.927*	-3.026*
			(2.793)	(2.141)	(-0.653)
30%	90.119*	0.589	12.549*	10.406*	-2.144
			(2.706)	(2.244)	(-0.462)
40%	50.578*	0.445	9.451*	7.704*	-1.747
			(2.038)	(1.662)	(-0.377)
50%	64.233*	0.505	10.436*	9.048*	-1.388
			(2.251)	(1.951)	(-0.299)

Note. AN = Angry context, DI = Disgust context and NC = No context, face alone. * = $p < .001$. Adjusted p value for the Bonferroni corrected post-hoc paired samples t-tests, $\alpha = \frac{0.05}{3} = 0.01$.

Appendix J

Statistics for Correlations conducted in Chapter 4

Table J1

Correlations between proportion of "angry" responses (no-context) and magnitude of contextual effects

Morph	No-context vs Angry shift		No-context vs Disgust shift	
	r	*p*	*r*	*p*
−50%	-0.570*	< 0.001	-0.295	0.006
−40%	-0.584*	< 0.001	-0.312*	0.003
−30%	-0.638*	< 0.001	-0.362*	< 0.001
−20%	-0.773*	< 0.001	-0.297	0.006
−10%	-0.645*	< 0.001	-0.393*	< 0.001
0%	-0.691*	< 0.001	-0.372*	< 0.001
10%	-0.657*	< 0.001	-0.403*	< 0.001
20%	-0.599*	< 0.001	-0.598*	< 0.001

30%	-0.435*	< 0.001	-0.57*	< 0.001
40%	-0.184	0.089	-0.666*	< 0.001
50%	-0.202	0.063	-0.698*	< 0.001

Note. Single asterisk (*) denotes $p < 0.004$ (adjusted significance criterion $\alpha = \frac{0.05}{12}$).

The series of tables below indicate correlations conducted per emotional intensity between the magnitude of contextual effects, Total AHS scores, SCS scores (i.e., independent / interdependent subscales), values for the degree of interference, and estimates of sigma from the FLT. The adjusted significance criterion $\alpha = \frac{0.05}{12} = 0.004$. The *p* values are provided in paratheses.

Table J2

-50% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	-0.075	_						
	(0.492)							
3. Interference	-0.187	-0.137	_					
	(0.085)	(0.210)						
4. Total AHS	0.227	0.183	-0.035	_				
	(0.035)	(0.091)	(0.749)					

5. Int_SCS	0.141	0.064	0.088	0.3	_			
	(0.195)	(0.557)	(0.418)	(0.005)				
6. Ind_SCS	-0.052	0.045	0.041	0.116	-0.03	_		
	(0.632)	(0.683)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	0.014	0.014	-0.036	-0.09	0.156	-0.016	_	
	(0.897)	(0.895)	(0.744)	(0.411)	(0.152)	(0.887)		
8. Abs_Sigma	0.089	0.045	0.214	0.028	0.106	-0.06	0.571	_
	(0.415)	(0.680)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J3

-40% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	0.129	_						
	(0.238)							
3. Interference	0.003	-0.055	_					
	(0.977)	(0.616)						
4. Total AHS	0.078	0.031	-0.035	_				
	(0.476)	(0.778)	(0.749)					
5. Int_SCS	-0.075	-0.033	0.088	0.3	_			
	(0.49)	(0.763)	(0.418)	(0.005)				
6. Ind_SCS	0.057	0.036	0.041	0.116	-0.03	_		
	(0.601)	(0.742)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	0.077	-0.051	-0.036	-0.09	0.156	-0.016	_	

	(0.479)	(0.641)	(0.744)	(0.411)	(0.152)	(0.887)		
9. Abs_Sigma	-0.006	-0.062	0.214	0.028	0.106	-0.06	0.571	_
	(0.956)	(0.57)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J4

-30% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	-0.024	_						
	(0.827)							
3. Interference	-0.077	0.106	_					
	(0.478)	(0.333)						
4. Total AHS	0.161	0.01	-0.035	_				
	(0.139)	(0.93)	(0.749)					
5. Int_SCS	0.082	-0.082	0.088	0.3	_			
	(0.452)	(0.452)	(0.418)	(0.005)				
6. Ind_SCS	-0.023	0.072	0.041	0.116	-0.03	_		
	(0.832)	(0.509)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	-0.254	0.033	-0.036	-0.09	0.156	-0.016	_	

	(0.018)	(0.764)	(0.744)	(0.411)	(0.152)	(0.887)		
10. Abs_Sigma	-0.143	-0.012	0.214	0.028	0.106	-0.06	0.571	_
	(0.191)	(0.912)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J5

-20% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	0.069	_						
	(0.528)							
3. Interference	-0.07	-0.065	_					
	(0.52)	(0.551)						
4. Total AHS	-0.081	0.052	-0.035	_				
	(0.459)	(0.635)	(0.749)					
5. Int_SCS	-0.067	-0.064	0.088	0.3	_			
	(0.539)	(0.556)	(0.418)	(0.005)				
6. Ind_SCS	-0.085	0.149	0.041	0.116	-0.03	_		
	(0.435)	(0.172)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	-0.089	0.006	-0.036	-0.09	0.156	-0.016	_	

	(0.415)	(0.955)	(0.744)	(0.411)	(0.152)	(0.887)		
11. Abs_Sigma	-0.017	-0.11	0.214	0.028	0.106	-0.06	0.571	_
	(0.874)	(0.312)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J6

-10% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	0.204	_						
	(0.06)							
3. Interference	-0.072	0.024	_					
	(0.509)	0.826						
4. Total AHS	-0.097	-40.47	-0.035	_				
	(0.373)	0.997	(0.749)					
5. Int_SCS	-0.09	-0.179	0.088	0.3	_			
	(0.412)	0.1	(0.418)	(0.005)				
6. Ind_SCS	-0.154	0.049	0.041	0.116	-0.03	_		
	(0.156)	0.654	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	0.01	0.072	-0.036	-0.09	0.156	-0.016	_	

	(0.927)	0.509	(0.744)	(0.411)	(0.152)	(0.887)		
12. Abs_Sigma	-0.014	-0.079	0.214	0.028	0.106	-0.06	0.571	_
	(0.901)	0.472	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J7

0% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	0.168	_						
	(0.123)							
3. Interference	-0.11	-0.088	_					
	(0.313)	(0.419)						
4. Total AHS	-0.028	0.063	-0.035	_				
	(0.801)	(0.567)	(0.749)					
5. Int_SCS	-0.002	-0.087	0.088	0.3	_			
	(0.984)	(0.426)	(0.418)	(0.005)				
6. Ind_SCS	-0.108	0.11	0.041	0.116	-0.03	_		
	(0.322)	(0.313)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	-0.091	0.034	-0.036	-0.09	0.156	-0.016	_	

	(0.405)	(0.759)	(0.744)	(0.411)	(0.152)	(0.887)		
13. Abs_Sigma	0.142	0.085	0.214	0.028	0.106	-0.06	0.571	_
	(0.191)	(0.436)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J8

10% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	0.108	_						
	(0.323)							
3. Interference	-0.024	0.095	_					
	(0.826)	(0.384)						
4. Total AHS	-0.08	0.022	-0.035	_				
	(0.465)	(0.84)	(0.749)					
5. Int_SCS	-0.041	-0.119	0.088	0.3	_			
	(0.708)	(0.274)	(0.418)	(0.005)				
6. Ind_SCS	-0.224	-0.051	0.041	0.116	-0.03	_		
	(0.038)	(0.641)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	0.01	0.118	-0.036	-0.09	0.156	-0.016	_	

	(0.926)	(0.28)	(0.744)	(0.411)	(0.152)	(0.887)		
14. Abs_Sigma	0.119	0.053	0.214	0.028	0.106	-0.06	0.571	_
	(0.277)	(0.625)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J9

20% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	0.131	_						
	(0.229)							
3. Interference	0.05	-0.033	_					
	(0.646)	(0.762)						
4. Total AHS	-0.027	-0.083	-0.035	_				
	(0.806)	(0.445)	(0.749)					
5. Int_SCS	0.074	0.099	0.088	0.3	_			
	(0.501)	(0.366)	(0.418)	(0.005)				
6. Ind_SCS	-0.177	0.032	0.041	0.116	-0.03	_		
	(0.103)	(0.767)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	0.047	0.18	-0.036	-0.09	0.156	-0.016	_	

	(0.666)	(0.097)	(0.744)	(0.411)	(0.152)	(0.887)		
15. Abs_Sigma	0.008	0.171	0.214	0.028	0.106	-0.06	0.571	_
	(0.945)	(0.116)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J10

30% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	0.119	_						
	(0.275)							
3. Interference	-0.016	-0.127	_					
	(0.881)	(0.244)						
4. Total AHS	-0.034	-0.007	-0.035	_				
	(0.753)	(0.946)	(0.749)					
5. Int_SCS	-0.062	-0.091	0.088	0.3	_			
	(0.569)	(0.402)	(0.418)	(0.005)				
6. Ind_SCS	-0.113	-0.114	0.041	0.116	-0.03	_		
	(0.302)	(0.296)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	-0.108	0.132	-0.036	-0.09	0.156	-0.016	_	

	(0.321)	(0.226)	(0.744)	(0.411)	(0.152)	(0.887)		
16. Abs_Sigma	-0.027	0.152	0.214	0.028	0.106	-0.06	0.571	_
	(0.808)	(0.161)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J11

40% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	0.102	_						
	(0.35)							
3. Interference	-0.008	0.011	_					
	(0.943)	(0.918)						
4. Total AHS	0.145	0.189	-0.035	_				
	(0.182)	(0.082)	(0.749)					
5. Int_SCS	0.075	0.028	0.088	0.3	_			
	(0.493)	(0.798)	(0.418)	(0.005)				
6. Ind_SCS	-0.078	0.041	0.041	0.116	-0.03	_		
	(0.473)	(0.71)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	-0.077	-0.004	-0.036	-0.09	0.156	-0.016	_	

	(0.479)	(0.968)	(0.744)	(0.411)	(0.152)	(0.887)		
17. Abs_Sigma	0.017	-0.121	0.214	0.028	0.106	-0.06	0.571	_
	(0.876)	(0.268)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Table J12

50% Morph

Variable	1	2	3	4	5	6	7	8
1. Angry shift	_							
2. Disgust Shift	0.157	_						
	(0.15)							
3. Interference	-0.03	0.018	_					
	(0.782)	(0.866)						
4. Total AHS	-0.061	-0.186	-0.035	_				
	(0.578)	(0.086)	(0.749)					
5. Int_SCS	0.081	-0.102	0.088	0.3	_			
	(0.459)	(0.35)	(0.418)	(0.005)				
6. Ind_SCS	-0.101	-0.009	0.041	0.116	-0.03	_		
	(0.353)	(0.935)	(0.709)	(0.286)	(0.785)			
7. Rel_Sigma	-0.127	-0.127	-0.036	-0.09	0.156	-0.016	_	

	(0.243)	(0.246)	(0.744)	(0.411)	(0.152)	(0.887)		
18. Abs_Sigma	0.046	-0.009	0.214	0.028	0.106	-0.06	0.571	–
	(0.676)	(0.937)	(0.048)	(0.801)	(0.329)	(0.583)	(< .001*)	

Note. AHS = Analysis-Holism Scale, Int_SCS = Interdependent Subscale, Ind_SCS = Independent Subscale, Rel_Sigma = Sigma values from relative task, Abs_Sigma = Sigma values from absolute task.

Appendix K

Statistics for One-way ANOVAs and 2 × 2 ANOVAs conducted in Chapter 5

Table K1

Results from one-way repeated measures ANOVA examining contextual effects in the emotion classification task

Morph (%)	*F*	η_p^2	Post hoc *t*-tests *t* (*Cohen's d*)		
			AN-DI	AN-NC	NC-DI
−50%	112.313	0.474	14.676* (2.265)	4.704* (0.726)	-9.971* (-1.539)
−40%	143.516	0.535	16.741* (2.583)	6.114* (0.943)	-10.626* (-1.640)
−30%	120.215	0.491	15.440* (2.382)	6.480* (1.000)	-8.960* (-1.383)
−20%	73.324	0.371	12.071* (1.863)	5.193* (0.801)	-6.878* (-1.061)
−10%	55.935	0.31	10.474* (1.616)	3.966 (0.612)	-6.509* (-1.004)

0%	40.447	0.245	8.986* (1.387)	4.158* (0.642)	-4.828* (-0.745)
10%	58.729	0.321	10.810* (1.668)	4.731* (0.730)	-6.079* (-0.938)
20%	112.192	0.474	14.658* (2.262)	10.001* (1.543)	-4.657* (-0.719)
30%	131.507	0.514	15.648* (2.415)	11.514* (1.777)	-4.134* (-0.638)
40%	102.499	0.452	13.685* (2.112)	10.488* (1.618)	-3.197* (-0.493)
50%	94.285	0.431	13.021* (2.009)	10.289* (1.588)	-2.732 (-0.422)

Note. AN = Angry context, DI = Disgust context and NC = No context, face alone. * = $p < .005$. Adjusted p value for the Bonferroni corrected post-hoc paired samples t-tests, $\alpha = \frac{0.05}{3} = 0.016$.

Table K2

Correlations between proportion of "angry" responses (no-context) and magnitude of contextual effects

Morph	No-context vs Angry shift		No-context vs Disgust shift	
	r	*p*	*r*	*p*
−50%	-0.710*	< 0.001	-0.439*	< 0.001
−40%	-0.767*	< 0.001	-0.288	0.008
−30%	-0.804*	< 0.001	-0.394*	< 0.001
−20%	-0.810*	< 0.001	-0.281	0.009
−10%	-0.802*	< 0.001	-0.307*	0.004
0%	-0.747*	< 0.001	-0.275	0.011
10%	-0.721*	< 0.001	-0.378*	< 0.001
20%	-0.617*	< 0.001	-0.489*	< 0.001
30%	-0.406*	< 0.001	-0.619*	< 0.001
40%	-0.230	0.036	-0.621*	< 0.001

50%	-0.219	0.045	-0.621*	< 0.001

Note. Single asterisk (*) denotes p < 0.0025 (adjusted significance criterion of $\alpha = \frac{0.05}{20}$)

Table K3

*Number of fixations: Results from post-hoc comparisons for the interaction of ROI * Context*

Morph	Paired-samples t-tests *t* (*p* value)			
	F_AN / B_AN	F_AN / F_DI	B_AN / B_DI	F_DI /B_DI
−40	-2.38	-2.92	-4.30*	-3.25*
	(.117)	(.027)	(< .001)	(.010)
−30	-3.05	-2.04	-2.85	-3.76*
	(.018)	(.266)	(.033)	(.002*)
30	-1.18	2.13	-2.34	-3.26*
	(1)	(.215)	(.131)	(.010)
40	-1.51	1.39	-2.35	-3.70*
	(.804)	(1)	(.127)	(.002)

Note. The p values are provided in parentheses. Single asterisk (*) denotes p < .0125 (adjusted significance criterion of $\alpha = \frac{0.05}{4}$) for comparisons. Single asterisk on morph intensity denotes significant interaction between ROI and context. AN = Angry context, DI = Disgust context, F = Face ROI and B = Body ROI. The column headings denote "ROI_Context" (e.g., F_AN; Face ROI – Angry context).

Table K4

*Fixation duration: Results from post-hoc comparisons for the interaction of ROI * Context*

Morph	Paired-samples t-tests *t* (*p* value)			
	F_AN / B_AN	F_AN / F_DI	B_AN / B_DI	F_DI /B_DI
−40	6.868* (< 0.001)	-1.838 (0.418)	1.727 (0.527)	6.678* (< 0.001)
−30	5.871* (< 0.001)	-1.811 (0.443)	2.536 (0.078)	10.057* (< 0.001)
+20	6.263* (< 0.001)	-1.024 (1.000)	7.513* (0.01)	-9.073* (< 0.001)

Note. The *p* values are provided in parentheses. Single asterisk (*) denotes p < .0125 (adjusted significance criterion of $\alpha = \frac{0.05}{4}$) for comparisons. Single asterisk on morph intensity denotes significant interaction between ROI and context. AN = Angry context, DI = Disgust context, F = Face ROI and B = Body ROI. The column headings denote “ROI_Context” (e.g., F_AN; Face ROI – Angry context).

Appendix L

Statistics for Correlations conducted in Chapter 5

Table L1

Correlations conducted for angry / disgust shifts and attentional priority for number of fixations

Morph	Correlations between magnitude of contextual effects and attentional priority			
	Pearson's *r* (*p* value)			
	Angry shift vs Priority^{fix_AN}	Angry shift vs Priority^{fix_DI}	Disgust shift vs Priority^{fix_DI}	Disgust shift vs Priority^{fix_AN}
−50%	-0.077	-0.089	0.175	0.128
	(0.484)	(0.419)	(0.112)	(0.247)
−40%	-0.006	-0.052	0.193	0.079
	(0.958)	(0.637)	(0.078)	(0.477)
−30%	-0.073	-0.073	0.198	0.196

	(0.512)	(0.510)	(0.071)	(0.074)
−20%	-0.112	-0.124	0.173	0.188
	(0.312)	(0.262)	(0.116)	(0.087)
−10%	-0.071	-0.106	0.184	0.203
	(0.523)	(0.337)	(0.093)	(0.063)
0%	-0.080	-0.164	0.144	0.143
	(0.467)	(0.136)	(0.191)	(0.196)
10%	-0.071	-0.132	0.215	0.225
	(0.523)	(0.230)	(0.049)	(0.039)
20%	-0.110	-0.169	0.178	0.165
	(0.318)	(0.124)	(0.106)	(0.135)
30%	-0.085	-0.233	0.083	0.057
	(0.444)	(0.033)	(0.453)	(0.606)
40%	-0.266	-0.341*	-0.008	0.049
	(0.014)	(0.002)	(0.941)	(0.656)
50%	-0.071	-0.197	-0.026	-0.061

	(0.523)	(0.073)	(0.814)	(0.584)

Note. FIX = number of fixations. AN = Angry context, DI = Disgust context. The superscript in the column headings "Gaze metric_Context" (e.g., FIX_AN; Number of fixations, Angry context). Adjusted significance criterion of $\alpha = \frac{0.05}{20} = 0.0025$

Table L2

Correlations conducted for angry / disgust shifts and attentional priority for fixation duration

Morph	Correlations between magnitude of contextual effects and attentional priority			
	Pearson's *r* (*p* value)			
	Angry shift vs Priority^{dur_AN}	Angry shift vs Priority^{dur_DI}	Disgust shift vs Priority^{dur_DI}	Disgust shift vs Priority^{dur_DI}
−50%	0.058	-0.007	-0.021	0.060
	(0.602)	(0.951)	(0.853)	(0.588)
−40%	0.089	-0.018	0.090	0.167
	(0.421)	(0.869)	(0.415)	(0.128)
−30%	-0.028	0.060	0.180	0.144
	(0.798)	(0.588)	(0.102)	(0.192)
−20%	-0.147	0.069	-0.064	0.001

	(0.181)	(0.532)	(0.564)	(0.992)
−10%	0.094	0.034	0.225	0.048
	(0.394)	(0.758)	(0.039)	(0.662)
0%	0.048	-0.146	0.090	0.299
	(0.666)	(0.185)	(0.416)	(0.006)
10%	-0.118	0.035	0.267	-0.031
	(0.287)	(0.752)	(0.014)	(0.778)
20%	0.087	-0.091	0.083	0.065
	(0.43)	(0.411)	(0.450)	(0.555)
30%	-0.094	-0.058	0.064	0.075
	(0.394)	(0.599)	(0.562)	(0.495)
40%	-0.048	-0.201	-0.161	-0.067
	(0.667)	(0.066)	(0.143)	(0.542)
50%	0.058	-0.007	-0.021	0.060
	(0.602)	(0.951)	(0.853)	(0.588)

Note. DUR = fixation duration. AN = Angry context, DI = Disgust context. The superscript in the column headings "Gaze metric_Context" (e.g., DUR_AN; Fixation duration, Angry context). Adjusted significance criterion of $\alpha = \frac{0.05}{20}$ = 0.0025

Table L3

Correlations conducted for angry / disgust shifts and attentional priority for proportion of time spent

Morph	Correlations between magnitude of contextual effects and attentional priority			
	Pearson's r (p value)			
	Angry shift vs Priority^{prop_AN}	Angry shift vs Priority^{prop_DI}	Disgust shift vs Priority^{prop_DI}	Disgust shift vs Priority^{prop_DI}
−50%	-0.180	-0.107	0.148	0.086
	(0.101)	(0.335)	(0.180)	(0.434)
−40%	0.048	0.029	0.142	0.049
	(0.665)	(0.795)	(0.199)	(0.659)
−30%	-0.080	-0.003	0.079	0.167
	(0.469)	(0.980)	(0.474)	(0.130)
−20%	-0.120	-0.113	0.060	0.122

	(0.276)	(0.306)	(0.590)	(0.268)
−10%	-0.036	-0.071	0.160	0.191
	(0.748)	(0.519)	(0.147)	(0.082)
0%	-0.050	-0.172	0.086	0.198
	(0.650)	(0.119)	(0.434)	(0.071)
10%	-0.092	-0.084	0.223	0.181
	(0.404)	(0.447)	(0.042)	(0.099)
20%	-60.270	-0.089	0.048	0.064
	(0.996)	(0.423)	(0.666)	(0.563)
30%	-0.161	-0.245	-0.009	-0.042
	(0.144)	(0.025)	(0.932)	(0.707)
40%	-0.154	-0.230	-0.026	-0.027
	(0.161)	(0.036)	(0.812)	(0.809)
50%	0.058	-0.007	-0.021	0.060
	(0.602)	(0.951)	(0.853)	(0.588)

Note. PROP = proportion of time spent. AN = Angry context, DI = Disgust context.The superscript in the column headings "Gaze metric_Context" (e.g., PROP_AN; Proportion of time spent, Angry context). Adjusted significance criterion of $\alpha = \frac{0.05}{20} = 0.0025$

Table L4

Correlations conducted between classification shifts and attentional shifts for gaze metrics

Morph	Correlations between classification shifts and attentional shifts Pearson's *r* (*p* value)					
	Classification shift vs Attentional shift^{face_FIX}	Classification shift vs Attentional shift^{body_FIX}	Classification shift vs Attentional shift^{face_DUR}	Classification shift vs Attentional shift^{body_DUR}	Classification shift vs Attentional shift^{face_PROP}	Classification shift vs Attentional shift^{body_PROP}
−50%	-0.176	-0.232	0.115	-0.087	-0.036	-0.182
	(0.109)	(0.034)	(0.297)	(0.432)	(0.744)	(0.097)
−40%	-0.054	-0.313	0.026	-0.027	0.093	-0.222
	(0.627)	(0.004)	(0.814)	(0.810)	(0.399)	(0.042)
−30%	-0.213	-0.215	-0.013	0.158	-0.202	0.196

	(0.051)	(0.049)	(0.907)	(0.150)	(0.065)	(0.074)
−20%	0.095	0.089	-0.213	-0.069	-0.078	0.139
	(0.389)	(0.420)	(0.051)	(0.534)	(0.482)	(0.208)
−10%	-0.190	-0.093	0.100	-0.204	0.031	0.048
	(0.083)	(0.399)	(0.367)	(0.063)	(0.783)	(0.663)
0%	-0.119	-0.130	-0.056	-0.019	-0.035	-0.016
	(0.282)	(0.240)	(0.615)	(0.861)	(0.751)	(0.888)
10%	0.166	0.006	0.115	-0.087	0.057	-0.068
	(0.132)	(0.960)	(0.297)	(0.432)	(0.604)	(0.537)
20%	-0.061	-0.098	0.151	0.036	0.107	-0.036
	(0.584)	(0.375)	(0.169)	(0.748)	(0.332)	(0.743)
30%	0.124	-0.170	-0.159	-0.218	0.132	-0.184
	(0.260)	(0.122)	(0.149)	(0.047)	(0.230)	(0.094)
40%	-0.129	-0.129	-0.039	-0.306	0.081	-0.109
	(0.243)	(0.243)	(0.727)	(0.005)	(0.466)	(0.322)
50%	0.072	-0.154	-0.036	-0.182	-0.034	-0.054

	(0.514)	(0.161)	(0.744)	(0.097)	(0.760)	(0.625)

Note. FIX = number of fixations, DUR = fixation duration, PROP = proportion of time spent. The superscript in the column headings "ROI_Gaze metric" (e.g., body_FIX; Body ROI, Number of fixations). Adjusted significance criterion of $\alpha = \frac{0.05}{20} = 0.0025$