# The Effects of Body Posture on Emotion Perception: A Developmental and Theoretical Analysis

by

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## Abstract

Previously, studies investigating emotional face perception – regardless of whether they involved adults or children – presented participants with static photos of faces in isolation. In the natural world, faces are rarely encountered in isolation. In the few studies that have presented faces in context, the perception of emotional facial expressions is altered when paired with an incongruent context. For both adults and 8-year-old children, reaction times increase and accuracy decreases when facial expressions are presented in an incongruent context depicting a similar emotion (e.g., sad face on a fear body) compared to when presented in a congruent context (e.g., sad face on a sad body; Meeren, van Heijnsbergen, & de Gelder, 2005; Mondloch, 2012). This effect is called a congruency effect and does not exist for dissimilar emotions (e.g., happy and sad; Mondloch, 2012). Two models characterize similarity between emotional expressions differently; the emotional seed model bases similarity on physical features, whereas the dimensional model bases similarity on underlying dimensions of valence an arousal.

Study 1 investigated the emergence of an adult-like pattern of congruency effects in pre-school aged children. Using a child-friendly sorting task, we identified the youngest age at which children could accurately sort isolated facial expressions and body postures and then measured whether an incongruent context disrupted the perception of emotional facial expressions. Six-year-old children showed congruency effects for sad/fear but 4-year-old children did not for sad/happy. This pattern of congruency effects is consistent with both models and indicates that an adult-like pattern exists at the youngest age children can reliably sort emotional expressions in isolation.

In Study 2, we compared the two models to determine their predictive abilities. The two models make different predictions about the size of congruency effects for three emotions: sad, anger, and fear. The emotional seed model predicts larger congruency effects when sad is paired with either anger or fear compared to when anger and fear are paired with each other. The dimensional model predicts larger congruency effects when anger and fear are paired together compared to when either is paired with sad. In both a speeded and unspeeded task the results failed to support either model, but the pattern of results indicated fearful bodies have a special effect. Fearful bodies reduced accuracy, increased reaction times more than any other posture, and shifted the pattern of errors. To determine whether the results were specific to bodies, we ran the reverse task to determine if faces could disrupt the perception of body postures. This experiment did not produce congruency effects, meaning faces do not influence the perception of body postures. In the final experiment, participants performed a flanker task to determine whether the effect of fearful bodies was specific to faces or whether fearful bodies would also produce a larger effect in an unrelated task in which faces were absent. Reaction times did not differ across trials, meaning fearful bodies' large effect is specific to situations with faces.

Collectively, these studies provide novel insights, both developmentally and theoretically, into how emotional faces are perceived in context.

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## General Introduction

Understanding and responding to emotional facial expressions allows people to successfully navigate social relationships in their environment. The ability to quickly and accurately recognize emotional expressions is an evolutionarily adaptive skill because it can help facilitate appropriate approach or avoidance behaviour (Marsh, Ambady, & Kleck, 2005; Schmidt & Cohn, 2001). Emotional facial expressions convey important social information, such as a person's internal emotional state and behavioural intentions (Fridlund, 1994; McArthur & Baron, 1983). The difference between correctly recognizing an angry face as angry and incorrectly identifying an angry face as happy is crucial. Correctly perceiving an angry face will warn of us of threat, whereas misattributing happiness to this same face could lead us to approach a dangerous situation.

Adults are experts at processing emotional facial expressions (Adolphs, 2002; Ekman, 1992, 1999; Fridlund, 1991; Russell, 1980). Adults can quickly and accurately recognize emotional facial expressions, even when presented in static photographs (e.g., Ekman, 1971, 1993; Izard, 1971). Ekman (1971) showed pictures of emotional expressions to observers in five cultures and asked them to choose from among six emotion categories (anger, sad, fear, happy, surprise, disgust) the one that best represented the expression. Recognition rates were high for each emotion – many above 90% – and were similar across the five different cultures (but see Russell, 1994).

Adults' expertise is especially evident in studies that present non-intense exemplars of emotional expressions. Matsumoto, Consolacion, Yamada, Suzuki, and

Franklin (2002) morphed angry, happy, sad, and surprised expressions with neutral expressions to create multiple intensity levels. Participants were shown 64 expressions and asked to place each expression into one of nine categories: anger, contempt, disgust, fear, happiness, sadness, surprise, no emotion, and other. Participants performed well above chance levels, even for the lowest intensity level (a blend of 50% neutral and 50% expression).

Similarly, Gao and Maurer (2009) presented adults with photos of happy, sad, and fear facial expressions morphed with neutral expressions; each expression was presented at 20 levels of intensity. The authors calculated the threshold to detect an emotion in the face (i.e., that the face was not neutral) and the percentages of misidentifications of expressions deemed to be conveying emotion. For each expression, the threshold to differentiate the emotion from neutral was between 20 and 25% intensity. Happy expressions had extremely high recognition rates; sad and fear expressions had slightly lower recognition rates, with most errors involving misidentification of sad as fear and fear as sad. In summary, adults are experts at recognizing intense exemplars of emotional expressions and are also able to detect these expressions when they are more subtle exemplars. Studying non-intense exemplars of emotion is extremely important because we often encounter subtle expressions in the real world.

**Faces In vs. Out of Context**

In most studies on face perception – regardless of whether they involve adults or children – participants are presented with static photos of faces in isolation. In the natural world, faces are rarely encountered in isolation. The reliance on presenting isolated faces in studies investigating face perception is likely a result of early research based on the

Discrete Categories theory of emotion perception. This theory states there are six basic, universal emotions – happy, sad, anger, fear, surprise, and disgust – and that these are perceived categorically in a bottom-up manner from the muscle configurations in the face (Ekman, 1970; Izard, 1997). When someone perceives a certain facial configuration, they immediately recognize it as belonging to a specific emotion category. Susskind, Littleworth, Bartlett, Movellan, and Anderson (2007) showed that a computational model could correctly categorize facial expressions based on the similarity between image pixels, despite having no understanding of emotion categories. This study shows that emotional information can be read-out from the face based on purely physical elements and that emotional expressions can be sorted into distinct categories from this information. Humans judged images of the six basic emotions and were asked to rate how well they corresponded to a set of labels on a scale from 1 to 7 (1 being 'not at all'; 7 being 'very much'; Susskind et al., 2007). The human data were similar to that of the computer, further supporting the computational model.

Although it is interesting to know how accurately adults and children recognize emotions in isolated faces, presenting faces in isolation lacks ecological validity. In the real world faces are accompanied by rich contextual information, which contributes to conveying the emotional state of an individual. For example, both the face and the body can convey information about the emotional state of an individual (Boone & Cunningham, 1998; Mondloch, 2012; Van den Stock, Righart, & de Gelder, 2007; Vieillard & Guidetti, 2009; Wallbott, 1998). Clenched fists raised in the air indicate that an individual is angry, just as an angry face does. Likewise, contextual information such as background scenes, music, and vocal expressions can all convey emotional information (de Gelder & Vroomen, 2000; Righart & de Gelder, 2008a; Van den Stock, Peretz, Grezes, & de Gelder, 2009; Van den Stock et al., 2007).

There are two reasons why it is critical to conduct studies in which faces are presented in context. First, presenting faces in isolation may underestimate the observer's ability to recognize a person's emotional state. There is evidence that emotional facial expressions are recognized at a higher rate when presented with a congruent context than when presented in isolation. Aviezer et al. (2008) found that participants' accuracy for isolated disgust faces was only 65%, but rose to 91% when a disgust face was paired with a disgust body.

Second, recent evidence suggests that our perception of emotional facial expressions is actually quite fragile and can be altered when the face is presented in an incongruent context. For example, Meeren, van Heijnsbergen, and de Gelder (2005) asked adult participants to make two-alternative forced-choice judgments of fearful and angry facial expressions presented in congruent (e.g., angry face on an angry body) and incongruent (e.g., angry face on a fearful body) contexts. Stimuli were presented for 200 ms and participants were required to make quick judgments of the emotion displayed in the face. Despite being instructed to ignore the body, participants were less accurate and slower on incongruent trials compared to congruent trials (a congruency effect), indicating that body postures affected judgments of facial expressions (see also Aviezer et al., 2008; Mondloch, 2012). Brain activity was also recorded, and electrophysiological correlates provided evidence that the integration of the face and body takes place at the very earliest stage of face processing. Larger amplitudes of the occipital P1 component at 115 ms were found for incongruent trials compared to congruent (Meeren et al., 2005).

Rapid presentation times suggest these effects are perceptual in nature, but the effects also exist with unlimited presentation times (Aviezer et al., 2008). Similar context effects have been observed when the context consists of background scenes, music, and vocal expressions (Righart & de Gelder, 2008a; Van den Stock et al., 2009; Van den Stock et al., 2007).

Two models of emotion perception explain why context might affect our perception of faces. According to the **dimensional model** (see Figure 1), context effects will occur when two emotions are similar on two underlying dimensions, valence (pleasant vs. unpleasant) and arousal (low vs. high). These dimensions are conveyed in the face and are used to attribute an emotion to the expression (Russell, 1980; Russell & Bullock, 1985). According to the dimensional model, in the first stage of processing emotional facial expressions, the dimensions of valence and arousal are read out directly and effortlessly from the face (Russell, 1997). The combination of this information then determines which emotion the observer attributes to the expresser. For example, when an emotion is high in arousal and positive in valence, observers perceive happy; when an emotion is low in arousal and negative in valence, observers perceive sadness. When two emotions are highly similar on these two dimensions – such as fear and anger, both of which are negatively valenced and high in arousal – there is more effortful top-down processing that occurs and that top-down processing is highly dependent on the context (Russell, 1997). According to Russell's model, in these instances the context can shift the categorization of emotions towards the emotion in the context. In contrast, when two emotions differ on these two dimensions – such as happy and sad, which differ in both valence and arousal – the second stage of processing is unnecessary and the context has minimal influence.

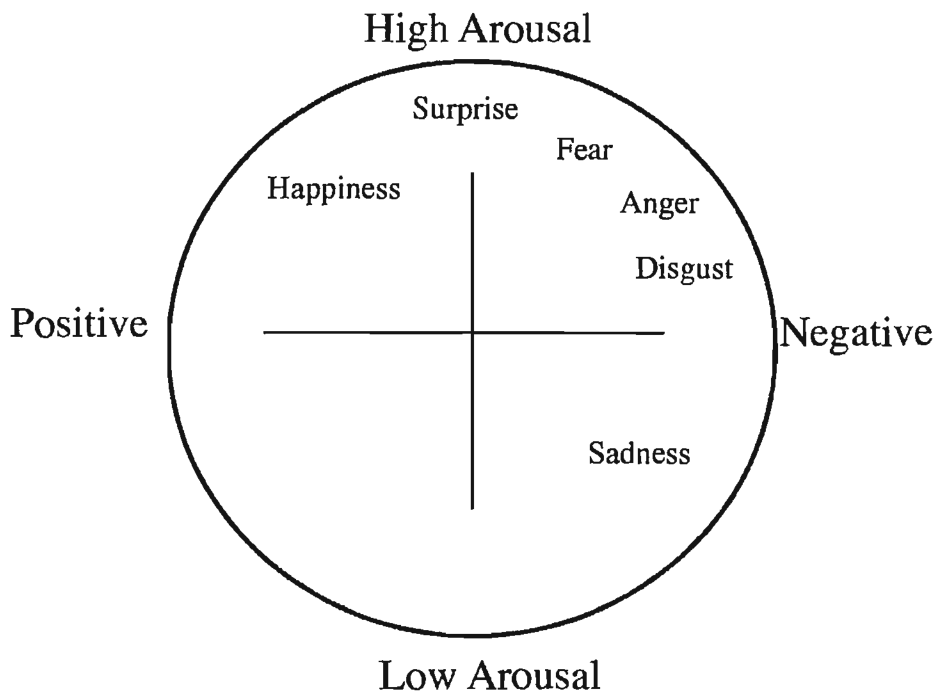


*Figure 1.* A schematic representation of the location of basic emotions on the dimensional model. The location of each emotion is based on two bipolar dimensions (valence and arousal). Based on Russell (1980).

Aviezer et al. (2008) directly illustrated that context influences adults' perception of both valence and arousal by asking adult participants to rate faces expressing sad and disgust on these dimensions when presented with congruent and incongruent bodies. Sad faces were presented on bodies depicting sadness and fear, whereas disgust faces were presented on bodies depicting disgust and pride. Sad and fear are both negatively valenced, but differ in arousal; fear is high in arousal and sad is low. Pride and disgust are both relatively high in arousal, but differ in valence; pride is positively valenced and disgust is negatively valenced. Aviezer et al. (2008) found that context influenced perceived arousal; sad faces paired with fear bodies were rated as higher in arousal than sad faces paired with sad bodies. Aviezer et al. (2008) also found that context influenced perceived valence; disgust faces paired with pride bodies were rated more positively than disgust faces paired with disgust bodies. The context was modulating perceptions of valence and arousal, which helps explain the reason why people's recognition of emotional facial expressions change in certain contexts.

Alternatively, the **emotional seed model** (see Figure 2) suggests that context effects will occur when facial displays of two emotions share physically similar characteristics, called emotional seeds (Aviezer, Hassin, Bentin, & Trope, 2008).

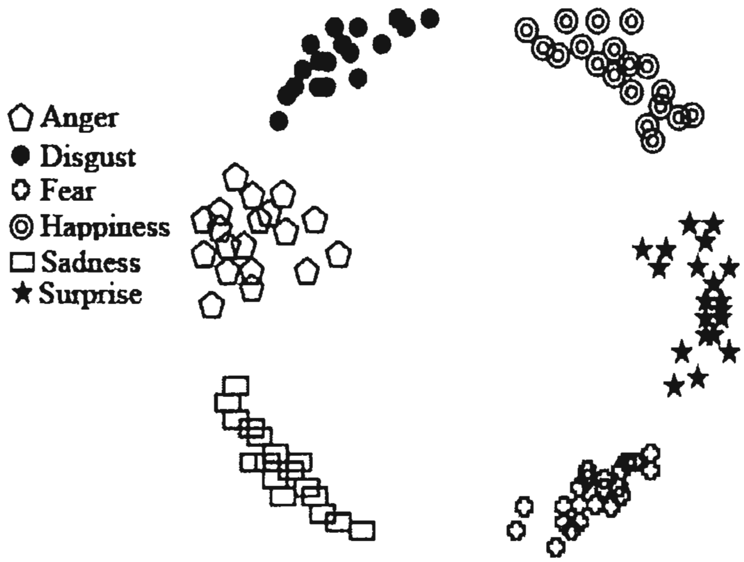


*Figure 2.* Computer-based categorization of emotions based on the physical similarity between facial expressions. The closer an emotion is to another, the more physically similar. Adapted from Susskind et al. (2007).

The way this model explains context effects is through the shared physical characteristics that certain emotions have in common. For example, anger and disgust share furrowed brows, fear and surprise share raised brows and wide eyes, and sad and fear share oblique eyebrows pulled together (Ekman & Friesen, 1976; Ekman & Friesen, 1978). When faces are viewed in isolation, these shared physical characteristics have little impact because the facial expression is not ambiguous; we can rely on other characteristics of the face for our interpretation. However, when faces are placed in an incongruent context, the interpretation of the shared physical characteristics becomes ambiguous. We start to perceive those emotional seeds as reflecting the emotion displayed in the context, thus increasing both error rates and reaction times when participants are asked to judge the face. For example, a disgust face on an angry body is more likely to be recognized as anger than a disgust face on a disgust body (Aviezer et al., 2008). This effect is because the interpretation of shared physical characteristics (the furrowed brows) is shifted by the body posture. These context effects may be mediated by a shift in scanning patterns; participants viewing a disgust face on an angry body spend more time looking at the eyes/eye brow region, which is the region typically associated with anger, rather than the mouth region, which is the region typically associated with disgust (Aviezer et al., 2008; Susskind et al., 2007).

Just as the dimensional model predicts that context effects will occur when the emotion displayed in the face is similar to the emotion in the context on the dimensions of valence and arousal, the emotional seed model predicts that context effects will be strongest when the number of shared emotional seeds is high. Aviezer et al. (2008) showed adults pictures of facial displays of disgust paired with bodies posing disgust, anger, sadness, and fear. The facial expressions associated with these body postures decrease in their physical similarity to disgust (with anger being most similar and fear being least similar) based on the output from both a computational model and human judgments of similarity (Susskind et al., 2007). Recognition of disgust was most impaired when placed on an angry body (the most similar context) and was least impaired when paired with a fearful body (the most dissimilar context) (Aviezer et al., 2008). Therefore, context will have more influence when the expressions are highly similar and will have less influence when they are highly dissimilar.

In summary, research has shown that context influences face perception in adults, although aside from Mondloch (2012), almost no research has been done with children, which suggests the need for developmental models of contextual effects. In Study 1, we examined whether the pattern of congruency effects present in adults and 8-year-old children (Mondloch, 2012) would exist at the youngest age at which children could be tested—6-year-olds for sad/fear and 4-year-olds for sad/happy. As predicted by both models, adults show congruency effects for similar emotions (i.e., sad and fear), but not for dissimilar emotions (i.e., happy and sad; Mondloch, 2012). Similarly, in the only developmental study to date, 8-year-old children show the same pattern as adults (Mondloch, 2012). Our goal was to determine whether the youngest children would show an adult-like pattern of congruency effects, or whether the pattern would be unique to their age group. It is interesting to test the youngest age group because a number of factors, such as inattention, slowly developing sensitivity to expressions, and failure to use multiple sources of information, might cause congruency effects to look entirely different in pre-school children compared to adults and even 8-year-olds.

Study 2 examined two influential models that explain the situations in which context effects will be greatest—the emotional seed model and the dimensional model. These models indicate that congruency effects will be largest when two emotions are highly similar, but the two models differ on their characterization of similarity. The dimensional model suggests fear and anger are more similar to each other than either is to sad, whereas the emotional seed model suggests anger and fear are more similar to sad than either is to the other, whereas. Accordingly, the two models make different predictions about which emotional pairings will produce the largest context effects. In Study 2, we presented angry, sad, and fearful faces on both congruent and incongruent body postures to determine whether one model can better predict congruency effects than the other. Testing these two models is important because they provide a useful tool to evaluate how people perceive facial expressions both in and out of context. However, no study has directly compared them to each other.

Collectively, these two studies provide novel contributions to how people perceive emotional facial expressions in context, something that has received relatively little examination.

# Study 1

## Introduction

Whereas adults are considered experts at perceiving emotional facial expressions, how this skill develops is not fully understood. One view is that the ability to recognize emotional facial expressions emerges early and develops quickly. To test this theory in infants, researchers use habituation. Infants are repeatedly shown one facial expression until the time they spend looking at that face decreases (they habituate) and then they are presented with a new facial expression. Increased looking times indicate that infants can discriminate between the two expressions. A variety of studies have used this technique to determine that infants can indeed discriminate between certain emotions (Barrera & Maurer, 1981; Caron, Caron, & Myers, 1982; Young-Browne, Rosenfeld, & Horowitz, 1977). Some argue that habituation is possible because very young infants already possess the ability to recognize and respond to a basic set of emotional expressions and can recognize when their caregiver is happy, sad, or afraid, for example (Izard, 1971, 1994). However, these habituation studies do not necessarily measure an infant's ability to actually recognize an emotion (attribute emotional meaning to a stimulus); rather, they are likely measuring an infant's ability to discriminate between features of a face, which is not equivalent. Knowing that two faces are different does not indicate an infant knows what each face represents emotionally (Caron et al., 1985; Widen & Russell, 2008b).

An alternative model suggests that infants are not sensitive to emotional categories per se, but that they are sensitive to one dimension, called valence, that differentiates between positive and negative emotional expressions. This initial sensitivity means positive emotional expressions are recognized earlier and more accurately than negative expressions (Boyatzis, Chazan, & Ting, 1993; Camras & Allison, 1985; Widen & Russell, 2003). These broad emotional categories are initially happy versus not happy, but eventually narrow as infants gain more experience (Widen & Russell, 2008b). Russell and Widen (2002) asked two-year-old children to sort emotional facial expressions into either a happy or angry box. Children placed anger, fear, and sad faces into the angry box with the same probability, but did not sort happy faces into the angry box. Similarly, when asked to find all the angry faces from an array of photos, two-year-old children rarely selected positive emotional facial expressions, but chose a variety of negative ones (Bullock & Russell, 1984; Denham & Couchoud, 1990). It is not until children later develop sensitivity to a second dimension, called arousal, that they are able to better discriminate between negative emotions and no longer treat every negative emotion as belonging to a single category (Widen & Russell, 2008b). Accordingly, the ability to accurately recognize prototypical facial expressions continues to develop until about 10 years of age (Camras, 1980; Camras & Allison, 1985; Gao & Maurer, 2009). Specifically, 4- and 5-year-old children are as accurate as older children and adults at recognizing happy facial expressions; however, they are significantly less accurate at recognizing sad, angry, fear, surprise, and disgust (in descending order) – although sometimes the order for sad and angry is reversed (Gao & Maurer, 2009; Widen & Russell, 2008b). These findings indicate that although infants can discriminate facial expressions, the ability to recognize and categorize them develops later.

However, there is some evidence that young children have a rudimentary ability to discriminate between negative emotions, indicating that their initial sensitivity may not be happy/not-happy exclusively. Montague and Walker-Andrews (2001) had 4-month-old infants participate in a game of peekaboo, in which a happy/surprise expression was replaced with either an anger, fear, or sadness expression. The authors found different looking times and affective responses based on the type of emotion. Children's reactions to emotions also differ based on the expresser, with a greater ability to distinguish between negative emotions expressed by certain familiar adults than unfamiliar adults. Montague and Walker-Andrews (2002) presented 3.5-month-old infants with happy, sad, and angry facial/vocal expressions presented by their parents and by strangers. Infants' looking patterns differed across emotions when viewing their mother's expressions, but not their father's or unfamiliar adult's expressions.

**Effects of Context on Children**

Classic studies of emotion perception in children investigated children’s ability to reconcile conflicting cues of emotion. For example, Gnepp (1983) presented preschool children, first graders, and sixth graders with emotional facial expressions in one of four conditions: single cue (either face or situation), congruent cues (matching face and situation), incongruent cues (non-matching face and situation), or incongruent cues plus a verbal explanation of the situation (e.g., “Here’s a boy (girl) whose bicycle is broken”). In the incongruent conditions, the youngest preschool children made judgments consistent with the facial expression; only later did children rely more on situational information. When asked after about the discrepancy between the face and the situation, first and sixth grade children were significantly more likely than preschool children to reconstruct the meaning of the facial expressive cues to fit the situation. For example, children often elaborated on the situation, sometimes changing the character’s appraisal of the situation, and other times claiming that the character was masking their true emotion. This age-related shift could occur because older children become more aware that others sometimes avoid expressing what they truly feel and alter their emotional expressions accordingly (Gnepp, 1983). It is important to note that this experiment did not specifically ask children to make judgments regarding the emotional facial expression displayed, rather children were asked "how do you think this boy (girl) feels?" This tells us little about how context actually affects emotional face perception and more about the post-perceptual, top-down processing of incongruent situations.

Only one study was designed to investigate whether children's perception of emotional facial expressions is altered when the face is presented in an incongruent context. In two separate experiments, Mondloch (2012) asked adults and 8-year-olds to judge happy versus sad facial expressions and sad versus fear facial expressions that were paired with congruent and incongruent body postures. Eight-year-olds, like adults, did not show congruency effects when presented with happy and sad facial expressions (highly dissimilar emotions), but did show congruency effects when presented with sad and fear emotional facial expressions (highly similar emotions). Adults and 8-year-old children differed in only one way; children showed larger congruency effects when presented with sad and fear emotional pairings, perhaps because their sensitivity to these emotions is not yet adult-like (Mondloch, 2012).

The finding that children, like adults, did show congruency effects for sad and fear, but did not for happy and sad, is not surprising. Although children make more errors (Camras, 1980; Camras & Allison, 1985; Gao & Maurer, 2009; Widen & Russell, 2008b) and have higher threshold sensitivities than adults (Gao & Maurer, 2009) when judging facial expressions, in some ways children's representation of emotional facial expressions is similar to that of adults. Gao, Maurer, and Nishimura (2010) used multi-dimensional scaling to map the perceptual structures of the six basic facial emotions with four levels of intensity in 7-year-olds, 14-year-olds, and a group of adults. In each trial, participants were presented with a triad of photographs of facial expressions and asked to indicate which was most different. Children's perceptual structure partially overlapped adults', with differences in the way they represented surprise, fear, and neutral expressions (Gao et al., 2010). Two findings in Gao et al.'s (2010) study help explain the pattern of congruency effects shown by Mondloch (2012): 1) children's similarity judgments reflected their sensitivity to the dimensions of both valence and arousal; and 2) children judged sad and fear to be more similar than sad and happy. These findings indicate that by 7 years of age both the emotional seed model and the dimensional model can capture children's representation of emotions and predict when context effects are likely to occur. However, it is unknown whether this same pattern of congruency effects would be observed in the youngest children who can reliably recognize emotions in both facial displays and contexts. As described below, there are two potential developmental patterns. Either context effects emerge slowly over time, or they exist at the youngest age children can recognize emotions in both faces and contexts.

**Current Study**

The fact that the majority of studies on preschool children's emotion perception include only isolated faces limits our ability to develop a comprehensive model of early emotion perception. Conducting studies with only isolated faces is not an ecologically valid measure of how children perceive emotional expressions in the real world, which means there is a hole in the children's face perception literature. Understanding how children perceive facial displays of emotion in context will provide valuable information both about the extent to which contexts enhance children's ability to determine others' emotional states and the extent to which, like adults, their representation of facial displays is susceptible to other information. The current study was designed to investigate the latter of these two issues. Preschoolers were asked to sort sad and fear faces paired with congruent and incongruent bodies, which we hypothesized would produce a congruency effect; another group of children were asked to sort happy and sad faces paired with congruent and incongruent bodies, which we hypothesized would not produce a congruency effect. Our strategy was to test the youngest children who could recognize the emotional expressions in both face and body to determine whether an adult-like pattern of congruency effects exists in young children, or whether congruency effects take on a unique pattern in children.

Our hypothesis that pre-school children will show congruency effects for sad versus fear expressions is based on two findings in the literature. First, early research shows that young children are able to extract emotional information from contextual cues — a prerequisite for congruency effects. Camras and Allison (1985) presented children from preschool to second grade with stories and line drawings of various situations. After hearing the stories, children were presented with photographs of three out of six basic emotional facial expressions. Half of the participants, after reading the first six stories, were asked to indicate which of the three photographs depicted the facial expression likely to be shown by the character in the story. After reading the second set of six stories, these children were presented with the emotional labels for the three photographs presented and asked to choose the one that described the person in the story. The order was reversed for the other half of the participants. Camras and Allison (1985) found that children's accuracy increases with age and that they perform better on verbal label trials compared to isolated face trials (although they still perform well with isolated faces). This study indicates that children can make inferences about emotions based on drawings and stories. Children do have the potential to use contextual cues in their understanding of emotion.

Second, preschool children are sensitive to dimensions of valence and arousal, just like adults and 7-year-old children, providing an opportunity for contextual cues to influence children's perception of these two dimensions. Russell and Bullock (1985) asked adults and a group of preschoolers between four and five years of age to rate the similarity-dissimilarity for emotional facial expression pairs (preschoolers were presented with a sorting task as a measure of similarity). Using multidimensional scaling, it was discovered that faces fell on two distinct bipolar dimensions—valence and arousal, although children's sensitivity to arousal takes time to develop (Boyatzis et al., 1993; Camras & Allison, 1985; Widen & Russell, 2003). The fact that preschoolers produce a similar structure to adults provides evidence that a circumplex of emotions exists even at a very young age (see Gao et al., 2010 for similar results in 7-year-old children). Furthermore, the systematic nature of children's errors in emotional facial expression recognition studies is also consistent with the underlying dimensions of the dimensional model. Bullock and Russell (1984) analyzed children's categorization errors on emotion tasks and discovered that children's errors can be predicted by the similarity of the stimuli based on the dimension of valence. When 4- and 5-year-old children made errors, over 50% of the time they were of expressions located adjacent to the correct expression on the emotional circumplex model; when 3-year-olds made errors they were located on expressions adjacent to the correct expressions approximately 40% of the time. If children's underlying representation of emotions is similar to that of adults, then context should similarly affect their recognition of emotional facial expressions.

Given that children are able to predict emotional state based on contextual cues (line drawings and stories) and are sensitive to valence and (to some extent) arousal, like adults, pre-school children should show congruency effects. Furthermore, although even infants are sensitive to valence, children's sensitivity to arousal takes time to emerge (Boyatzis et al., 1993; Camras & Allison, 1985; Widen & Russell, 2003). This slowly emerging sensitivity to arousal is why children are first able to discriminate between happy and non-happy emotional expressions, and only later are able to differentiate between negative expressions like sad, fear, and anger (Gao & Maurer, 2009; Widen & Russell, 2008b). Because of the slowly developing sensitivity to arousal, all negatively valenced emotions would be perceived as highly similar, and therefore, more ambiguous. Consequently, when two emotions are both negatively valenced, but differ in arousal (such as sad and fear), children will likely show especially large congruency effects because they have less information available than adults to differentiate the two. For example, an ambiguous emotion for children such as fear, which children do not recognize at adult-like levels until much later in childhood (Camras, 1980; Camras & Allison, 1985; Gao & Maurer, 2009), could require more affective information to correctly recognize. If a child looks more towards the body posture for affective information when trying to determine what emotion a fear facial expression is producing they will show greater congruency effects. On the other hand, the fact that children are highly sensitive to valence means that they should be able to easily discriminate between emotions that differ on this dimension, such as happy and sad emotions, just like adults.

However, there is evidence that suggests children's context effects will not necessarily assume the same pattern as those for adults. First, one possibility is that pre-school children may never show context effects, regardless of the similarity between emotions. Nelson and Russell (2011) presented children between the ages of 3 and 5 years with happy, sad, anger, and fearful emotional expressions in four dynamic cue conditions: isolated face, isolated voice, isolated body posture, and a multi-cue condition (face, body, and voice). Children ages 3- to 5-years were more accurate when asked to recognize the emotions in isolated faces ($m = .81$) and bodies ($m = .72$), than in emotional voices ($m = .43$). More importantly, children were no better at labeling emotions presented in the multi-cue condition than they were at labeling the emotions presented in the isolated face condition. This finding indicates that although children are sensitive to multiple cues to emotion, they may process these independently and not benefit from congruent contexts, at least when the stimuli are dynamic. Therefore, preschool children may not show congruency effects, regardless of the similarity between the emotional pairings, because they process various cues to emotion independently of each other. The absence of congruency effects in preschool children would indicate that children are able to rely solely on the information in the face when determining which emotion is being expressed, at least when instructed to do so.

A second possibility is that context effects in young children are ubiquitous, unlike the selective pattern observed in adults. This possibility is because young children have difficulty allocating their attention appropriately (Choi, Lotto, Lewis, Hoover, &

Stelmachowica, 2008; Irwin-Chase & Burns, 2000; Takio et al., 2009), which means they may be unable to ignore the context even when the two emotions are very dissimilar (happy/sad), despite being instructed to do so. If children look towards the body more than adults, they should show congruency effects with dissimilar emotions, even though adults do not.

Consequently, the primary question of this study was whether the recognition of emotional facial expressions in children between 3- and 6-years-of-age is influenced by emotional body expressions and whether these effects are limited to conditions in which the emotional stimuli being paired are similar (e.g., sad and fear) rather than dissimilar (e.g., happy and sad). To investigate this question, a child-friendly method (adapted fro Gao & Maurer, 2009) was designed in which participants were read a story and were asked to sort congruent and incongruent face-body compound stimuli into one of two houses, each of which represented one emotion. Participants were instructed to ignore the body and base their judgments on the facial expression. A control group consisting of adult participants was tested to ensure that our child-friendly house-sorting paradigm could elicit a congruency effect for the sad-fear pairing, analogous to effects previously shown in a speeded task using the same stimuli (Mondloch, 2012). We asked participants to sort sad and fearful stimuli in Experiment 1 and happy and sad stimuli in Experiment 2. Because our goal was to test the youngest age at which children are able to recognize the emotions conveyed by both the face and body, we began by testing adults and 4-year-old children; based on the performance of 4-year-olds we subsequently tested older (6-year-old) children with sad/fearful expressions and younger (3-year-old) children with happy/sad facial expressions. Collectively, the results of these studies provide novel insights about the nature of context effects at the youngest age children are able to reliably recognize emotion in body postures.

## Experiment 1

### Method

**Participants.** The final sample comprised three groups of 12 participants: undergraduate students (n = 12) between the ages of 18 and 26 ($M = 20.9$), 6-year-old children (n = 12) from age 5.5 to 6.5 ($M = 5.99$), and 4-year-old children (n = 12) from age 3.5 to 4.5 ($M = 3.93$). Participants were tested on two blocks of trials because pilot testing indicated that children were unable to complete four blocks of trials, likely because they experience difficulty discriminating sad versus fearful expressions, making four blocks too long for children to maintain interest and motivation. Children were recruited from a community database or a school database and were given a small toy as a reward for their participation. Adults received partial course credit or a small monetary reward for their participation. An additional six 6-year-old children were tested, but were excluded from final analysis for failing to pass criterion trials (see procedure for more details).

**Materials.** We presented photographs of 8 models' faces (4 male); each model displayed either a sad or a fear facial expression. All face stimuli were part of the validated NimStim Face Stimulus Set (Tottenham et al., 2009). The face stimuli were selected based on validation rating information provided by Tottenham et al. (2009); the expression depicted by each image used in Experiment 1 was correctly identified by over 70% of participants in Tottenham et al. (2009). All face images were resized to approximately 2.2 cm horizontally x 2.8 cm vertically and cropped such that each model's hair and face contour were similar for each expression.

Each face stimulus appeared once on a congruent body posture and once on an incongruent body posture. Body postures were taken from Mondloch (2012); each of four models (two male) provided two sad and two fearful postures that were correctly labeled by over 80% of adult participants (see Mondloch, 2012 for validation details). The compound face-body stimuli were created using Adobe Photoshop Version 8 editing software. The isolated faces were cut with the lasso function and fused with a same-sex body using the smudge function, creating 16 emotional facial stimuli aligned with 8 same-sex congruent body postures (face and body emotion matching) and 8 same-sex incongruent body postures (face and body emotion did not match). The compound stimuli were realistically proportioned creating a face to body ratio of approximately 1:6 (see Meeren et al., 2005). Misaligned versions of the stimuli were created by detaching each face from the body using the cut and lasso functions. The heads were shifted approximately 2 cm to the left of the body.

**Procedure.** Written consent was obtained from adult participants or parents of the child participants prior to testing. Participants sat at a table across from a researcher in a quiet room in a laboratory at Brock University or at the child's school. Participants were presented with two houses created out of cardboard. One was labeled the fear house and was decorated very darkly and looked very scary; the second house was labeled the sad house, which was decorated in a way that appeared very sad, with a dull house in disrepair and a cartoon person crying. To make the task fun for children, each child participant was introduced to a puppet operated by the experimenter. The puppet was introduced as Officer Goodman, the sheriff of Scary/Sad Town, and children were invited to help Officer Goodman sort the people of Scary/Sad Town into their houses. Adults performed the task without the use of a puppet. Participants were told they would be presented with a series of pictures of different people and they would have to determine whether each person belonged in the scared house or the sad house based on their face. The entire protocol comprised four phases: isolated face trials, misaligned trials, test trials, and isolated body trials.

The isolated faces block was designed to ensure participants were able to correctly identify sad and fearful faces in the absence of context; participants were shown eight of the 16 faces (4 sad) in isolation and were required to correctly judge six of the eight facial expressions to pass. Theoretically a participant could correctly judge only 50% of one emotion and still pass our criterion if they correctly identified 100% of the other emotion. We were unable to set a more strict criterion because fear is a very difficult emotion, even for adults (Russell, 1994; Tottenham et al., 2009), and setting stricter criterion for younger children would require testing a very large number of participants to find 12 that could pass. Additionally, although a participant would only be at chance for one emotion, there is still room for congruency effects to exist because performance can drop below chance levels on incongruent trials. If any participant could not correctly judge six of the eight facial expressions we could not reliably conclude that they gained any information from the isolated faces and, consequently, we would be unable to make conclusions about the effects of context. Participants were given the following instructions: *We're going to see pictures of faces and you need to decide if the* *face is scared or sad. If the face is scared it goes in the scared house, and if the face is sad it goes in the sad house.*

The misaligned training block was designed to allow participants to practice ignoring the body (see Mondloch, Pathman, Maurer, Le Grand, & de Schonen, 2007) for a similar approach when testing children on the composite face task). There was no criterion set for this block. Prior to the misaligned block child participants were told: "*A magician has come to town and he did a magic trick that made it look like people's heads are floating away from their bodies. We need to help the people to get to their own house to end the magic trick. Being a police officer, I'm really big on following rules and the biggest rule is to ignore the body and only look at the face*". All participants were told to indicate whether the face was showing scared or sad by placing them in the corresponding house. There were eight misaligned trials; half of the trials were congruent (n = 2 sad faces) and half were incongruent (n = 2 sad faces).

Following the misaligned training block, participants completed two blocks of aligned test trials each comprising eight face-body compounds. Trials within each block were presented in a fixed random order and the order of the four blocks was counterbalanced. In each block, half of the trials were congruent (n = 2 sad faces) and half were incongruent (n = 2 sad faces). Prior to each block of test trials all participants were told a story about a group of people in Scary/Sad Town; for child participants the story was told by the puppet. The story explained that the people they were about to see were either scared or sad because of events that happened to them at the zoo or circus. One story was as follows: *A big group of people that live in Scary/Sad town have just returned from their trip to the zoo! Some of the people went to see a great, big snake at* *the zoo and the snake was so big that when they saw it they were very scared. Other people went to see the baby monkeys, but the monkeys were sleeping and so the people didn't get to see them. These people are very sad because they didn't get to see the monkeys. Now that these people are back from the zoo, we need to make sure they get to the right houses! We need to look at these people's faces and decide if they go in the scared or sad house; and remember, the biggest rule is that you do not look at their bodies.*

In each block of test trials there was a catch trial in which a picture of an object depicting fear (e.g., a ghost) or sadness (e.g., a broken bicycle) was presented. Participants were required to place these in either the sad or scared house. These were inserted to maintain children's interest, to ensure that the participants were still attentive at the end of the task, and that they understood the concept of sad and fear.

After completing the test blocks, participants completed a block of trials in which eight isolated body postures (n = four sad) were presented (with the faces blurred) to ensure they were able to identify the emotional body postures. Prior to this block participants were told the following: *Ok, this is the last part of our game! It's really foggy out in Scary/Sad Town. You're going to see pictures of people, but because it's so foggy, you won't be able to see their face. You'll have to decide if the person is scared or sad by looking at their body. If the body is showing scared, put it in the scared house; if the body is showing sad, put it in the sad house.* Participants were required to accurately identify six of the eight emotional body postures in order to be included in the final analysis. Participants were excluded from final analysis if they failed to meet this criterion because if participants were unable to correctly identify isolated bodies it would be impossible to interpret either the presence or absence of congruency effects.

Children were encouraged for their good work throughout the experiment and after each set of trials they were awarded a sticker; encouragement was independent of the participants' accuracy.

**Results**

**Criteria trials: Isolated face and isolated body trials.** When tested with isolated faces, all adults passed our criteria (six of eight correct) and were very accurate (*M* correct = .94). All adult participants correctly sorted stimuli presented on each of the two catch trials. Adults were perfect on isolated body trials as well. This accuracy level for isolated emotional body posture is similar to those previously reported (Schindler, Van Gool, & de Gelder, 2008; van Heijnsbergen, Meeren, Grèzes, & de Gelder, 2007).

In total, six 6-year-old children were excluded from final analysis. Two children failed to meet criterion on isolated face trials and five children failed to meet criterion on isolated body trials; one child failed both face and body trials. The 12 6-year-old children included in the final analysis had high accuracy on isolated face trials (*M* = .92) and on isolated body trials (*M* = .93). All 6-year-old participants correctly sorted the stimuli on the two catch trials.

Of the 12 4-year-old children tested, only three children passed the inclusion criteria. Seven failed to pass the isolated faces criterion and five failed to pass the isolated bodies criterion; three children failed both. All participants correctly sorted the stimuli on the catch trials. Because most (75%) 4-year-old children failed to meet our inclusion criteria their congruency effects were not analyzed.

**Influence of congruency on accuracy.** A 2 (age: 6-year-olds and adults) x 2 (congruency: congruent and incongruent trials) mixed model ANOVA was conducted to determine whether accuracy scores on aligned trials differed as a function of congruency and age. Overall, participants were more accurate on congruent than incongruent trials, $F(1, 22) = 37.10, p < .001, \eta^2 = .628$. A significant main effect of age was also found, $F(1, 22) = 18.81, p < .001, \eta^2 = .461$; overall adults were more accurate than 6-year-olds. There was a significant age x congruency interaction, $F(1, 22) = 12.90, p < .01, \eta^2 = .370$. Thus, the accuracy scores on aligned trials varied as a function of whether the facial expressions and emotional body postures were congruent or incongruent and the magnitude of this effect was larger for 6-year-olds ($M = .32$) than for adults ($M = .09$).

To determine whether accuracy scores differed on congruent compared to incongruent trials for both adults and children, separate paired sample t-tests were conducted for each age group (see Figure 3.1). Overall, adults were more accurate on congruent trials ($M = .95$) than they were on incongruent trials ($M = .86$), $t(11) = 2.35, p < .04, d = .34$. Similarly, 6-year-old children were more accurate on congruent trials ($M = .85$) than they were on incongruent trials ($M = .53$), $t(11) = 5.72, p < .001, d = .49$. Interestingly, the excluded four 6-year-olds who failed isolated bodies, but passed isolated faces were found to be no more accurate on congruent trials ($M = .72$) than they were on incongruent trials ($M = .72$).

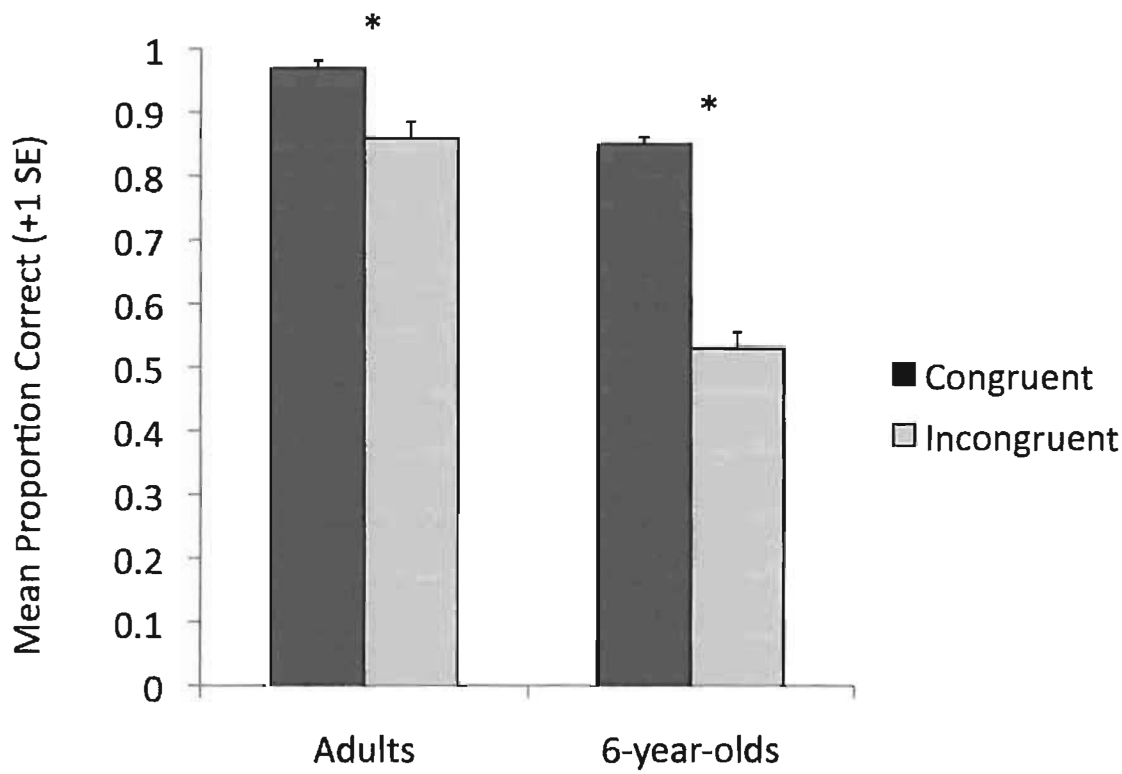


*Figure 3.1*: Adults' and 6-year-olds' mean proportion correct for sad/fear congruent and incongruent trials. Both groups are significantly more accurate on congruent trials than incongruent trials. The size of this difference is larger for children.

**Discussion**

In Experiment 1, adults showed a congruency effect with sad and fear emotional pairings; adults were better at recognizing emotional facial expressions in congruent contexts than they were in incongruent contexts. Aside from Aviezer et al. (2008), who asked participants to provide arousal ratings of sad expressions on fear bodies, this study was the first to present adults with sad-fear emotional body pairs for an unlimited amount of time. The fact that adults still showed congruency effects despite an unlimited presentation time shows how strong congruency effects are with sad and fear emotional pairs. Finding congruency effects in adults using our child-friendly method (adapted from Gao & Maurer, 2009) validated the procedure for testing pre-school children. The results from Experiment 1 also replicate previous research showing that adults' perception of facial expressions is influenced by body posture (Aviezer et al., 2008; Mereen et al., 2005; Mondloch, 2012; Van den Stock et al., 2007).

Experiment 1 is the first study to provide evidence that the perception of facial expressions in children younger than 8 years is influenced by body posture. In Experiment 1, we found that both adults and 6-year-olds showed a congruency effect when presented with sad and fear face-body compounds for an unlimited amount of time. The magnitude of the congruency effect was greater in 6-year-olds than in adults. This could possibly be because there is a ceiling effect for adults, but Mondloch (2012) showed a similar pattern of results with 8-year-olds and adults, and an analysis of residuals in that study indicated the difference in the size of effects was not attributable to baseline performance. Additionally, Mondloch (2012) showed that morphing the emotional expressions with neutral expressions, thus making the task more difficult for adults (closer to the difficulty a child participant would perceive), did not change the magnitude of effects. Accordingly, because 8-year-olds show larger effects in Mondloch (2012), it is not surprising that 6-year-olds show this same pattern. Because 4-year-olds were unable to reliably recognize emotional body postures and facial expressions in isolation, we concluded that congruency effects do not emerge gradually for similar emotions like sad and fear; they exist at the youngest age at which children can recognize the emotional expressions presented in faces and bodies, which in our study was 6 years. Not surprisingly, the four 6-year-olds who failed our criterion for isolated bodies but passed isolated faces did not show a congruency effect, indicating congruency effects exist only in conjunction with children's sensitivity to body expressions of emotion.

Because children showed a greater magnitude of congruency effects than adults for sad and fear emotional pairings it eliminated the possibility that children will never show congruency effects because they have trouble integrating multiple cues of affect, which, based on Nelson and Russell (2011), was a distinct possibility. Nelson and Russell (2011) found that preschool children are no better at recognizing emotional facial expressions paired with congruent body postures and voices than they are at recognizing emotional facial expressions in isolation. In our study, children could integrate information from body postures and these body postures did influence perception of emotional facial expressions. These results may differ from Nelson and Russell (2011) because they used dynamic expressions and we used static. Perhaps dynamic facial expressions capture attention, rendering additional information ineffectual. Or maybe dynamic facial expressions provide the most information, making all other information irrelevant. Finally, Nelson and Russell (2011) only provided congruent cues and perhaps there is no benefit to congruency, but there is a cost to incongruency, which is why we found context effects. It's even possible that dynamic stimuli are so clear in their emotional information that there is no confusion over which emotion is being expressed, regardless of whether the stimuli are congruent or incongruent, thereby eliminating congruency effects all together.

There are two possible explanations for why children showed congruency effects for sad/fear. Like adults, children may show congruency effects only when categorizing two emotions that are similar. Preschool children and adults have a similar representation of emotions in terms of valence and/or arousal (Bullock & Russell, 1984; Russell & Bullock, 1985), although their sensitivity to arousal takes time to develop (Boyatzis et al., 1993; Camras & Allison, 1985; Widen & Russell, 2003). In addition, both 7- and 14-year-old children and adults produce almost identical perceptual structures of facial expressions based on similarity judgments (Gao et al., 2010). This structure is fairly similar to the one produced by computer models by Susskind et al. (2007), which might indicate that children and adults perceive emotions as more or less similar based on physical characteristics. This finding is consistent with evidence that when children misidentify fearful expressions they are likely to misidentify them as sad; and when children misidentify sad expressions they are likely to misidentify them as fear (Gao & Maurer, 2009). The fact that children showed larger congruency effects than adults for sad/fear is likely attributable to the fact that children's emotion categories are not yet adult-like. Children's ability to recognize fear in isolated faces does not become adult-like until age 10 and the ability to recognize sad is not adult-like until age 7 (Gao & Maurer, 2009; Kolb, Wilson, & Taylor, 1992; Vicari, Reilly, Pasqualetti, Vizzotto, &

Caltagrione, 2000). Consequently, children's perception of these emotions in faces may be more susceptible to contextual influences. According to this explanation, children's context effects should be large for similar emotions such as sad and fear, and should be small or absent when categorizing dissimilar emotions for which they have adult-like proficiency (e.g., sad versus happy).

But the results of Experiment 1 do not preclude another possible explanation—that children will always show context effects because they are unable to allocate their attention properly (Choi et al., 2008; Irwin-Chase & Burns, 2000; Takio et al., 2009). Perhaps children attended to the body posture despite being instructed not to. If this were the case, we would expect congruency effects to exist in all situations, even for emotions that are quite dissimilar or emotions for which children have an adult-like proficiency.

In Experiment 2 we tested these two alternative explanations by using happy and sad as the emotional pairings. Children gain adult-like expertise with happy and sad emotional expressions by five and seven years respectively (Gao & Maurer, 2009; Kolb et al., 1992; Vicari et al., 2000), and Mondloch (2012) showed that 8-year-old children, like adults, show no congruency effects with happy and sad face-body compounds. Although 4-year-old children may have more difficulty than adults recognizing sad, they are extremely proficient at recognizing happy expressions (Boyatzis et al., 1993; Camras & Allison, 1985; Russell & Widen, 2002; Widen & Russell, 2003); young children will categorize a variety of negative emotions as the same, but are able to differentiate happy from all of them (Bullock & Russell, 1984; Denham & Couchoud, 1990; Russell & Widen, 2002). Therefore, even if a 4-year-old has trouble recognizing a sad expression, they should easily discriminate it from happy. Based on this evidence, children should have an easy time discriminating between happy and sad.

Adults and 7-year-old children both perceive happy and sad as nearly direct opposites when making similarity judgments (Gao et al., 2010). In addition, happy and sad are direct opposites on 4- and 5-year-old children's representation of emotional expressions on the dimensions of valence and arousal (Bullock & Russell, 1984; Russell & Bullock, 1985). Accordingly, young children may produce a pattern of congruency effects similar to adults (i.e., that congruency effects may not exist for happy and sad pairings, even for children as young as four years). If, however, congruency effects do exist with happy and sad, it likely would indicate that younger children are unable to allocate their attention and do indeed look more towards the body compared to adults. Such a result would make the interpretation of Experiment 1 ambiguous. Adults were not tested in Experiment 2 because Mondloch (2012) showed they do not show congruency effects with happy and sad, even when presented for limited amounts of time.

## Experiment 2

### Method

**Participants.** Children (n = 12) from ages of 3.5 and 4.5 years (*M* = 3.82) and children (n = 12) from age 2.5 to 3.5 (*M* = 3.08) participated in Experiment 2. Children were recruited from a community database or a school database and were given a small toy as a reward for their participation

**Materials.** In Experiment 2, we presented photographs of 16 models (8 male); each model displayed either a sad or a happy facial expression. All face stimuli were part of the validated NimStim Face Stimulus Set (Tottenham et al., 2009). The face stimuli were selected based on validation rating information provided by Tottenham et al. (2009); each image used in Experiment 2 was correctly identified by over 80% of participants in Tottenham et al. (2009). All face images were resized to approximately 2.2 cm horizontally x 2.8 cm vertically and cropped such that each model's hair and face contour were similar for each expression.

Each face stimulus appeared once on a congruent body and once on an incongruent body posture. Body postures were taken from Mondloch (2012); each of four models (two male) provided two sad and two happy postures that were correctly labeled by over 80% of adult participants (see Mondloch, 2012 for validation details). The compound face-body stimuli were created exactly the same as they were in Experiment 1. This created 32 emotional facial expressions aligned with 16 same-sex congruent body postures (face and body emotion matching) and 16 same-sex incongruent body postures (face and body emotion did not match).

**Procedure.** The procedure was identical to that used in Experiment 1 except that participants were asked to sort stimuli into a happy house or a sad house based on facial expression. Stories that explained why some people looked fearful were replaced with comparable stories that explained why some people looked happy (e.g., *Some of the people got to see a baby monkey at the zoo! The monkey was so cute and they were very happy because they got to see it.*) Likewise, stimuli presented on fear catch trials were replaced with pictures of candy and ice cream (i.e., stimuli that should be placed in the happy house). In contrast to Experiment 1, 4-year-old children were capable of completing four blocks of happy/sad trials, likely because they have less difficulty sorting happy and sad emotions than they do sad and fear. However, 3-year-old children were only presented with two blocks of trials; pilot testing indicated that four blocks of trials were too many for 3-year-olds.

**Results**

**Criteria trials: Isolated face and isolated body trials.** All 4-year-old participants performed without error on isolated face trials, successfully sorted stimuli presented on each of the four catch trials, and were extremely accurate on isolated body trials ($M = .86$). Similarly, all 3-year-old children passed our criteria for isolated faces; three children made one mistake and the rest performed without error. All 3-year-old participants successfully sorted stimuli presented on catch trials. In contrast to 4-year-olds, only two 3-year-olds met the criterion on isolated body trials ($M = .55$). Because congruency effects require that participants accurately recognize emotions in both the body and the face 3-year-olds' congruency effects were not analyzed.

**Influence of congruency on accuracy.** For each participant the number of trials on which they selected the correct facial expression was calculated for both congruent and incongruent trials. A paired samples t-test was conducted to determine if accuracy scores on aligned trials differed as a function of congruency. Overall, 4-year-old children were no more accurate on congruent trials ($M = .96$) than they were on incongruent trials ($M = .94$), $t(11) = 1.08$, $p > .30$, $d = .16$ (see Figure 3.2).

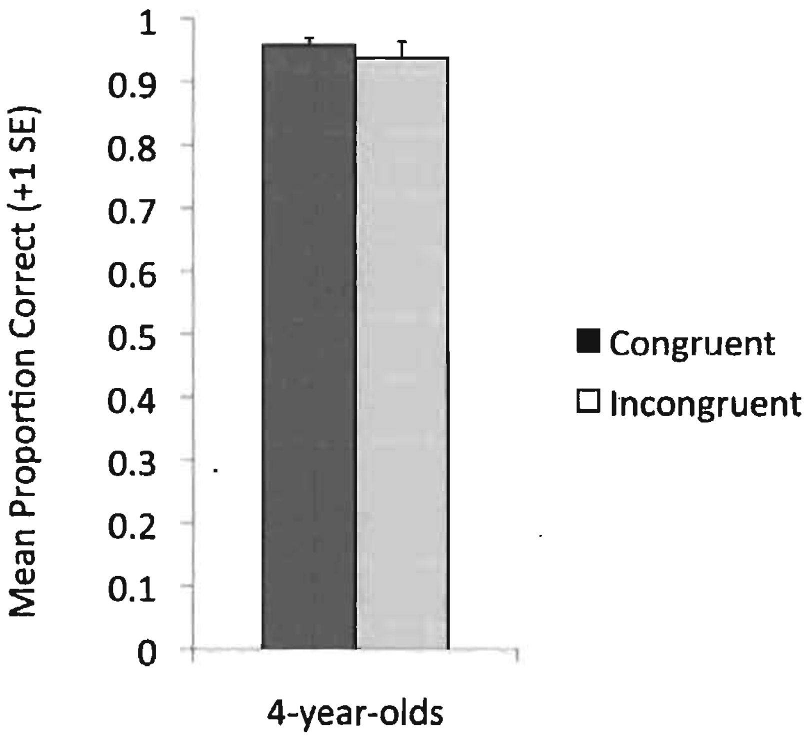


*Figure 3.2*: 4-year-olds' mean proportion correct for sad/happy congruent and incongruent trials. There is no difference in accuracy between congruent trials and incongruent trials.

**Discussion**

In Experiment 2, we found that 4-year-olds do not show a congruency effect when presented with happy and sad face-body compounds. Although 3-year-olds were able to reliably recognize happy and sad facial expressions, they were unable to do so with body postures, so their congruency effects were not analyzed. In other words, at the youngest age at which children were able to reliably recognize both happy and sad expressions in both the face and body, they did not show congruency effects. This result is consistent with the findings by Mondloch (2012), who showed that neither 8-year-old children nor adults show a pattern of congruency effects when presented with happy and sad expressions.

There was no predicted difference in the size of congruency effects between children and adults for happy and sad because children have as much expertise with happy as adults do. The absence of congruency effects in both age groups for happy/sad pairings provides further evidence that children's congruency effects, like those of adults, depend on the similarity between the emotion displayed in the face and the body. For children, happy and sad are opposite on a circumplex of emotions (Russell & Bullock, 1985), based on valence and arousal (Bullock & Russell, 1984). This representation is similar to adult's circumplex of emotions (Russell, 1980; Russell & Bullock, 1985). Adults and 7- and 14-year-old children also perceive happy and sad as opposites when making similarity judgments (Gao et al., 2010). Children in Experiment 1 showed large congruency effects when the emotions displayed in both the face and body were negatively valenced but differed in arousal (sad and fear); yet in Experiment 2, even younger children did not show congruency effects when the two emotions differed in both valence and arousal (happy and sad). Clearly, similarity is important.

The findings in Experiment 2 also strengthen what we found in Experiment 1. The fact that children as young as four years did not show congruency effects for happy and sad contradicts the possibility that there were only congruency effects in Experiment 1 because 6-year-olds could not properly allocate their attention. If the children in our study were unable to allocate their attention, we should have found congruency effects for all emotions, even dissimilar ones like happy and sad.

In addition to providing insights about how body postures influence children's perception of facial expressions, our study provided novel insights into the development of children's sensitivity to body postures, something about which little is known. Surprisingly, 3-year-olds were unable to reliably categorize happy and sad body postures in isolation, despite the vast difference between the two postures. It is possible that young children do not have enough experience with these body postures and therefore are unable to understand the emotional meaning behind them. Our finding that sensitivity to happy and sad emotional facial expressions preceded that of happy and sad emotional body postures, suggests that knowledge of facial expressions helps bootstrap knowledge of body postures and helps children learn the emotional meaning of these postures.

Our finding that 3-year-olds were unable to reliably recognize body postures is in contrast to Nelson and Russell (2011) who reported that 3- to 5-year-old children were able to recognize happy and sad bodies in over 75% of trials with no improvements between 3 and 5 years. However, they used dynamic displays, which could account for the discrepancy between our results. The results from Nelson and Russell (2011) are consistent with Boone and Cunningham (1998), who showed that children as young as five years are able to perceive both sad and happy in dance forms of expressive body movement. Perhaps children learn to recognize static postures later than dynamic movements. Dynamic movements may have more information available to children, thus making recognition easier.

In summary, the primary finding of Experiment 2 was that 4-year-old children, like adults, were not influenced by incongruent body posture when judging happy/sad facial expressions.

## General Discussion

The primary goal of the study was to determine the influence of emotional body postures on young children's perception of emotional facial expressions. The results of Experiment 1 and 2 provide the first evidence that children younger than 8 years of age produce similar patterns of context effects as both older children and adults. Like adults and 8-year-olds, 6-year-olds' perception of sad and fearful facial expressions was disrupted when the facial expressions were presented in the context of incongruent body postures. But, also like adults and 8-year-olds, 4-year-old children did not show congruency effects when sad and happy facial expressions were presented in the context of incongruent body postures.

Aside from Mondloch (2012), very few studies have examined the influence that context has on recognition of emotional facial expressions. One of these studies was conducted by Gnepp (1983), who presented children with emotional facial expressions in either congruent or incongruent situations. Children were asked, "How does this boy (girl) feel?" Younger children were more likely to rely on the facial expression, whereas older children were more likely to rely on the situation for their judgments. This finding is different from our study because it is asking how children attribute emotion to a person in different situations, whereas we are asking how do children perceive emotional facial expressions in different contexts.

The results of Experiment 1 and 2 support the hypothesis that context effects do not emerge slowly. Rather, they emerge suddenly for similar emotions, but do not exist at all for dissimilar emotions. In Experiment 1, 4-year-old children were unable to reliably recognize sad and fearful expressions presented in both isolated faces and body postures; however, 6-year-old children were able to recognize these stimuli and they did show congruency effects with these emotions. These results lead us to conclude that for sad and fear, two similar emotions, context effects do not emerge gradually; they are present at the youngest age children are able to reliably recognize sad and fearful emotional expressions in body postures. In Experiment 2, 3-year-old children were unable to recognize happy and sad expressions presented in isolated body postures; however, 4-year-old children were able to and they did not show congruency effects with these emotions. These results lead us to conclude that for happy and sad, two highly dissimilar emotions, context effects are absent even at the youngest age children can reliably recognize happy and sad emotional expressions in both faces and body postures.

A lack of congruency effects in Experiment 2 means that the results of Experiment 1 are likely caused by similarity between emotions. Based on both physical similarity (Susskind et al., 2007) and the dimensions of valence and arousal (Russell, 1980; Russell & Bullock, 1985), sad and fear are similar, whereas happy and sad are dissimilar. Collectively, the results from Experiment 1 and Experiment 2 show that congruency effects exist, and are largest, for similar emotions, but are smallest, or even non-existent, for dissimilar emotions at all stages of development.

However, despite similarities in the pattern of effects, there are certain differences between children and adults. In Experiment 1, 6-year-old children showed larger congruency effects than adults for sad and fear, two emotions for which they do not yet have an adult-like proficiency (Gao & Maurer, 2009; Widen & Russell, 2008b). This finding would indicate that although the existence of congruency effects depends on similarity between emotions, the size of congruency effects depends on the level of expertise with the emotions. The fact that the difference in congruency effects was found with sad and fear pairings is unsurprising considering how the ability to recognize fear develops. Fear is very difficult to recognize compared to other emotions, even for adults (Russell, 1994; Tottenham et al., 2009), and children do not reach adult-like expertise until much later in childhood (Gao & Maurer, 2009; Widen & Russell, 2008b). The difference in expertise for children and adults may be much larger for an emotion like fear compared to an emotion like sad, thus contributing to the difference in the size of congruency effects between children and adults. In terms of the models, children may be less sensitive to the dimensions underlying each model (i.e., to subtle physical characteristics and arousal), possibly making the distance between emotions on children's perceptual structure smaller. It may not be until children have greater sensitivity to the underlying dimensions of valence and arousal, or the subtle physical differences between emotions, that they perceive emotions like sad and fear to be as similar as adults perceive them.

Developmentally, the lack of congruency effects when happy is involved is not surprising either. Happy is quite dissimilar from all other emotions, and is differentiated from all other emotions very early on in development (Russell & Widen, 2002; Widen & Russell, 2008b). Perhaps happy holds a special status that means it can never be interfered with. One explanation might be that while growing up, and especially during infancy, most people a child encounters present very intense happy expressions and do so frequently. A child may become an expert with happy quite quickly, even very subtle expressions of it, facilitating its distinction from other, negative, emotions. Happy may also be preferentially processed. We know that children learn to differentiate emotions on the basis of valence first (Russell & Widen, 2002; Widen & Russell, 2008b), so perhaps the valence of an expression is processed first, and if it is determined that the expression is positively valenced then nothing else matters. Happy is one of the few positively valenced emotions, so reading out positive valence from an expression almost always will indicate a happy expression. There is evidence of congruency effects with happy faces paired with fear and disgust background scenes (Righart & de Gelder, 2008a, 2008b), but these are limited almost solely to reaction times, meaning accuracy is still protected for happy faces. Additionally, there is a congruency effect with happy and fear face-body pairs, but the effect is asymmetrical. Van den Stock et al. (2007) found lower accuracy for fearful expressions paired with happy bodies compared to those paired with fearful bodies, but did not find the same pattern for happy faces.

Additionally, the results of Experiment 1 directly contradict the Discrete Model of emotion perception, which predicts that context does not have an influence on our perceptions of emotional facial expressions. However, Experiment 1 showed that sad and fear body postures do alter the perceptions of sad and fear facial expressions, in both adults and children.

The results of both experiments are consistent with both the Emotional Seed Model and the Dimensional Model. Both models state that sad and fear are relatively similar to each other, and thus should produce congruency effects, which is what we found in both adults and young children in Experiment 1. Additionally, both models state that happy and sad are highly dissimilar, and thus should not produce congruency effects, which is what we found in young children in Experiment 2. The models of emotion perception, which were developed on adults, are also consistent with data from children. This indicates that while emotional perception may not be fully adult-like in young children, the mechanisms behind context effects are the same in both children and adults.

Finally, our research shows that the development of emotion perception is not analogous across cues. The ability to perceive emotions in faces precedes that ability to do so in body postures, at least for happy and sad postures presented as static images. It is possible that children's perception of emotional body postures is aided by their knowledge of emotional facial expressions, and thus takes longer to develop.

**Future Research**

Children did not show congruency effects in Experiment 2, precluding the possibility that context effects only exist in Experiment 1 because children cannot allocate their attention properly. However, we cannot determine whether children show larger congruency effects than adults for sad and fear because they spend more time looking at the body posture. The only way to determine this would be to add an eye-tracking component to the study. This type of experiment was not used in the current study because we believed 4-year-old children would require an interactive hands-on paradigm in order to complete the experiment. But 4-year-old children were not able to reliably recognize face and body expressions of fear and sad, even in our interactive, hands-on paradigm; the youngest children capable of recognizing sad and fear in our study were 6-year-olds. An eye-tracking study with 6-year-olds is more feasible than one with 4-year-olds, and is an avenue for potential follow-up research.

In Experiment 2, 3-year-old children were unable to reliably recognize isolated happy and sad body postures. To circumvent this issue, while still examining context effects with these emotions at these ages, a follow-up study could be designed with emotional facial expressions presented on emotional background scenes. This method has already been shown to elicit congruency effects in adults (Righart & de Gelder, 2008a, 2008b) and could allow us to determine if congruency effects exist at even younger ages. This study could provide further support for our suggestion that context effects do not develop gradually; they emerge for certain similar emotions as soon as we are able to reliably recognize the contexts. However, this type of study would not work with sad and fear expressions because 4-year-old children could not recognize those expressions in both isolated faces and bodies.

Additionally, we theorized that perhaps children gain an early expertise with happy due to the frequency with which it is encountered in a child's environment. However, children who do not perceive happy expressions as intensely or frequently ma not show the same expertise with happy. For these children, happy may not be as dissimilar to all other emotions as happy is for most children, making happy susceptible to congruency effects. For example, a child who grows up in a home with a mother who has depression or a child who grows up in an abusive home may not perceive intense exemplars of happy as frequently as a child who did not grow up in these environments. There is some research that suggests abused children are more sensitive to expressions of anger than control children (Pollak, Cicchetti, Hornung, & Reed, 2000). For children from atypical homes, happy may not be quite as different from all other emotions as it usually is because it has not been perceived as frequently. Consequently, if emotions such as sad (in the depression example) or anger (in the abusive home example) are perceived as less similar to other negative emotions on account of the child's relative expertise, congruency effects should not be as large with these expressions.

It is important to continue studying contextual effects because until recently they have been largely ignored in the literature. However, it is clear that context can play a large role in how we perceive emotional facial expressions. It is important to consider how context affects face perception because facial expressions are a highly informative cue for social interaction. When interacting socially, people tend to look at another person in the face when conversing, and the face can provide a lot of important information. For example, if a person has a sad facial expression, they are likely to elicit sympathy from others. Alternatively, if a person is expressing a fearful expression, they are likely to receive a much different response from others. But as shown in Experiment 1, accuracy drops dramatically when either a sad or fearful expression is placed in an incongruent context. Because children are even less sensitive to these expressions, their social interaction may be more affected than adults' when certain facial expressions do not match the context in which they are presented.

Context effects are also important to study because they have implications for court testimonies, especially for children. A child may encode a situation as completely different if they perceive a facial expression incorrectly, and they may therefore not extract the appropriate social information from an event.

**Limitations**

One potential criticism of this research is that children and adults only display congruency effects because the body posture is physically much larger than the facial expression, making it more likely to influence a person's response. However, the lack of congruency effects by 4-year-old children in Experiment 2 discredits the notion that body postures simply influenced emotional facial recognition because of the relative size difference. If body posture influences face perception because its size biases attention towards the body then there should have been a congruency effect regardless of the emotions being conveyed. The lack of congruency effects with happy/sad confirms that maintaining our stimuli with a natural head-to-body ratio is indeed appropriate.

Another concern is that arms extended over the head for fear bodies (see Appendix 2) attracted attention in Experiment 1 and caused the congruency effects. However, Experiment 2 also disqualifies this notion because happy bodies have similar postures, and yet there are no congruency effects in Experiment 2. Plus, a group of 6-year-old children in Experiment 1 were unable to pass our isolated body trials, and these children did not show congruency effects. If congruency effects were solely a product of raised arms capturing attention, there should have been congruency effects in this group, despite their inability to gain emotional meaning from the body postures.

Another potential limitation is that our study used a two-alternative forced-choice design. In each experiment, children could either choose from happy/sad or sad/fear. Adding a third emotion would greatly increase task demands and uncover more information about how children's sensitivity to emotions develops. For example, in Experiment 2, children may be categorizing based on happy/not happy, rather than happy and sad. The addition of another negative emotion, such as anger, might make it more difficult for children who now have to determine the difference between sad and anger, not simply happy and not happy.

In summary, context effects in the youngest children able to reliably recognize emotions in faces and bodies will show a similar pattern of congruency effects as adults; they will show a congruency effect with sad and fear, but will not show a congruency effect with happy and sad.

## Study 2

### Introduction

The results of Study 1 helped provide information that children's context effects are similar to those of adults, even at a very young age. Congruency effects for the youngest children that are able to reliably recognize specific emotions in faces and bodies follow the same pattern as those of adults. Effects are large for sad and fear (i.e., similar emotions) and non-existent for happy and sad (i.e., dissimilar emotions). According to both the emotional seed model and the dimensional model, happy and sad are dissimilar whereas sad and fear are similar, indicating that the results of Study 1 are consistent with both models. Based on the results of Study 1 and Mondloch (2012) it seems likely that these two popular models of emotion perception apply to children as well as adults.

However, although the results of most studies to date are consistent with the two models, they are unable to differentiate between the two. This inability to differentiate is because the literature on context effects has focused solely on emotion pairs for which both models make similar predictions (see Table 1). Consistent with both models, congruency effects have been shown with both fear and anger (Meeren et al., 2005) and sad and fear (Mondloch, 2012) face-body pairings, but do not exist with happy and sad face-body pairings (Mondloch, 2012).

| Study | Context | Emotion in Face | Emotion in Context | Results |
|---|---|---|---|---|
| Meeren et al., (2005) | Body Postures | Fear and Anger | Fear and Anger | Faster and more accurate when congruent |
| Aviezer et al. (2008) | Body Postures | Disgust | Disgust, anger, sad, fear | Congruency effects decreasingly large for anger, sad, and fear |
| Righart & de Gelder (2008a) | Emotional background scene | Fear and happiness | Fear, happiness, and neutral | Faster for happy in congruent/neutral scenes vs. fear scenes; no difference for fear in congruent/neutral scenes vs. happy scenes |
| Righart & de Gelder (2008b) | Emotional background scene | Disgust, fear, happiness | Disgust, fear, happiness | Faster for happy in congruent vs. fear or disgust scenes; no difference for fear in congruent vs. happy scenes; little or no effects for accuracy |
| Van den Stock et al., (2007) | Body Postures | Morphed happy and fear | Happy and fear | Less accurate for fear face paired with happy body, but not vice versa; congruency effects increase when expressions are ambiguous |
| de Gelder & Vroomen (2000) | Voices | Morphed happy and sad | Happy and sad | Sad voices increase sad response; happy voices lower sad response; effects smaller when told to look at the face |
| Mondloch (2012) | Body Postures | 1. Sad and Fear<br>2. Happy and Sad | 1. Sad and Fear<br>2. Happy and Sad | 1. More accurate when congruent<br>2. No congruency effects |

*Table 1*: Studies examining the influence of context on the perception of emotional facial expressions.

In addition to previous studies not distinguishing between these two influential models, three findings suggest that neither model can adequately explain some of the complexities in the findings: 1) Several studies suggest that there may be differences in the influence of scenes versus body postures on the perception of emotional facial expressions. Happy faces placed in incongruent fearful or disgust scenes result in slower reaction times than happy faces in congruent or neutral scenes, with little or no effects on accuracy (Righart & de Gelder, 2008a, 2008b). In contrast, when fearful faces are presented in happy scenes, reaction times are not slower, with little or no effects for accuracy, compared to when fearful faces are presented in congruent or neutral scenes (Righart & de Gelder, 2008a, 2008b). 2) The size of congruency effects is greater for a 3-alternative forced-choice task compared to a 2-alternative forced-choice task (Righart & de Gelder, 2008b). 3) Under some conditions congruency effects are asymmetrical. When body postures served as the context, the accuracy with which adults perceived happy expressions was not influenced by fearful postures, but the accuracy with which adults perceived fearful expressions was influenced by happy postures (Van den Stock et al., 2007). Collectively, these results highlight the complexity of congruency effects and the importance of determining the predictive ability of both models of emotion perception.

Expanding the types of emotions used is important because the two models differ in the basis of similarity between emotions and although both agree on certain predictions (e.g., congruency effects should be large for sad and fear), they do make opposite predictions for other emotional pairings. For example, according to the dimensional model, fear and anger are both high in arousal and negative in valence, whereas sad is negative in valence and low in arousal. Therefore, fear and anger are more similar to each other than either is to sad. Consequently, context effects should be larger when anger and fear are paired together compared to when either anger or fear is paired with sad. The emotional seed model would predict a different pattern of congruency effects. Based on the multidimensional scaling output produced by Susskind et al. (2007) (see Figure 2), sad is more physically similar to both anger and fear than anger and fear are to each other. Therefore, congruency effects should be larger when anger or fear is paired with sad compared to when anger and fear are paired together. Aviezer et al. (2008) provided support for this model by pairing disgust faces with disgust, anger, sad, and fearful body postures, finding the largest context effects for anger, slightly less for sad, and the least for fear.

The primary goal of Study 2 was to determine the relative abilities of each model of emotion perception to predict context effects. To investigate this question, we created a task using the three emotions with which the two models make different predictions: sad, anger, and fear. In Experiment 1a, we used a paradigm similar to Mondloch (2012) and presented participants with congruent and incongruent face-body compounds for limited presentation times. Participants were asked to judge the emotional facial expression while ignoring the body posture. In Experiment 1b, we used the same paradigm, but presented the stimuli for an unlimited amount of time to see if either model was more predictive under different viewing conditions. Using unlimited presentation times is important because Aviezer et al. (2008) conducted their study with unlimited presentation times, meaning the emotional seed model may only be predictive under this specific condition. In Experiment 2, we used a paradigm similar to Experiment 1a, except participants were asked to judge the body posture and ignore the facial expression to see if facial expressions produce the same pattern of congruency effects as body postures. Asking participants to judge the body posture was important to determine whether congruency effects are consistent across different modes of presentation, or whether they are strictly a product of body postures influencing the perception of faces. Finally, in Experiment 3, we used a flanker task to determine if participants had an attentional bias towards any of the emotions when displayed in body postures. Collectively, the results provide novel insights into the predictive ability of two popular models of emotional perception recognition. Additionally, because both models are fundamentally about how people perceive emotion, and not just congruency effects, this study will have a broad impact on our understanding of emotion perception.

## Experiment 1a

### Method

**Participants.** Participants were undergraduate students (n = 24) between the ages of 19 and 25 ($M = 21.6$). Adults received partial course credit or a small monetary reward for their participation. An additional participant was tested, but excluded from final analysis for failing to pass criterion trials (see procedure for more details). Participants all had normal or corrected-to-normal vision.

**Materials.** We utilized 18 photographs of human faces created from 6 models (3 male). All models posed a sad, angry, and fearful expression. Each photograph appeared four times on a congruent body and eight times on an incongruent body (four per each of the alternate emotions). In addition, four of those models (2 female) were photographed displaying happy expressions that were used in catch trials. These faces appeared once on a congruent body and three times on an incongruent body. All face stimuli were part of the validated NimStim Face Stimulus Set (Tottenham et al., 2009). The face stimuli were selected based on validation rating information provided by Tottenham et al. (2009); the emotion displayed by each image that we used was correctly identified by over 70% of participants in Tottenham et al. (2009). All face images were resized to approximately 2.2 cm horizontally x 2.8 cm vertically and cropped such that each model's hair and face contour were similar for each expression.

Photographs of the bodies of four models (two male) were used. Body postures were taken from Mondloch (2012); each of four models provided two sad, two anger, and two fearful postures that were correctly labeled by over 80% of adult participants (see Mondloch, 2012 for validation details). In addition, an extra four happy body postures (one per model) were used in catch trials.

The compound face-body stimuli were created using Adobe Photoshop Version 8 editing software. The isolated faces were cut with the lasso function and fused with a same-sex body using the smudge function. This created 18 emotional facial expressions that were each aligned with four same-sex congruent body postures (face and body emotion matching) and eight same-sex incongruent body postures (face and body emotion did not match), creating a total of 216 unique compound face-body pairs. There were an additional 16 catch trials; four were happy faces paired with same-sex congruent body postures and 12 were happy faces paired with same-sex incongruent body postures. The compound stimuli were realistically proportioned creating a face to body ratio of approximately 1:6 (see Meeren et al., 2005). Catch trials included congruent trials in addition to incongruent to better replicate the composition of the rest of the test trials.

**Procedure.** Written consent was obtained from adult participants prior to testing. Following visual screening procedures to ensure normal or corrected-to-normal vision, in this and all other experiments, stimuli were presented to participants on a 23-inch LG computer monitor in a laboratory at Brock University. The task was programmed with Cedrus Superlab Version 4 and participants were required to make their responses with a Logitech controller. Participants could make one of three responses on each trial. One button was labeled 'F' and was always used to indicate recognition of a fearful facial expression; one button was labeled 'S' and was always used to indicate recognition of a sad facial expression; and one button was labeled 'A' and was always used to indicate recognition of an angry facial expression. Prior to each block of trials verbal instructions were given to participants while corresponding written instructions were displayed on the computer monitor. Each test trial consisted of test stimulus, followed by a blank response screen, which itself was followed by a fixation stimulus (*) presented for approximately one second that simply indicated that the next test trial was about to begin. The fixation stimulus was located around the shoulder region of the test stimuli.

The entire protocol comprised three phases: isolated face trials, test trials, isolated body trials. The initial isolated faces block consisted of two parts: a practice section and a criterion section. The isolated faces block of trials was designed to ensure participants were able to correctly identify angry, sad, and fearful faces in the absence of context. The practice section consisted of six trials (two sad faces, two fearful faces, and two angry faces) in which faces were presented for 2 seconds. Participants were required to respond whether the face was angry, sad, or fearful. After the six practice trials, participants were presented with 12 criterion trials (four of each emotion), in which stimuli were presented for 600 ms. To meet our criterion, participants were required to correctly recognize ten of twelve criterion stimuli; each participant was allowed three attempts to meet this requirement.

The criterion was set to ensure participants were performing at above chance levels. If they could not perform above chance we could not reliably conclude that they gained any information from the isolated faces and, consequently, we would be unable to make conclusions about the effects of context. They were given the following instructions: *We're going to see pictures of faces and you need to decide if the face is angry, sad, or fearful.*

Following the isolated faces block and prior to the test block, participants completed 12 practice trials to help them get accustomed to the task. Participants were told that the task was to determine if the stimuli's face was displaying a sad, fear, or anger expression. Participants were explicitly told to ignore the body. In the first four trials, stimuli were presented for 2 seconds, whereas in the final eight trials stimuli were presented for 600 ms. After the practice trials, participants completed a large block of test trials comprising 216 face-body compounds. Stimuli were presented in a different random order to each participant. Within this test block, one third of the trials were congruent (n = 72) and two-thirds were incongruent (n = 144).

Amongst the test trials there were 16 catch stimuli, which consisted of a happy face presented with congruent (n = 4) and incongruent (n = 12) body postures. These trials were designed to ensure that participants were attentive in the task. Participants were required to correctly recognize 13 out of the 16 happy catch trials to be included in the final analysis. Participants were told that there would also be some trials with happy faces, and for those trials they were required to say the word 'happy' out loud instead of making a response with the controller.

After completing the test blocks, participants completed a block of trials in which isolated body postures were presented (with the faces blurred) to ensure they were able to identify the emotional body postures. Participants were required to accurately identify twenty of the twenty-four emotional body postures. Participants were excluded from final analysis if they failed to meet this criterion because if participants were unable to correctly identify isolated bodies it would be impossible to interpret either the presence or absence of congruency effects.

## Results

**Criteria trials: Isolated face and isolated body trials.** Participants were given three attempts to pass our isolated face criterion trials (10 out of 12 correct). When tested with isolated faces, all but one adult passed our criteria and were extremely accurate (*M* correct = .91). Three participants had to repeat the isolated face trials three times before passing and seven participants had to repeat the isolated face trials twice before passing. Adults were also extremely accurate on catch trials (*M* = .99) and isolated body trials (*M* = .97). This accuracy level for isolated emotional body postures is similar to those previously reported (Meeren et al., 2007; Schindler et al., 2007).

**Accuracy.** A 3 (face emotion: sad, fear, anger) x 3 (body emotion: sad, fear, anger) repeated measures ANOVA was conducted to determine whether the proportion correct differed across trials. There was a main effect for face emotion, $F(2, 46) = 27.716$, $p < .001$, $\eta^2 = .546$. This means that the proportion correct varied as a function of facial expression. The proportion correct for fear faces (*M* = .73) was significantly lower than those for anger faces ($M = .91$), $t(23) = -6.951$, $p < .001$, $r = .61$, and sad faces ($M = .89$), $t(23) = -4.927$, $p < .001$, $r = .58$. There was no difference in the proportion correct for sad faces ($M = .89$) versus anger faces ($M = .91$), $t(23) = -1.003$, $p = .326$. Secondly, there was a main effect for body emotion, $F(2, 46) = 3.911$, $p = .027$, $\eta^2 = .145$. This means that the proportion correct for facial expressions varied across body postures. The proportion correct for facial expressions paired with sad bodies ($M = .83$) was significantly lower than the proportion correct for facial expressions paired anger bodies ($M = .86$), $t(23) = -3.065$, $p = .005$, $r = .17$, but not fear bodies ($M = .83$), $t(23) = -.363$, $p = .72$. There was no difference in the proportion correct for facial expressions paired with fear bodies ($M = .83$) versus facial expressions paired with anger bodies ($M = .86$), $t(23) = -1.845$, $p = .078$. There was a significant face emotion x body emotion interaction, $F(4, 92) = 44.434$, $p < .001$, $\eta^2 = .659$. This means that the proportion correct for facial expressions depends on the body posture with which they are paired.

Because the interaction was significant we conducted three separate one-way repeated measures ANOVAs holding facial expression constant to determine the effect that body posture had on the proportion correct for each facial expression. This was followed by three two-tailed paired samples t-tests planned a priori to determine whether the proportion correct differed between congruent and incongruent trials and whether accuracy differed across the two incongruent trials (see Figure 4.1).

***Accuracy for Anger Faces.*** The proportion correct for anger faces varied as a function of body emotion, $F(2, 46) = 8.270$, $p = ,001$, $\eta^2 = .264$. Participants had a larger proportion correct on congruent trials ($M = .95$) than both incongruent fear anger/fear body trials ($M = .87$), $t(23) = 3.567$, $p = .002$, $r = .34$, and incongruent anger face/sad body trials ($M = .90$), $t(23) = 3.442$, $p = .002$, $r = .30$. There was no difference in the proportion correct on incongruent anger face/sad body trials ($M = .90$) versus incongruent anger face/fear body trials ($M = .87$), $t(23) = 1.265$, $p = .219$. This result is inconsistent with both the dimensional and emotional seed model; the dimensional model predicts greater interference from fear postures whereas the emotional seed model predicts greater interference from sad postures.

***Accuracy for Sad Faces.*** The proportion correct for sad faces varied as a function of body emotion, $F(2, 46) = 52.603$, $p < .001$, $\eta^2 = .696$. Participants had a larger proportion correct on congruent trials ($M = .95$) than both incongruent sad face/fear body trials ($M = .79$), $t(23) = 9.407$, $p < .001$, $r = .67$, and incongruent sad face/anger body trials ($M = .92$), $t(23) = 2.907$, $p = .008$, $r = .19$. Participants had a larger proportion correct on incongruent sad face/anger body trials ($M = .92$) than incongruent sad face/fear body trials ($M = .79$, $t(23) = 6.172$, $p < .001$, $r = .59$, a result that is inconsistent with both the dimensional and emotional seed models; both models predict congruency effects of similar magnitude when sad faces are presented with fearful and angry bodies.

***Accuracy for Fear Faces.*** The proportion correct for fear faces varied as a function of body emotion, $F(2, 46) = 39.173$, $p < .001$, $\eta^2 = .630$. Participants had a larger proportion correct on congruent trials ($M = .84$) than both incongruent fear face/sad body trials ($M = .64$), $t(23) = 8.136$, $p < .001$, $r = .56$, and incongruent fear face/anger body trials ($M = .70$), $t(23) = 6.029$, $p < .001$, $r = .41$. Participants had a larger proportion correct on incongruent fear face/anger body trials ($M = .70$) than incongruent fear face/sad body trials ($M = .64$), $t(23) = 2.669$, $p = .014$, $r = .16$. Thus, consistent with the emotional seed model, accuracy decreased the most when fear faces were paired with sad bodies.

***Accuracy for Congruent Trials.*** A one-way repeated measures ANOVA was conducted to determine if there was a difference in the proportion correct on the three types of congruent trials (anger, sad, fear). There was a significant main effect of congruent emotion, $F(2, 46) = 13.732, p < .001, \eta^2 = .374$, indicating that the proportion correct differed as a function of the emotion on congruent trials. There was no difference between the proportion correct on sad congruent ($M = .95$) and anger congruent trials ($M = .95$), $t(23) = .138, p = .891$. However, the proportion correct on fear congruent trials ($M = .84$) was lower than on both sad congruent trials ($M = .95$), $t(23) = -3.921, p = .001, r = .49$, and anger congruent trials ($M = .95$), $t(23) = -4.275, p < .001, r = .47$.

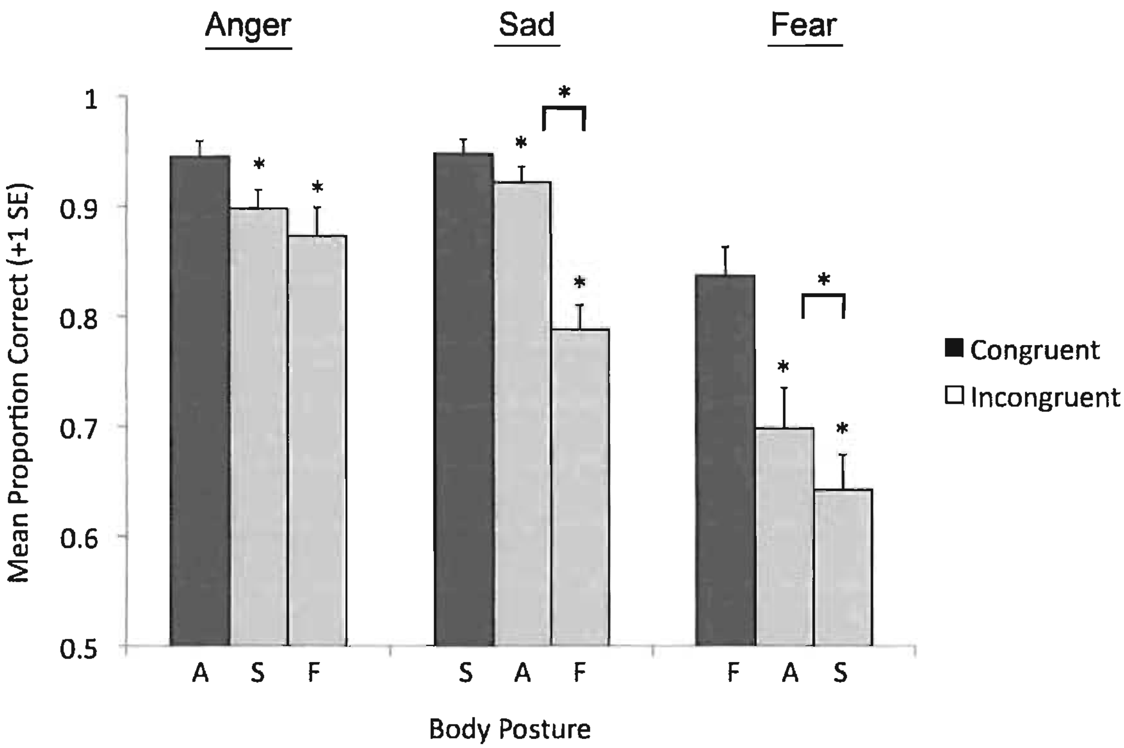


*Figure 4.1:* Mean proportion correct for trials on short presentation time task. Bars grouped by facial expression.

**Reaction times**. A 3 (face emotion: sad, fear, anger) x 3 (body emotion: sad, fear, anger) repeated measures ANOVA was conducted to determine whether reaction times differed across trials. There was a main effect for face emotion, $F(2, 46) = 11.542, p < .001, \eta^2 = .334$. This main effect means that reaction times varied as a function of facial expression. Reaction times for fear faces ($M = 1376.42$) were significantly longer than those for sad faces ($M = 1210.37$), $t(23) = 4.290, p < .001, r = .24$, and anger faces ($M = 1249.78$), $t(23) = 3.083, p = .005, r = .19$. There was no difference in reaction times for sad faces ($M = 1210.37$) versus anger faces ($M = 1249.78$), $t(23) = -1.455, p = .159$. Secondly, there was a main effect for body emotion, $F(2, 46) = 5.283, p = .009, \eta^2 = .187$. This main effect means that reaction times for facial expressions varied across body postures. Reaction times for facial expressions paired with fear bodies ($M = 1327.49$) were significantly longer than those paired with sad bodies ($M = 1244.72$), $t(23) = 2.577, p = .017, r = .13$, and anger bodies ($M = 1264.37$), $t(23) = 2.282, p = .032, r = .10$. There was no difference in reaction times for facial expressions paired with anger bodies ($M = 1264.37$) versus sad bodies ($M = 1244.72$), $t(23) = 1.087, p = .288$. There was a significant face emotion x body emotion interaction, $F(4, 92) = 10.193, p < .001, \eta^2 = .307$. This interaction means that reaction times for facial expressions depend on the body posture with which they are paired.

To follow up this significant interaction, we conducted three separate one-way repeated measures ANOVAs holding facial expression constant to determine the effect that body posture had on reaction times for each facial expression. Each ANOVA was followed by three paired samples t-tests planned a priori to determine whether reaction times differed between congruent and incongruent trials and whether reaction times on the two incongruent trials differed from each other (see Figure 4.2).

***Reaction Times for Anger Faces.*** Reaction times for anger faces varied as a function of body emotion, $F(2, 46) = 5.709$, $p = .006$, $\eta^2 = .199$. Participants were faster on congruent trials ($M = 1185.81$) than incongruent anger face/fear body trials ($M = 1334.13$), $t(23) = -2.775$, $p = .011$, $r = .24$. There was no difference in speed on congruent trials ($M = 1185.81$) versus incongruent anger face/sad body trials ($M = 1229.40$), $t(23) = -1.802$, $p = .085$, $r = .09$. There was no difference in speed on incongruent anger face/sad body trials ($M = 1229.40$) versus incongruent anger face/fear body trials ($M = 1334.13$), although it was approaching significance, $t(23) = -2.029$, $p = .054$, $r = .16$. These results are somewhat consistent with the dimensional model; reaction times increased the most when anger faces were paired with fearful bodies, although reaction times for sad bodies were no different from congruent trials, which the dimensional model would not have predicted. The results are not consistent with the emotional seed model, which predicts longer reaction times for sad bodies.

***Reaction Times for Sad Faces.*** Reaction times for sad faces varied as a function of body emotion, $F(2, 46) = 12.801$, $p < .001$, $\eta^2 = .358$. Participants were faster on congruent trials ($M = 1121.75$) than both incongruent sad face/fear body trials ($M = 1327.88$), $t(23) = -3.975$, $p < .001$, $r = .32$, and incongruent sad face/anger body trials ($M = 1181.48$), $t(23) = -2.416$, $p = .024$, $r = .14$. Participants were faster on incongruent sad face/anger body trials ($M = 1181.48$) than incongruent sad face/fear body trials ($M = 1327.88$), t(23) = -3.296, $p = .003$, $r = .23$, a result inconsistent with both the dimensional and emotional seed model; both models predict congruency effects of similar magnitude when sad faces are presented with either anger or fear bodies.

***Reaction Times for Fear Faces.*** Reaction times for fear faces varied as a function of body emotion, $F(2, 46) = 4.977, p = .011, \eta^2 = .178$. Participants were faster on congruent trials ($M = 1320.46$) than both incongruent fear face/sad body trials ($M = 1383.00$), $t(23) = -2.309, p = .03, r = .08$, and incongruent fear face/anger body trials ($M = 1425.81$), $t(23) = -2.834, p = .009, r = .13$. There was no difference in speed on incongruent fear face/anger body trials ($M = 1425.81$) versus incongruent fear face/sad body trials ($M = 1383.00$), $t(23) = 1.202, p = .242$, a result inconsistent with both the dimensional and emotional seed model. The dimensional model predicts longer reaction times for angry bodies and the emotional seed model predicts longer reaction times for sad bodies.

***Reaction Times for Congruent Trials.*** A one-way repeated measures ANOVA was conducted to determine if there was a difference in reaction times on congruent trials. There was a significant main effect of congruent emotion, $F(2, 46) = 11.787, p < .001, \eta^2 = .339$, indicating that reaction times differed as a function of the emotion on congruent trials. Participants were faster on sad congruent ($M = 1121.75$) than both anger congruent trials ($M = 1185.81$), $t(23) = -2.710, p = .012, r = .15$, and fear congruent trials ($M = 1320.46$), $t(23) = -4.089. p = .001, r = .32$. Reaction times on anger congruent trials ($M = 1185.81$) were faster than reaction times on fear congruent trials ($M = 1320.46$), $t(23) = -2.798, p = .010, r = .22$.

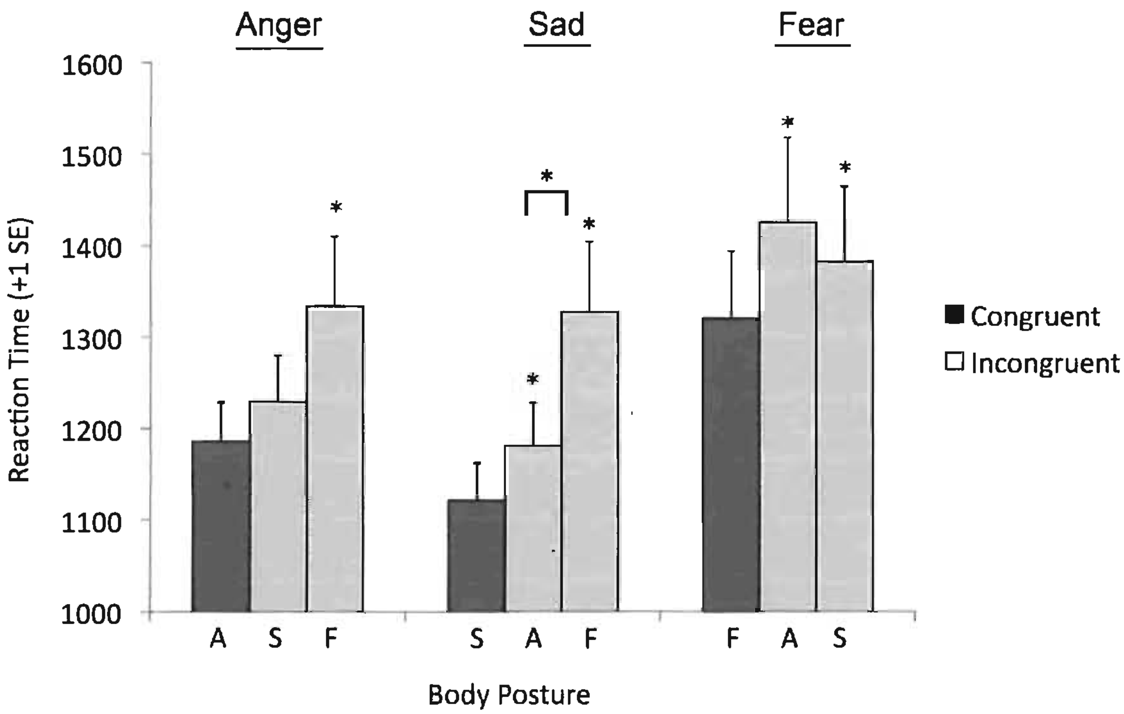


*Figure 4.2:* Reaction times for trials on short presentation time task. Bars grouped by facial expression.

**Errors Analysis**. An analysis of errors was conducted to determine whether participants were biased in the type of errors they made. On any one trial a participant can make one of two errors. For example, an error for a fear expression will either be a sad error or an anger error. Looking at the pattern of errors across trial types allowed us to determine whether participants' bias shifted in a systematic way when the body posture was incongruent. Would errors be biased towards the body posture? In other words, if participants made an error on an incongruent trial would they be more likely to say the emotion displayed in the body posture or would the pattern of errors be similar to that on congruent trials? To determine this we calculated the proportion of one type of error made on each incongruent trial (e.g., proportion of errors in which participants responded fear when a sad face was on a fear body, and when an sad face was on an anger body) and compared it to the proportion of that same error made on the congruent trial (e.g., proportion of errors in which participants responded fear versus anger when a sad face was on a sad body). We only needed to look at one of the two possible errors because we used proportion of errors, so if we knew about changes in the proportion of one type of error we would know about the other because they are inversely related. We also used proportion of errors rather than error rate because we wanted to control for the number of errors made. We wanted to control for the number of errors because on some trials, such as those with fear faces, participants made more total errors than on other trials, such as those with anger faces. If there is a bias towards the body, the proportion of errors for an emotion should increase when on the corresponding body posture compared to the proportion of errors made in congruent conditions. For example, if errors are biased towards the body, the proportion of fear errors should be greater when a sad face is paired with a fear body than the proportion of fear errors when a sad face is paired with a sad body; in contrast, the proportion of fear errors should be lower when a sad face is paired with an anger body than the proportion of fear errors when a sad face is paired with a sad body.

First, to determine if there was a bias in the type of errors made on congruent trials, we conducted three one-sample t-tests (one per facial expression) comparing the error proportions to .5. This test was designed to determine whether the pattern of errors for each expression was biased even in the absence of body posture. We then followed this with three one-way repeated measures ANOVAs to determine whether the proportion of one type of error for the same facial expression differed as a function of the body posture. In other words, we determined whether incongruent body postures influenced the type of errors participants made. Each ANOVA was followed by a simple contrast comparing the proportion of errors on each incongruent trial to the proportion of errors made on the congruent trial (see Figure 4.3). This analysis would determine whether the difference in the proportion of errors was different from those on congruent trials. In other words, does the proportion of errors change as a result of different body postures.

***Proportion of Errors with Anger Faces.*** On congruent trials, the proportion of fear errors ($M = .40$) was not different from chance, although it was approaching significance, $t(23) = -2.002, p = .057$, indicating that there was no bias on congruent trials. This discrepancy appears large, but nine participants made a higher proportion of fear errors on congruent trials, eight made a lower proportion of fear errors, and seven had exactly .50 in their proportion of fear errors. This variance is the likely cause of the non-significance. When holding an anger face constant, the proportion of fear errors differed across body posture, $F(2, 46) = 4.274, p = .02, \eta^2 = .157$. Consistent with the dimensional model, a simple contrast showed that the proportion of fear errors was significantly greater when an anger face was paired with a fear body ($M = .61$) than when an anger face was paired with an anger body ($M = .40$), $F(1, 23) = 6.587, p = .017, \eta^2 = .223$; however, the proportion of fear errors was not significantly different when an anger face was paired with a sad body ($M = .40$) than when an anger face was paired with an anger body ($M = .40$), $F(1, 23) = .001, p = .981$. The emotional seed model predicts sad bodies to shift the pattern of errors.

***Proportion of Errors with Sad Faces.*** On congruent sad trials, the proportion of fear errors ($M = .52$) did not differ from chance, $t(23) = .29, p = .774$, indicating that there was no bias on congruent trials. When viewing sad faces, the proportion of fear errors differed across body postures, $F(2, 46) = 16.42, p < .001, \eta^2 = .417$. A simple contrast showed that the proportion of fear errors was significantly greater when a sad face was paired with a fear body ($M = .85$) than when a sad face was paired with a sad body ($M = .52$), $F(1, 23) = 32.409, p < .001, \eta^2 = .585$; however, the proportion of fear errors was not significantly different when a sad face was paired with an anger body ($M = .43$) than when a sad face was paired with a sad body ($M = .52$), $F(1, 23) = 1.298, p = .266, \eta^2 = .053$. These results are inconsistent with both the dimensional and the emotional seed model. Both models predict that neither body should bias errors more than the other.

***Proportion of Errors with Fear Faces.*** On congruent fear trials, the proportion of sad errors ($M = .82$) was significantly different from chance, $t(23) = 5.156, p < .001$, indicating that participants were biased towards making a sad error on congruent trials.

When holding a fear face constant, the proportion of sad errors did not differ across body posture, $F(2, 46) = 2.151, p = .128, \eta^2 = .086$. The fact that participants are always more likely to make a sad error than an anger error when viewing fear faces is consistent with the emotional seed model. The dimensional model, however, predicts anger bodies to shift the pattern of errors.

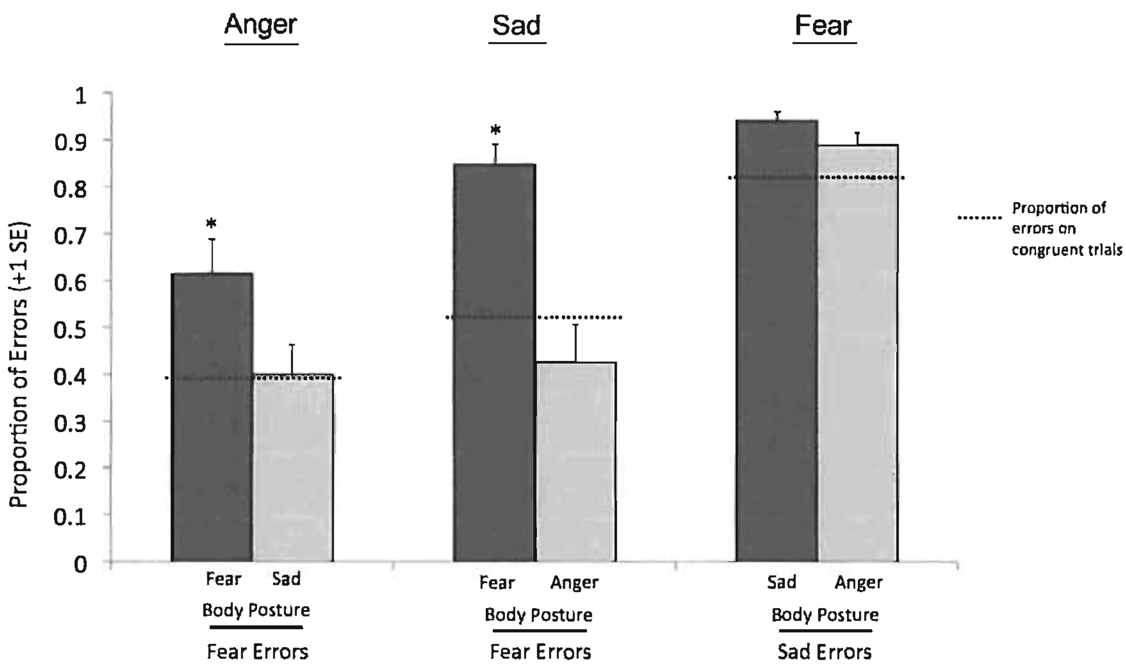


*Figure 4.3:* Error analysis for short presentation time task. Bars grouped by facial expression.

**Discussion**

In Experiment 1a, adults showed a congruency effect with every combination of emotional pairing; adults were better at recognizing emotional facial expressions in congruent contexts than they were in incongruent contexts. Based on the two models this result is expected. However, we were more concerned with determining the relative size differences between context effects for different emotional pairings, which would help determine the relative predictive abilities of the emotional seed model and the dimensional model. Experiment 1a was the first study, to our knowledge, that attempted to directly compare the two popular models of emotion perception.

When anger faces are paired with sad versus fear bodies, the emotional seed model predicts that sad bodies cause more interference, whereas the dimensional model predicts that fear bodies cause more interference. Our data do not support either of these predictions. For anger faces, both sad and fearful body postures reduced the proportion correct relative to congruent trials, but not one more than the other. When analyzing reaction times, only fearful postures cause an increase in reaction times. This effect is what the dimensional model predicts, although the dimensional model predicts that sad bodies produce interference as well, just not as much as fearful bodies. When analyzing the pattern of errors there was no difference in the proportion of errors on congruent trials; if participants made an error, they were just as likely to make a fear error as they were a sad error. However, the proportion of fear errors increased significantly when anger faces were paired with fear bodies, compared to congruent trials. In contrast, the proportion of fear errors did not decrease significantly (i.e., the proportion of sad errors did not increase significantly) when anger faces were paired with sad bodies compared to congruent trials. These results indicate that only fearful bodies can shift the pattern of errors, not anger or sad bodies. The dimensional model would make this prediction.

When sad faces are paired with anger versus fear bodies, both the emotional seed model and the dimensional model predicts both anger and fear bodies to cause interference, but not one more than the other. Our data did not support this prediction. For sad faces, both anger and fearful postures reduced the proportion correct, but fearful postures reduced the proportion correct to a greater extent. Both anger and fearful postures increased reaction times, but fearful bodies increased reaction times to a greater extent. When analyzing the pattern of errors there was no difference in the proportion of errors made on congruent trials; if participants made an error they were no more likely to make a fear error than an anger error. However, when sad faces were paired with fearful bodies, the proportion of fear errors significantly increased compared to congruent trials. The proportion of fear errors did not decrease significantly when sad faces were paired with anger bodies, compared to congruent trials. These results again indicate that only fearful bodies were able to shift the pattern of errors, not anger or sad bodies. Neither model would make this prediction.

When fear faces are paired with sad versus anger bodies, the emotional seed model predicts that sad bodies cause more interference, whereas the dimensional model predicts that anger bodies cause more interference. Our data do not support either of these predictions. For fear faces, both sad and anger body postures reduced the proportion correct, but sad postures created a larger decrease. This effect is what the emotional seed model predicts. Both anger and sad postures increased reaction times, but not one more than the other. Neither model predicts this result. There was a significant difference in the proportion of errors on congruent trials; if participants made an error they were more likely to make a sad error than an anger error. However, the proportion of errors did not significantly increase when fear faces were paired with sad bodies or anger bodies. These results indicate that neither body posture is shifting the pattern of errors for fear faces, there is just always more likely to be sad errors than anger errors. It is important to note that the proportion of sad errors is quite high on congruent trials, so there may be no increase in the proportion on either body posture because participants are at ceiling. The emotional seed model predicts that participants would be more likely to make a sad error than an anger error, but it would also predict a shift towards sad when a fear face is on a sad body.

On congruent trials, fear trials had the lowest accuracy and had the slowest reaction times. Sad congruent trials had faster reaction times than anger congruent trials, but there was no difference in accuracy.

The results from Experiment 1a provide little support for either model of emotion perception; each model only correctly made two of nine predictions. However, there seems to be something special about fearful bodies. For sad faces and angry faces, fear posture had the largest effect of reaction times and biased errors; fearful bodies decreased accuracy for sad faces more than angry bodies did, although they did not decrease accuracy more for angry faces than sad did. This pattern of results suggest that people have an attentional bias towards fearful bodies and under short presentation times people implicitly pick up more information from those body postures than any other. Perhaps this effect is due to certain evolutionary factors. Fear is a very difficult emotion to recognize in facial expressions, even for adults (Russell, 1994; Tottenham et al., 2009).

Because of the important social information fear conveys it is possible some evolutionary advantage existed for those able to accurately detect this emotion in others. If fear is conveying information about a danger it is especially important to perceive from a distance, but judging solely based on a facial expression would be difficult. Therefore, to compensate, perhaps an attentional bias for fearful body postures has developed over time. This bias would be specific to fear because sad and, to some extent, anger do not convey the same sort of information that is important to recognize before getting close to another person. Consequently, an attentional bias for fear could explain why neither model was able to make accurate predictions about the size of certain congruency effects.

Our results are surprising given evidence from Aviezer et al. (2008) that support the emotional seed model. Aviezer et al. (2008) presented disgust faces with disgust, anger, sad, and fearful bodies for an unlimited amount of time, and found the size of congruency effects were the largest for anger bodies, somewhat less for sad bodies, and the smallest for fearful bodies. One large difference was that Aviezer et al. (2008) only presented disgust faces, whereas we presented sad, anger, and fearful faces. The other major difference was that they presented their stimuli for an unlimited amount of time, which could account for the discrepancy in our results. To examine this possibility, in Experiment 1b we tested another group of participants on the same task with one exception: stimuli were presented for an unlimited amount of time.

## Experiment 1b

### Method

**Participants.** Participants were undergraduate students (n = 24) between the ages of 18 and 22 (*M* = 19.7). Adults received partial course credit or a small monetary reward for their participation. All participants had normal or corrected-to-normal vision.

**Materials and Procedure.** The materials were identical to those used in Experiment 1. The procedure was identical to that used in Experiment 1 except that participants had an unlimited amount of time to categorize the stimuli based on facial expression.

**Results**

**Criteria trials: Isolated face and isolated body trials.** Participants were given three attempts to pass our isolated face criterion trials (10 out of 12 correct). When tested with isolated faces, all adults passed our criteria and were very accurate (*M* correct = .93). Two participants had to repeat the isolated face trials three times before passing and one participant had to repeat the isolated face trials twice before passing; no participants were unable to pass our isolated face criterion trials. Adults were perfect on all catch trials and very accurate on isolated body trials (*M* = .97). These levels are similar to those found in Experiment 1a.

**Accuracy.** A 3 (face emotion: sad, fear, anger) x 3 (body emotion: sad, fear, anger) repeated measures ANOVA was conducted to determine whether the proportion correct differed across trials. There was a main effect for face emotion, $F(2, 46) = 26.073$, $p < .001$, $\eta^2 = .531$. This main effect means that the proportion correct varied as a function of facial expression. The proportion correct for fear faces (*M* = .81) was significantly lower than for anger faces (*M* = .96), $t(23) = -6.456$, $p < .001$, $r = .57$, and sad faces (*M* = .95), $t(23) = -4.639$, $p < .001$, $r = .55$. There was no difference in the proportion correct for sad faces (*M* = .95) versus anger faces (*M* = .96), *t*(23) = -.464, *p* = .647. Secondly, there was no main effect for body emotion, although it was approaching significance, $F(2, 46) = 3.093, p = .055, \eta^2 = .119$. This lack of main effect means that the proportion correct for facial expressions did not vary across body postures. There was a significant face emotion x body emotion interaction, $F(4, 92) = 19.404, p < .001, \eta^2 = .458$. This interaction means that the proportion correct for each facial expression depended on the body posture with which it was paired.

Because the interaction was significant we conducted three separate one-way repeated measures ANOVAs holding facial expression constant to determine the effect that body posture had on the proportion correct for each facial expression. Each ANOVA was followed by three two-tailed paired samples t-tests planned a priori to determine whether the proportion correct differed between congruent and incongruent trials and whether accuracy differed across the two incongruent trials (see Figure 5.1).

***Accuracy for Anger Faces***. The proportion correct for anger faces varied as a function of body emotion, $F(2, 46) = 3.227, p = .049, \eta^2 = .123$. Participants had a larger proportion correct on congruent trials (*M* = .98) than both incongruent anger face/fear body trials (*M* = .94), *t*(23) = 2.120, *p* = .045, *r* = .25, and incongruent anger face/sad body trials (*M* = .95), *t*(23) = 2.186, *p* = .039, *r* = .23. There was no difference in the proportion correct on incongruent anger face/sad body trials (*M* = .95) versus incongruent anger face/fear body trials (*M* = .94), *t*(23) = .601, *p* = .554. This result is inconsistent with both the dimensional and emotional seed model; the dimensional model predicts greater interference from fearful bodies whereas the emotional seed model predicts greater interference from sad bodies.

***Accuracy for Sad Faces.*** The proportion correct for sad faces varied as a function of body emotion, $F(2, 46) = 9.601, p < .001, \eta^2 = .294$. Participants had a larger proportion correct on congruent trials ($M = .99$) than incongruent sad face/fear body trials ($M = .91$), $t$ ($t(23) = 3.392, p = .003, r = .41$. There was no difference in the proportion correct on congruent trials ($M = .99$) versus incongruent sad face/anger body trials ($M =$ .96), $t(23) = 1.947, p = .64$, a result that is inconsistent with both the dimensional and emotional seed model. Participants had a larger proportion correct on incongruent sad face/anger body trials ($M = .96$) than incongruent sad face/fear body trials ($M = .91$), $t(23) = 3.046, p = .006, r = .26$, a result that is inconsistent with both the dimensional and emotional seed model; both models predict congruency effects of similar magnitude when sad faces are presented with fearful and angry bodies.

***Accuracy for Fear Faces.*** The proportion correct for fear faces varied as a function of body emotion, $F(2, 46) = 20.388, p < .001, \eta^2 = .470$. Participants had a larger proportion correct on congruent trials ($M = .89$) than both incongruent fear face/sad body trials ($M = .73$), $t(23) = 5.10, p < .001, r = .44$, and incongruent fear face/anger body trials ($M = .81$), $t(23) = 3.554, p = .002, r = .27$. Participants had a larger proportion correct on incongruent fear face/anger body trials ($M = .81$) than incongruent fear face/sad body trials ($M = .73$), $t(23) = 4.039, p = .001$. Thus, consistent with the emotional seed model, accuracy decreased the most when fear faces were paired with sad bodies.

***Accuracy for Congruent Trials.*** A one-way repeated measures ANOVA was conducted to determine if there was a difference in the proportion correct on the three types of congruent trials (anger, sad, fear). There was a significant main effect of congruent emotion, $F(2, 46) = 14.175$, $p < .001$, $\eta^2 = .381$, indicating that the proportion correct differed as a function of the emotion on congruent trials. There was no difference between the proportion correct on sad congruent ($M = .99$) versus anger congruent trials ($M = .98$), $t(23) = .749$, $p = .461$. However, the proportion correct on fear congruent trials ($M = .89$) was lower than both sad congruent trials ($M = .99$), $t(23) = -4.037$, $p = .001$, $r = .50$, and anger congruent trials ($M = .98$), $t(23) = -3.733$, $p = .001$, $r = .46$.

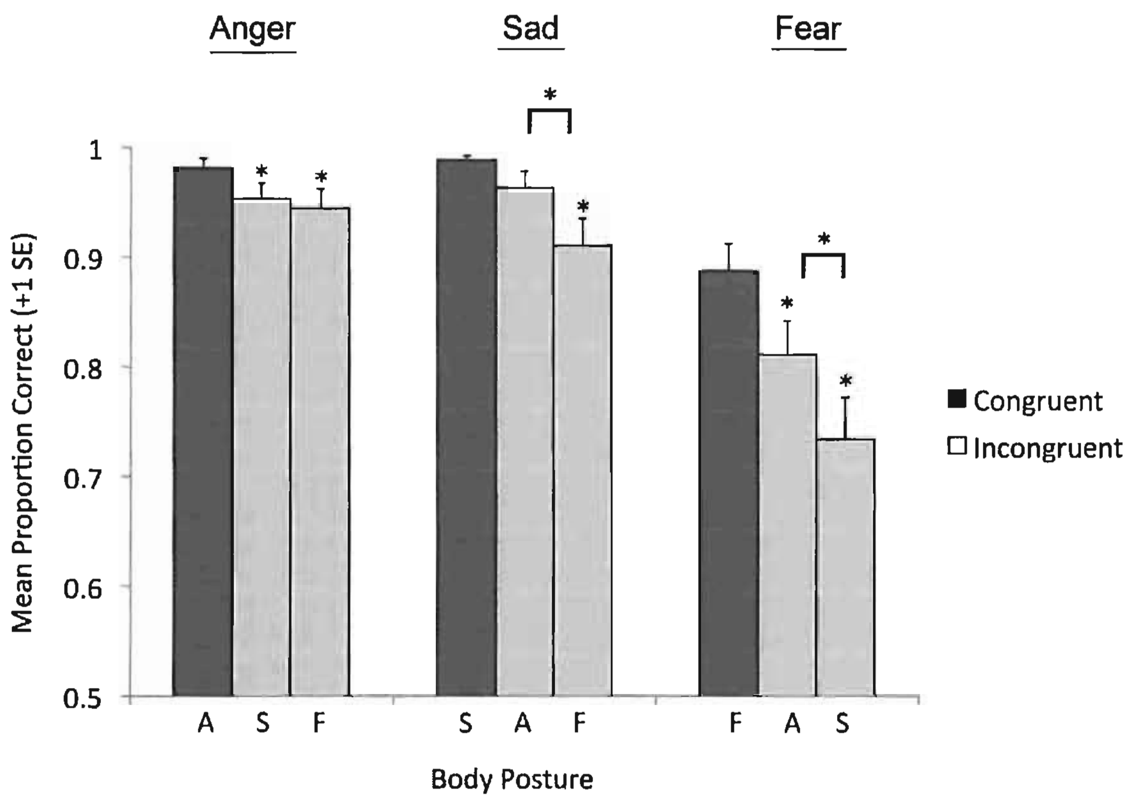


*Figure 5.1:* Mean proportion correct for trials on unlimited presentation time task. Bars grouped by facial expression.

**Reaction times**. A 3 (face emotion: sad, fear, anger) x 3 (body emotion: sad, fear, anger) repeated measures ANOVA was conducted to determine whether reaction times differed across trials. There was a main effect for face emotion, $F(2, 46) = 11.084, p < .001, \eta^2 = .325$. This means that reaction times varied as a function of facial expression. Reaction times for fear faces ($M = 1844.29$) were significantly longer than those for both sad faces ($M = 1464.97$), $t(23) = 3.924, p = .001, r = .32$, and anger faces ($M = 1515.60$), $t(23) = 3.231, p = .004, r = .27$. There was no difference in reaction times for sad faces ($M = 1464.97$) versus anger faces ($M = 1515.60$), $t(23) = -.886, p = .385$. Secondly, there was a main effect for body emotion, $F(2, 46) = 5.330, p = .008, \eta^2 = .188$. This means that reaction times for facial expressions varied across body postures. Reaction times for facial expressions paired with fear bodies ($M = 1689.76$) were significantly longer than those paired with sad ($M = 1525.42$), $t(23) = 3.123, p = .005, r = .18$, and anger bodies ($M = 1609.68$), $t(23) = 2.109, p = .046, r = .07$. There was no difference in reaction times for facial expressions paired with sad bodies ($M = 1525.42$) versus those paired with anger bodies ($M = 1609.68$), $t(23) = -1.447, p = .161$. There was a significant face emotion x body emotion interaction, $F(4, 92) = 3.495, p = .011, \eta^2 = .132$. This interaction means that reaction times for facial expressions depend on the body posture with which they are paired.

To follow up this significant interaction, we conducted three separate one-way repeated measures ANOVAs holding facial expression constant to determine the effect that body posture had on reaction times for each facial expression. Each ANOVA was followed by three paired samples t-tests planned a priori to determine whether reaction times differed between congruent and incongruent trials and whether reaction times on the two incongruent trials differed from each other (see Figure 5.2).

***Reaction Times for Anger Faces.*** Reaction times for anger faces varied as a function of body emotion, $F(2, 46) = 10.678$, $p < .001$, $\eta^2 = .317$. Participants were faster on congruent anger trials ($M = 1411.08$) than incongruent anger face/fear body trials ($M = 1708.50$), $t(23) = -3.755$, $p = .001$, $r = .26$. There was no difference in speed on congruent trials ($M = 1411.08$) versus incongruent anger face/sad body trials ($M = 1427.21$), $t(23) = -.371$, $p = .714$, $r = .02$. Participants were faster on incongruent anger face/sad body trials ($M = 1427.21$) than incongruent anger face/fear body trials ($M = 1708.50$), $t(23) = -3.236$, $p = .004$, $r = .26$. These results are somewhat consistent with the dimensional model; reaction times increased the most when anger faces were paired with fearful bodies, although this model would also predict that sad bodies increase reaction times, just not as much as anger bodies, something that was not the case.

***Reaction Times for Sad Faces.*** Reaction times for sad faces varied as a function of body emotion, $F(2, 46) = 13.437$, $p < .001$, $\eta^2 = .369$. Participants were faster on congruent trials ($M = 1321.04$) than both incongruent sad face/fear body trials ($M = 1571.96$), $t(23) = -6.410$, $p < .001$, $r = .33$, and incongruent sad face/anger body trials ($M = 1501.92$), $t(23) = -3.246$, $p = .004$, $r = .22$. Participants were no faster on incongruent sad face/anger body trials ($M = 1501.92$) than incongruent sad face/fear body trials ($M = 1571.96$), $t(23) = -1.313$, $p = .202$, $r = .02$, a result that is consistent with both the dimensional model and the emotional seed model.

***Reaction Times for Fear Faces.*** Reaction times for fear faces did not vary as a function of body emotion, $F(2, 46) = .521$, $p = .597$, $\eta^2 = .022$, a result that is inconsistent with both the dimensional and emotional seed model.

***Reaction Times for Congruent Trials.*** A one-way repeated measures ANOVA was conducted to determine if there was a difference in reaction times on congruent trials. There was a significant main effect of congruent emotion, $F(2, 46) = 11.815$, $p < .001$, $\eta^2 = .339$, indicating that reaction times differed as a function of the emotion on congruent trials. Participants were slower on fear congruent trials ($M = 1788.81$) than both sad congruent ($M = 1321.04$), $t(23) = 3.711$. $p = .001$, $r = .38$, and anger congruent trials ($M = 1411.08$), $t(23) = -3.446$, $p = .002$, $r = .30$. There was no difference in reaction times on sad congruent trials ($M = 1321.04$) versus anger congruent trials ($M = 1411.08$), $t(23) = -1.548$, $p = .135$.

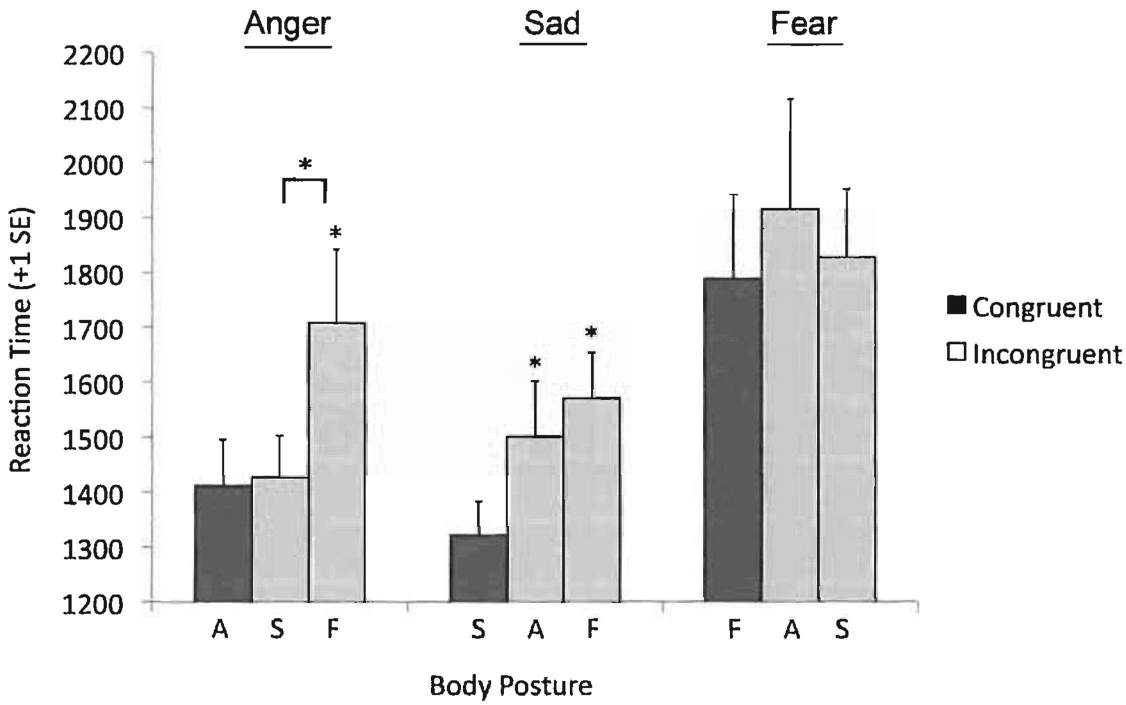


*Figure 5.2:* Reaction times for trials on unlimited presentation time task. Bars grouped by facial expression.

**Errors Analysis**. (See Figure 5.3). The error analysis was conducted in the same manner as in Experiment 1a.

***Proportion of Errors with Anger Faces.*** On congruent trials, the proportion of fear errors ($M$ = .42) did not differ from chance, $t(23) = -1.696, p = .103$, indicating that there was no bias on congruent trials. When holding an anger face constant, the proportion of fear errors did not differ across body posture, $F(2, 46) = 1.766, p = .182, \eta^2 = .071$. Regardless of the body posture with which an anger face was paired, the proportion of fear errors did not differ. These results are inconsistent with both the dimensional and emotional seed model. The dimensional model predicts that fearful bodies will shift the pattern of errors most whereas the emotional seed model predicts sad bodies will shift the pattern of errors.

***Proportion of Errors with Sad Faces.*** On congruent trials, the proportion of fear errors ($M$ = .52) did not differ from chance, $t(23) = .44, p = .664$, indicating there was no bias on congruent trials. When viewing sad faces, the proportion of fear errors differed across body postures, $F(2, 46) = 8.754, p = .001, \eta^2 = .276$. A simple contrast showed that the proportion of fear errors was significantly greater when a sad face was paired with a fear body ($M$ = .78) than when a sad face was paired with a sad body ($M$ = .52), $F(1, 23) = 11.754, p = .002, \eta^2 = .338$; however, the proportion of fear errors was not significantly lower when a sad face was paired with an anger body ($M$ = .50) than when a sad face was paired with a sad body ($M$ = .52), $F(1, 23) = .089, p = .768, \eta^2 = .004$. These results are inconsistent with both the dimensional and emotional seed model. Both models predict neither fear nor anger bodies will shift the pattern of errors more than the other.

***Proportion of Errors with Fear Faces.*** On congruent trials, the proportion of sad errors ($M = .87$) was significantly different than chance, $t(23) = 8.263$, $p < .001$, indicating that participants were biased towards making a sad error on congruent trials. The proportion of sad errors did not differ across body postures, $F(2, 46) = 1.813$, $p = .175$, $\eta^2 = .073$. Regardless of the body posture a fear face was paired with, the proportion of sad errors did not differ. The fact that participants were always more likely to make a sad error than an anger error when viewing fear faces is consistent with the emotional seed model.

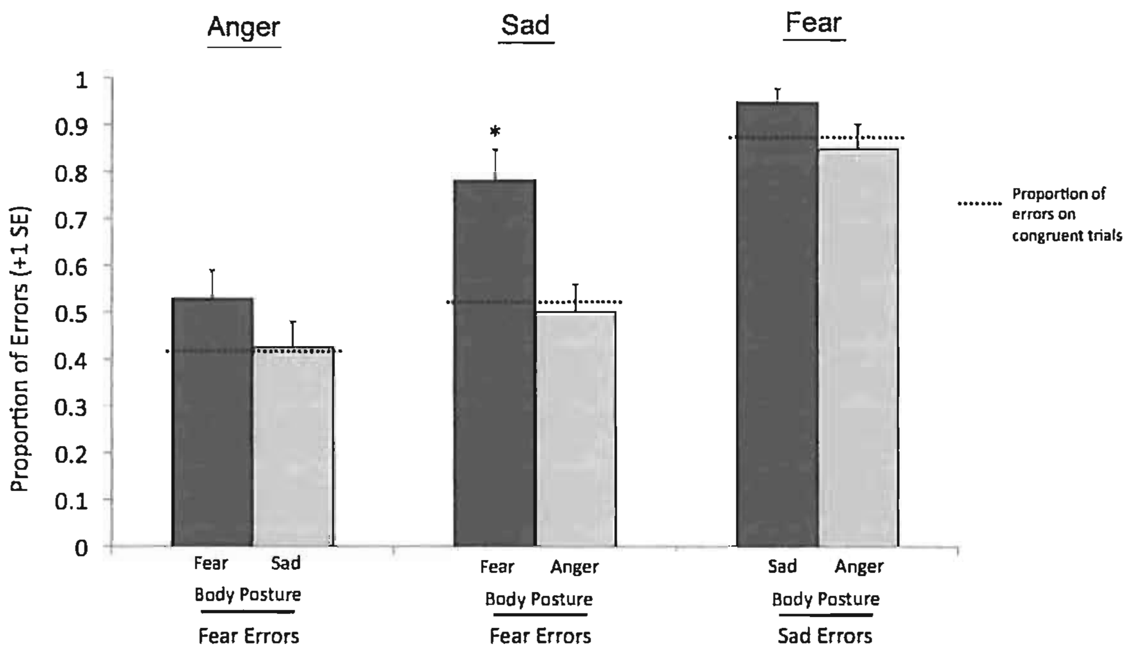


*Figure 5.3:* Error analysis for unlimited presentation time task. Bars grouped by facial expression.

**Discussion**

In general, the pattern of results in Experiment 1b was almost identical to those in Experiment 1a, except for the following differences. First, the magnitude of effects was smaller in Experiment 1b. Secondly, for sad faces, both anger and fearful postures increased reaction times, but not one more than the other, which is what both models predict. In contrast, in Experiment 1a, only fearful postures increased reaction times. Third, for fear faces, there was no difference in reaction times across all three body postures, whereas both anger and sad postures equally increased reaction times to fear faces in Experiment 1a. Neither model predicts either of those results. Fourth, there was no difference in reaction times for congruent sad and anger trials in Experiment 1b, whereas participants were faster with sad congruent trials than anger congruent trials in Experiment 1a. Finally, there was no difference in the proportion correct across bodies in Experiment 1b, whereas in Experiment 1a trials with sad bodies had lower accuracy than trials with anger bodies.

The results provide little support for either model of emotion perception; each model only correctly made three of nine predictions, which is a slightly higher proportion than in Experiment 1a, but still unimpressive. Experiment 1b disqualifies the possibility that the pattern of results in Experiment 1a was the result of limited presentation times. Using unlimited presentation times, like Aviezer et al. (2008), did not create a pattern of results more consistent with their model. Similarly, it has been suggested by the dimensional model that a more effortful top-down processing occurs with incongruent contexts (Russell, 1997), which might mean this model is accurate under long presentation times, yet our pattern of data did not support this possibility.

More importantly, just like in Experiment 1a, there seems to be something special about fearful bodies, even under unlimited presentation times. For sad faces and angry faces, fear posture had the largest effect on reaction times and biased errors; fearful bodies decreased accuracy for sad faces more than angry bodies did, although they did not decrease accuracy more for angry faces than sad did. Obtaining the same pattern of results in Experiment 1a and 1b confirms that our finding little evidence supporting both the dimensional model and emotional seed model cannot be attributed to having used short presentation times in Experiment 1a. It also provides additional support for the importance of fear bodies under a variety of viewing conditions.

Experiments 2 and 3 explored the generality of these effects in two different ways. In Experiment 2 we tested participants on the same task, but asked them to attend to the body posture, while ignoring the face. This task was to determine whether the pattern of congruency effects would be the same for the reverse condition. Do emotional facial expressions have the same influence on emotional body postures that these postures have on facial expressions? This question is important to explore because the dimensional model is described as being consistent across modalities, so according to this model, faces may have the same influence on the perception of body postures that body postures have on the perception of facial expressions. Furthermore, we wanted to determine whether it is specifically fear bodies that have the most influence on perception, or whether it is fear in general that has a large influence on perception. In Experiment 3 participants performed a flanker task to determine whether the effect of fear bodies is specific to faces or whether fear bodies would also produce a larger effect in an unrelated task in which faces were absent.

## Experiment 2

### Method

**Participants.** Participants were undergraduate students (n = 16) between the ages of 18 and 23 ($M = 21.9$). Adults received partial course credit or a small monetary reward for their participation. An additional five participants were tested, but excluded from final analysis for failing to pass criterion trials (see procedure for more details). All participants had normal or corrected-to-normal vision.

**Materials and Procedure.** The materials were identical to those used in Experiment 1. The procedure was largely similar to that used in Experiment 1 except that participants were told to ignore the facial expression and pay attention only to the body posture.

The entire protocol comprised three phases: isolated body trials, test trials, isolated face trials. The initial isolated bodies block consisted of two parts: a practice section and a criterion section. The isolated bodies block of trials was designed to ensure participants were able to correctly identify angry, sad, and fearful bodies in the absence of context. The practice section consisted of six trials (two sad bodies, two fearful bodies, and two angry bodies) in which bodies were presented for 2 seconds, and participants were required to respond whether the body was angry, sad, or fearful. After the six practice trials, participants were presented with 12 criterion trials (four of each emotion), in which stimuli were presented for 600 ms. To meet our criterion, participants were required to correctly recognize ten of twelve criterion stimuli; each participant was allowed three attempts to meet this requirement.

Following the isolated bodies block and prior to the test block, participants completed 12 practice trials. Participants were told that the task was to determine if the body of the stimulus was displaying a sad, fear, or anger expression. Participants were explicitly told to ignore the face. In the first four trials, stimuli were presented for 2 seconds, whereas in the final eight trials stimuli were presented for 600 ms. After the practice trials, participants completed a large block of test trials comprising 216 face-body compounds. Stimuli were presented in a different random order to each participant. Within this test block, one third of the trials were congruent (n = 72) and two-thirds were incongruent (n = 144).

Amongst the test trials there were 16 catch stimuli, which consisted of a happy body presented with congruent (n = 4) and incongruent (n = 12) facial expressions. These trials were designed to ensure that participants were attentive in the task. Participants were told that there would also be some trials with happy bodies, and for those trials they were required to say the word 'happy' out loud instead of making a response with the controller. Participants were required to correctly recognize 13 out of the 16 happy catch trials to be included in the final analysis.

After completing the test blocks, participants completed a block of trials in which isolated faces were presented to ensure they were able to identify the emotional facial expressions in the absence of context. Participants were required to accurately identify 15 of the 18 emotional facial expressions. Participants were excluded from final analysis if they failed to meet this criterion because if participants were unable to correctly identify isolated faces it would be impossible to interpret either the presence or absence of congruency effects.

**Results**

**Criteria trials: Isolated face and isolated body trials.** Participants were given three attempts to pass our isolated body criterion trials. One participant had to repeat the isolated body trials twice before passing; one additional participant failed to pass our isolated body criterion and was excluded from our final sample. Participants were given one chance to pass our isolated face criterion trials, rather than three times as in Experiment 1, because we were looking at the influence of faces on the perception of body postures. Training participants on faces was not important as participants were instructed to ignore the face and, in keeping with Experiments 1a and 1b (see also Mondloch, 2012) the to-be-ignored component of the face-body compound was presented in isolation only after test trials were complete. When tested with isolated faces, 16 adults passed our criteria (15 of 18 correct) and were extremely accurate (*M* correct = .89); five additional participants were unable to pass our isolated face criterion (*M* = .73). The 16 adults who passed both isolated face and isolated body criterion trials were perfect on all catch trials and very accurate on isolated body trials (*M* = .97). One of the participants who failed our isolated face criterion also failed our catch trial criterion trials. These levels are similar to those found in Experiment 1a.

**Accuracy.** A 3 (body emotion: sad, fear, anger) x 3 (face emotion: sad, fear, anger) repeated measures ANOVA was conducted to determine whether the proportion correct differed across trials. There was no significant effects for body emotion, $F(2, 30) = 1.980$, $p = .156$, for face emotion, although it was approaching significance, $F(2, 30) = .051$, $p = .950$, or for body emotion x face emotion interaction, $F(4,60) = 2.030$, $p = .102$. The results indicate that the proportion correct did not vary as a function of body posture or facial expression and that the proportion correct for body posture did not differ depending on the facial expression with which they were paired (see Figure 6.1).

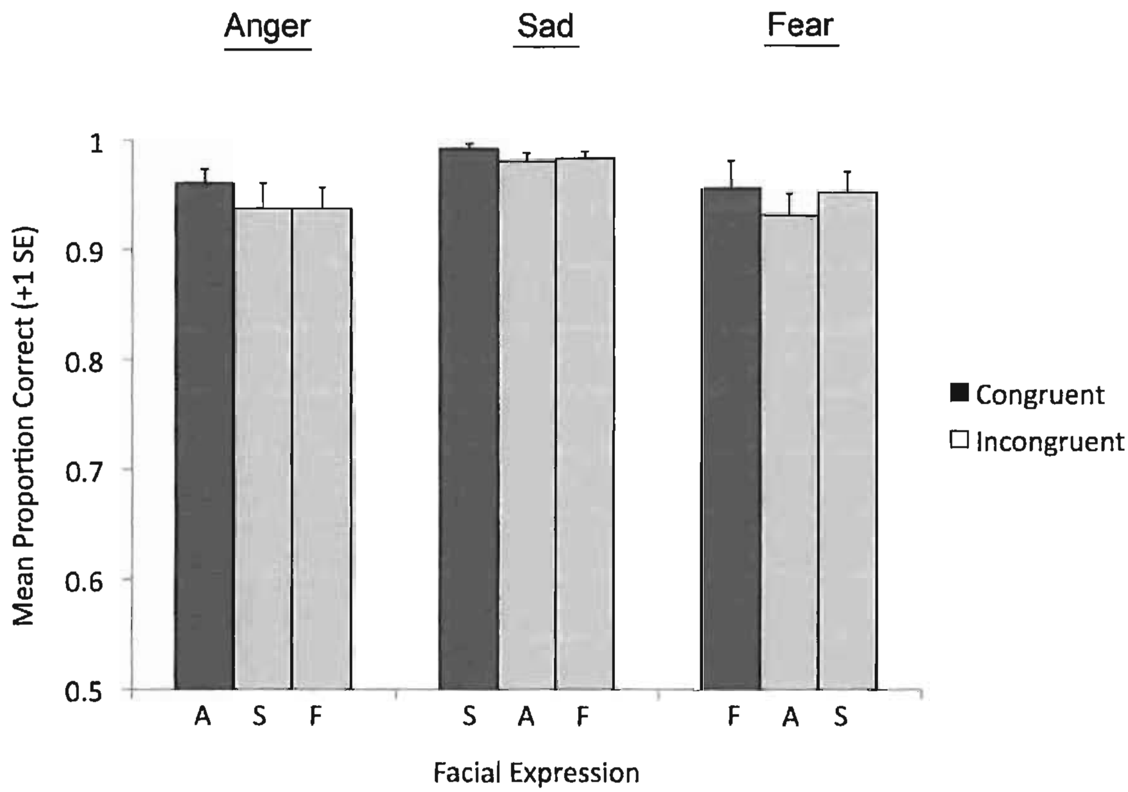


*Figure 6.1:* Mean proportion correct for reversal task (participants required to attend to body and ignore face). Bars grouped by body posture.

**Reaction times.** A 3 (body emotion: sad, fear, anger) x 3 (face emotion: sad, fear, anger) repeated measures ANOVA was conducted to determine whether reaction times differed across trials. There was a main effect for body emotion, $F(2, 30) = 7.385$, $p = .002$, $\eta^2 = .330$. This main effect means that reaction times varied as a function of body posture. Participants were faster for sad bodies ($M = 986.46$) than fear bodies ($M = 1121.75$), $t(15) = -3.649$, $p = .002$, $r = .45$, and for anger bodies ($M = 1065.28$), $t(15) = -3.337$, $p = .004$, $r = .32$. There was no difference in reaction times for fear bodies ($M = 1121.75$) versus anger bodies ($M = 1065.28$), $t(15) = 1.324$, $p = .205$. Secondly, there was no main effect for face emotion, $F(2, 30) = .078$, $p = .925$. This lack of a main effect means that reaction times for body postures did not vary across facial expressions. There was a significant body emotion x face emotion interaction, $F(4, 60) = 5.683$, $p = .001$, $\eta^2 = .275$. This interaction means that reaction times for body posture depended on the facial expression with which they are paired.

Three separate one-way repeated measures ANOVAs holding body posture constant and a priori paired samples t-tests were conducted to follow up that significant interaction (see Figure 6.2).

***Reaction Times for Anger, Sad, and Fear Bodies.*** Reaction times for anger bodies did vary as a function of face emotion, $F(2, 30) = 7.245$, $p = .003$, $\eta^2 = .326$. Participants were faster on congruent trials ($M = 1021.47$) than both incongruent anger body/sad face trials ($M = 1107.06$), $t(15) = -3.298$, $p = .005$, $r = .32$, and incongruent anger body/fear face trials ($M = 1067.31$), $t(15) = -2.135$, $p = .05$, $r = .19$. Participants were no faster on incongruent anger body/sad face trials ($M = 1107.06$) than incongruent anger body/fear face trials ($M = 1067.31$), $t(15) = -2.027$, $p = .061$. Reaction times for sad bodies did not vary as a function of face emotion, $F(2, 30) = .694, p = .507, \eta^2 = .044$. Reaction times for fear bodies did not vary as a function of face emotion, $F(2, 30) = 2.037, p = .148, \eta^2 = .120$.

***Reaction Times for Congruent Trials.*** A one-way repeated measures ANOVA was conducted to determine if there was a difference in reaction times on congruent trials. There was a significant main effect of congruent emotion, $F(2, 30) = 7.385, p = .002, \eta^2 = .330$, indicating that reaction times differed as a function of the emotion on congruent trials. Participants were faster on sad congruent ($M = 973.28$) than fear congruent trials ($M = 1103.34$), $t(15) = -3.84, p = .002, r = .40$. There was no difference in reaction times for anger congruent trials ($M = 1021.47$) versus sad congruent trials ($M = 973.28$), $t(15) = 1.790, p = .094$, or fear congruent trials ($M = 1103.34$), $t(15) = -2.021, p = .61$.

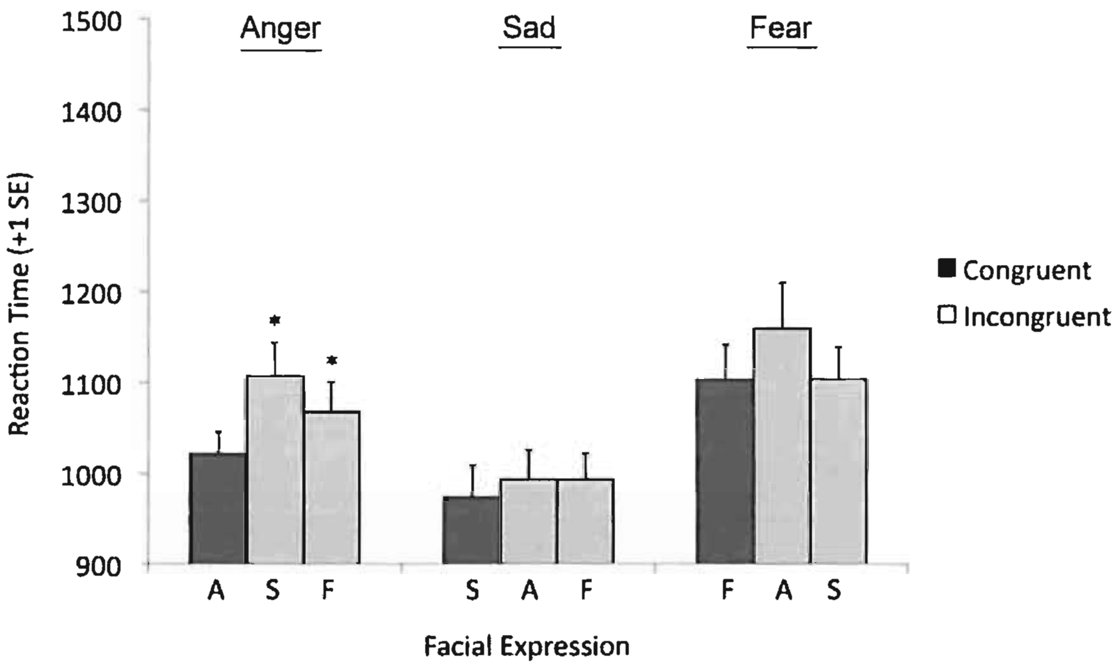


*Figure 6.2:* Reaction times for reversal task (participants required to attend to body and ignore face). Bars grouped by body posture.

**Errors Analysis**. (See Figure 6.3). The error analysis was conducted in the same manner as in Experiment 1a, except was now used to determine whether the proportion of errors shifted as a function of the incongruent facial expression.

***Proportion of Errors with Anger Bodies.*** On congruent trials, the proportion of fear errors ($M = .47$) did not differ from chance, $t(15) = -.368$, $p = .718$. When viewing angry bodies, the proportion of fear errors did not differ across facial expression, $F(2, 30) = 1.126$, $p = .338$, $\eta^2 = .070$. Regardless of the facial expression an angry body was paired with, the proportion of fear errors did not differ across conditions.

***Proportion of Errors with Sad Bodies.*** On congruent trials, the proportion of fear errors ($M = .44$) did not differ from chance, $t(15) = -1.464$, $p = .164$, indicating that there was no bias on congruent trials. When viewing sad bodies, the proportion of fear errors did not differ across facial expression, $F(2, 30) = .924$, $p = .408$, $\eta^2 = .058$.

***Proportion of Errors with Fear Bodies.*** On congruent trials, the proportion of sad errors ($M = .47$) did not differ from chance, $t(15) = -.848$, $p = .410$, indicating that there was no bias on congruent trials. When viewing fear bodies, the proportion of sad errors did not differ across facial expression, $F(2, 30) = 1.014$, $p = .375$, $\eta^2 = .063$. Regardless of the facial expression a fear body was paired with, the proportion of sad errors did not differ across conditions.

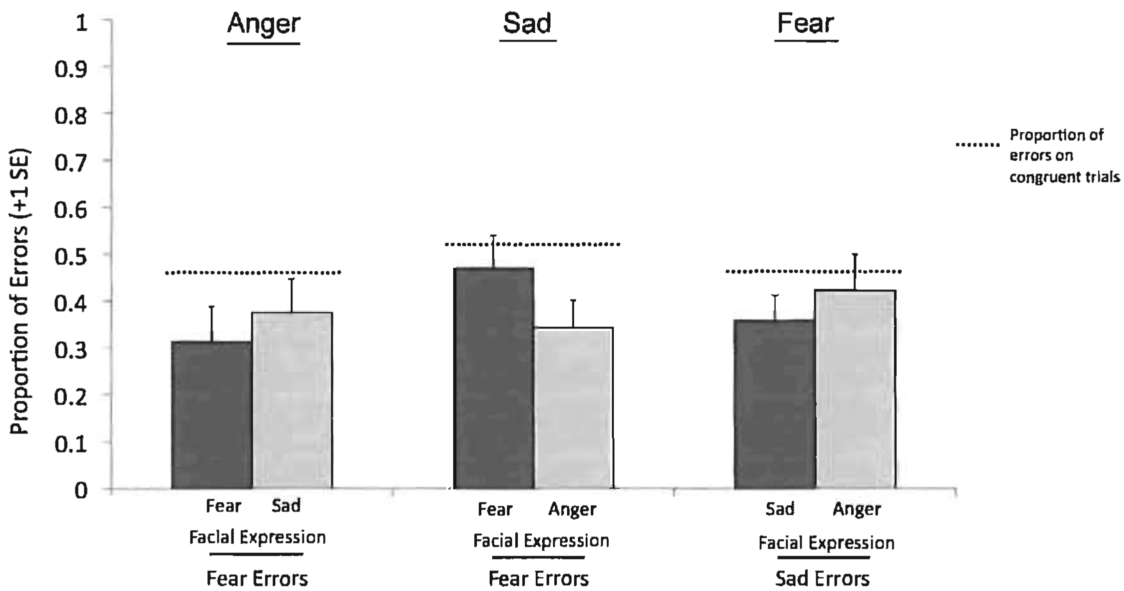


*Figure 6.3:* Error analysis for reversal task (participants required to attend to body posture and ignore face). Bars represent proportion of errors on incongruent trials. Bars grouped by body posture.

**Discussion**

Unlike Experiment 1a and 1b, congruency effects were largely non-existent in Experiment 2. The only congruency effect found was for angry bodies; participants were faster for angry congruent trials compared to incongruent trials. However, there was not an effect for accuracy, indicating that although there is a congruency effect, it is smaller than most of the effects in Experiment 1a and 1b. Overall, despite the small effects for angry bodies, facial expressions do not have the same influence on participants' perception of emotional body postures that body postures have on facial expressions.

One explanation is that body postures are much larger than faces, and this size difference may make it easier to ignore the facial expression, thereby making it difficult for the expression to alter people's perception of bodies. In Experiment 1a and 1b, people may be able to focus primarily on the facial expression, but the body postures are large enough that they still appear in the peripheral vision, which could be why they can influence perception of facial expressions.

Furthermore, facial expressions often have much more subtle differences between emotions, whereas the differences between body postures are quite distinct. For example, the difference between fearful and sad bodies is large; fearful bodies have arms raised and sad bodies have arms dropped. In contrast, the difference between sad and fearful faces is not as clear, which may be one reason why they are often confused with each other (Gao & Maurer, 2009; Gao et al., 2010). Across the first three experiments, participants' accuracy was consistently lower for isolated face trials than isolated body trials. For example, in Experiment 2, the mean accuracy for isolated face trials was .89 and for isolated bodies was .97.

The results of Experiment 2 suggest that it is specifically fear bodies that cause the large interference in Experiment 1a and 1b, not fear in general. Perhaps this effect is due to certain evolutionary factors. Fear is a very difficult emotion to recognize in facial expressions, even for adults (Russell, 1994; Tottenham et al., 2009). Recognition rates are far lower than most other emotions, especially happy, but even other negative emotions like sad and anger (Tottenham et al., 2009). However, fear is an expression that can relay important social information, so it's possible that some evolutionary advantage existed for those able to accurately detect this emotion in others. For example, if you see someone is fearful, that expression might be a cue to an impending danger; that person might be fearful because they have encountered a crocodile, snake, or some sort of other threat. Being able to quickly and effortlessly pick out this information would have an evolutionary advantage, especially from a distance. It is better to find out there is a crocodile or snake from a safe distance than discovering it while standing in its nest. Unfortunately, fear is hard to recognize from a person's face relative to other emotions even when two people are very close (Russell, 1994; Tottenham et al., 2009). It would be extremely difficult to ascertain the relevant information when viewing someone from a distance. Therefore, to compensate, perhaps an attentional bias for fearful bodies postures has developed over time. This would explain why fearful bodies cause so much interference.

To the best of our knowledge no other studies have compared reaction times for various body postures. Therefore, to test the possibility that there is an attentional bias for fearful bodies, in Experiment 3 we conducted a flanker task. A flanker task shows one target stimulus surrounded by either congruent or incongruent stimuli (Eriksen &

Eriksen, 1974). Participants are told to respond to the target stimulus and ignore the irrelevant flankers. Participants are usually faster when a target stimulus is flanked with congruent flankers than when the target stimulus is flanked with incongruent stimuli. This effect is called a flanker effect or an interference effect, which is dependent on difference between targets and flankers in distance from each other (Paquet & Craig, 1997; Yantis & Johnson, 1990), size (Miller, 1991), colour (Harms & Bundesen, 1983), and motion (Driver & Bayliss, 1989). Flanker effects have been shown with schematic faces, but are smaller for negative target faces than positive target faces (Fenske & Eastwood, 2003). This is consistent with a wealth of literature that suggests that negative emotions narrow attention, and positive emotions broaden attention (Derryberry & Tucker, 1994; Fredrickson, 1998, 2001; Fredrickson & Branigan, 2004). For example, in a visual search task, schematic negative facial expressions surrounded by neutral expressions guide attention to themselves more efficiently than positive facial expressions surrounded by neutral expressions (Eastwood, Smilek, & Merikle, 2001). Negative emotions can also interfere with performance on concurrent tasks. It takes longer to count features on a negative schematic face than a positive schematic face (Eastwood, Smilek, & Merikle, 2003). Negative emotions not only capture, but also hold attention. In a spatial-cueing task, Fox, Russo, and Dutton (2001) showed that negative schematic faces used as cues significantly increased reaction times to targets more than positive or neutral faces on invalid trials.

Theoretically, if fearful bodies cause perceptual narrowing that captures and holds attention, fear target bodies in a flanker task should be interfered with less by incongruent flankers. There should be little difference in reaction times as a function of whether congruent or incongruent bodies flank fearful target bodies. However, when fearful bodies are flankers, they should capture attention more than either sad or angry bodies. This means that flanker effects should be largest when fearful bodies are incongruent flankers compared to when either sad or anger bodies are incongruent flankers.

This flanker task is an appropriate follow-up because it relies on similar principles to the original study. Target postures always exist in the same position on each trial and participants know exactly where they are supposed to attend and what they are supposed to ignore. This is just like the original task where participants know the exact location of the facial expression they must attend to and the body posture they must ignore.

## Experiment 3

### Method

**Participants.** Participants were undergraduate students (n = 24) between the ages of 18 and 27 ($M = 20.1$). Adults received partial course credit or a small monetary reward for their participation.

**Materials.** We utilized 24 photographs of emotional body postures created from four models (two male). Body postures were taken from Mondloch (2012); each of four models provided two sad, two anger, and two fearful postures that were correctly labeled by over 80% of adult participants (see Mondloch, 2012 for validation details). These were the same body postures used in all other experiments.

Each stimulus comprised two identical flanking bodies surrounded a target body. The inner edge of each flanking body was placed 1 cm away from the outermost edge of the target body. Each of the 24 body postures was used as a target posture. In the 24 congruent trials the target postures were flanked by two body postures of the same emotion posed by the same target model, but the pose of the flanker expression was different. For example, male 1 posed two versions of angry, so in a congruent angry trial, angry pose 1 by male 1 would be the target body and the surrounding flanker bodies would be angry pose 2 by male 1. In 96 incongruent trials the target models were flanked by two body postures of a different emotion posed by the same target model. For example, angry pose 1 by male 1 would be the target body and the surrounding flankers would be fearful pose 1 by male 1 in one incongruent trial and sad pose 1 by male 1 in another incongruent trial. Each of the four models was utilized in 30 unique trials—6 congruent and 24 incongruent. Each pose was presented five times as the target, once on a congruent trial and four times on an incongruent trial; each pose was presented five times as a distracter, once on congruent trials and four times on incongruent trials. There were six poses per model. This created 120 different trials.

**Procedure.** Written consent was obtained from adult participants prior to testing. Following visual screening procedures, participants were seated at a table with a computer monitor in a lab at Brock University. The task was programmed with Cedrus Superlab Version 4 and participants were required to make their responses with a Logitech controller. Participants could make one of three responses on each trial. One button was labeled 'F' and was always used to indicate recognition of a fearful body posture; one button was labeled 'S' and was always used to indicate recognition of a sad body posture; and one button was labeled 'A' and was always used to indicate recognition of an angry body posture. Prior to each block of trials verbal instructions were given to participants while corresponding written instructions were displayed on the computer monitor. Each test trial consisted of a test stimulus, followed by a fixation stimulus (*) presented for approximately one second, which simply indicated that the next test trial was about to begin. The fixation stimulus was located around the shoulder region of the target stimuli. The entire protocol comprised two phases: practice trials and test trials.

The practice block consisted of 36 trials. There were 12 congruent trials and 24 incongruent trials. Stimuli were presented for an unlimited amount of time. The practice block was designed to allow participants to get comfortable with the task. Participants saw each emotion an equal number of times. The 36 trials presented in the practice block also appeared in the test blocks. We believed there were enough test trials in the four test blocks that participants would not gain any additional advantage from seeing a subset of test trials in the practice block. Before the start of the practice block participants were given the following instructions: *We're going to see pictures of body postures with blurred faces and you need to decide if the body in the centre is showing an angry, sad, or fearful expression. Please only focus on the body in the centre and ignore the bodies that surround it.*

After the practice trials, adult participants completed four blocks of 72 test trials. The same 24 congruent trials appeared in each block, meaning each congruent trial appeared four times across the entire experiment. In each block, 48 incongruent trials were used, which is a subset of the 96 total incongruent trials. This subset was counterbalanced across the four blocks, meaning that each incongruent trial appeared twice over the entire experiment and no incongruent trial appeared more than once in each block. Within each test block, a third of the trials were congruent (n = 24) and two-thirds were incongruent (n = 48), which was the same proportion as in Experiment 1 and 2. In total, participants saw 288 test trials over the four test blocks, which was 72 more test trials than in either Experiment 1 and 2.

When introducing the test block, participants were told the task was similar to the practice block. They were reminded that their task was to determine if the centre body posture was displaying a sad, fear, or anger expression. Participants were explicitly told to ignore the surrounding flanker bodies and respond as quickly and accurately as possible.

**Results**

**Accuracy**. A 3 (target emotion: sad, fear, anger) x 3 (flanker emotion: sad, fear, anger) repeated measures ANOVA was conducted to determine whether the proportion correct differed across trials. Despite accuracy being very high (>95%) for each of the three body emotions, there was a main effect for target emotion, $F(2, 46) = 4.101$, $p = .023$, $\eta^2 = .151$. This main effect means that the proportion correct did vary as a function of target emotion. Participants had a larger proportion correct on sad target trials ($M = .98$, $SD = 0.17$) than anger target trials ($M = .95$, $SD = .013$), $t(23) = 2.205$, $p = .038$, $r = .26$. There was no difference in the proportion correct on sad target trials ($M = .98$, $SD = 0.17$) versus fear target trials ($M = .98$, $SD = .022$), $t(23) = .332$, $p = .743$; there was no difference in the proportion correct on fear target trials ($M = .98$, $SD = .022$) versus anger target trials, although it was approaching significance, ($M = .95$, $SD = .013$), $t(23) = 2.037$, $p = .053$. Secondly, there was no main effect for flanker emotion, $F(2, 46) = .558$, $p = .576$, $\eta^2 = .024$. This lack of a main effect means that the proportion correct for target bodies did not vary across flankers. There was not a significant target emotion x flanker emotion interaction, $F(4, 92) = .807$, $p = .524$, $\eta^2 = .034$. This lack of an interaction means that the proportion correct for targets did not depend on the flankers with which they are paired (see Figure 7.1).

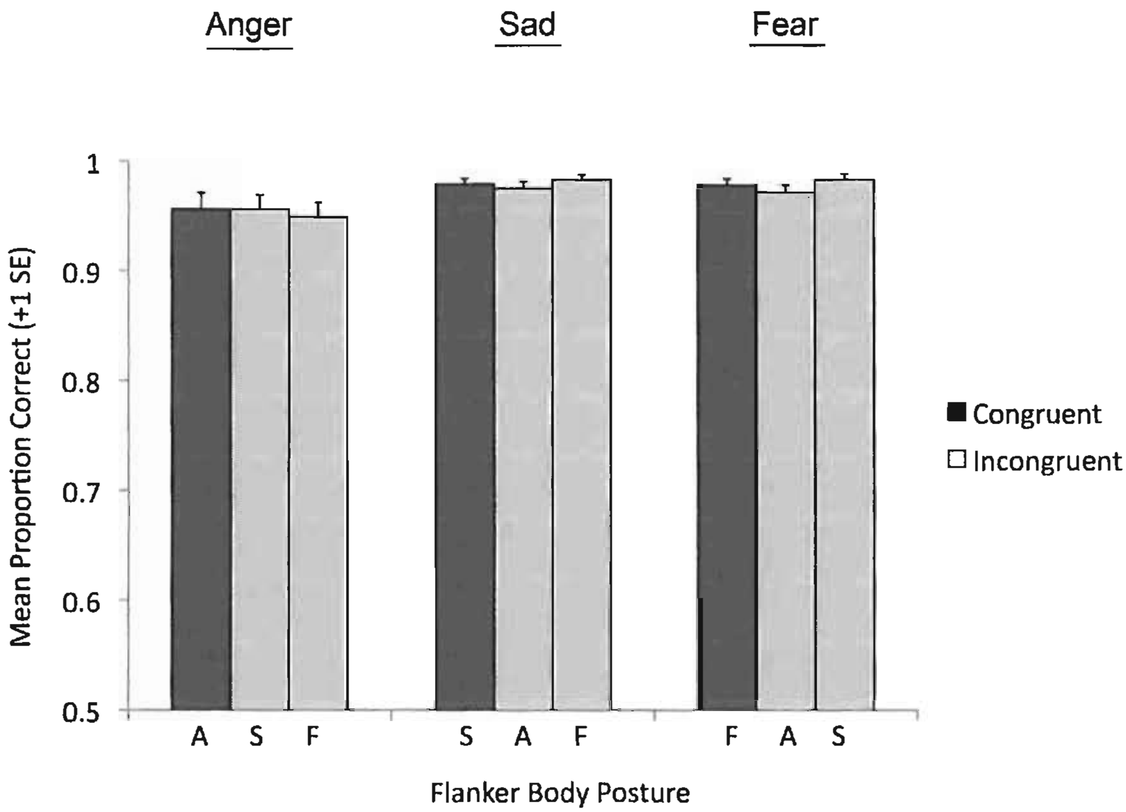


*Figure 7.1:* Mean proportion correct on flanker task. Bars grouped by target body posture.

**Reaction Times**. A 3 (target emotion: sad, fear, anger) x 3 (flanker emotion: sad, fear, anger) repeated measures ANOVA was conducted to determine whether reaction times differed across trials. There was no main effect for target emotion, $F(2, 46) = 1.689$, $p = .196$, $\eta^2 = .068$. This lack of a main effect means that reaction times did not vary as a function of target emotion. Secondly, there was no main effect for flanker emotion, $F(2, 46) = 2.334$, $p = .108$, $\eta^2 = .092$. This lack of a main effect means that reaction times for target bodies did not vary across flankers. There was not a significant target x flanker interaction, $F(4, 92) = .804$, $p = .526$, $\eta^2 = .034$. This lack of an interaction means that reaction times for targets did not depend on the flankers with which they are paired. Analyses of response times indicated there were no flanker effects; response times did not increase on incongruent trials (see Figure 7.2).

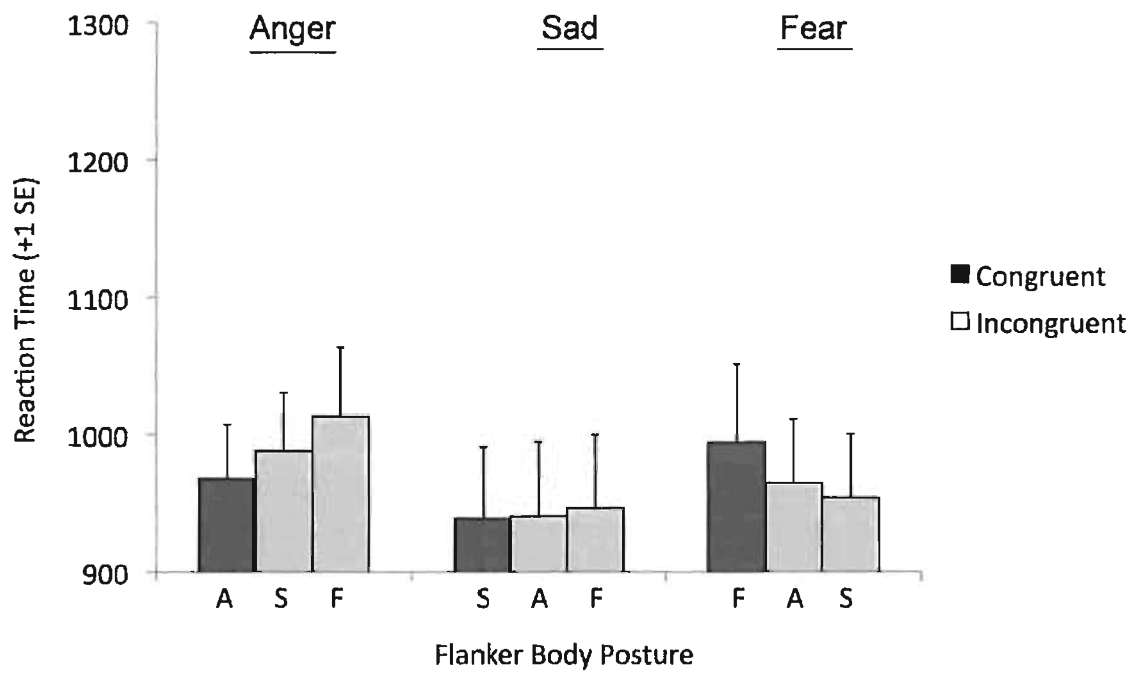


*Figure 7.2:* Reaction times on flanker task. Bars grouped by target body posture.

**Discussion**

In general, the results of Experiment 3 did not support the hypothesis that fearful bodies would drive flanker effects, which based on the results of Experiment 1a and 1b seemed probable. We hypothesized that flanker effects would be smaller or potentially even non-existent when fearful bodies were the targets. Similarly, we hypothesized that flanker effects should be largest when fearful bodies were the surrounding flanker bodies relative to when either sad or anger bodies were flankers. This hypothesis was because we thought people might have an attentional bias towards fearful bodies. Accordingly, fearful bodies should capture and hold attention, meaning fearful targets would be immune to the effects of sad or anger flankers, and anger and sad targets should be interfered with most by fearful flankers. However, there was no difference between reaction times for any trials. There was no additional cost for participants when fearful bodies were flanking targets, and fearful bodies received no extra protection from interference when they were targets. Participants were slightly more accurate on trials with sad target bodies compared to trials with anger target bodies, however there were no other significant differences in accuracy scores.

One explanation is that the task was simply too easy for participants. Accuracy on all trials was over 95 percent, so the task may not have been difficult enough for flanker effects to exist. One way to make the task more difficult would be to use more subtle postural expressions of the three emotions. However, flanker effects have been shown with schematic faces (e.g., Fenske & Eastwood, 2003), stimuli that are very easy to recognize. Therefore, it is not simply stimuli being too easy to recognize that is causing the lack of effects.

One possible explanation for our null results is that fearful bodies cannot take precedence in processing because participants responded too quickly to all body postures and response times were not longer for fearful postures than for angry and sad postures. Participants were responding at around 1000 ms for each posture, which is at least 100-150 ms quicker than participants were responding to stimuli in Experiment 1a. In Experiment 1a, because recognizing facial expressions was more difficult, there was enough time for fearful bodies to interfere with perception. In Experiment 3, however, the task was easy enough that reaction times were not long enough for a similar process to occur. This explanation would be similar to a global-local task, in which there is no interference from incongruency when participants are required to respond to the global level, but there is interference from incongruency when participants are required to respond to the local level (e.g., Navon, 1977).

## General Discussion

The results of Experiment 1a and 1b do not support either the dimensional model or the emotional seed model. Both models made a few correct predictions, but not enough to accumulate overwhelming support.

A potential reason the data did not fully support the two models is that we used a task with three different emotions in both the face and the body. In most studies (e.g., Meeren et al., 2005; Mondloch, 2012; Righart & de Gelder, 2008a) there are usually only two emotions that participants must choose between. The existence of a third emotional expression increases task demands, which may be a reason why our data did not conform to the pattern predicted by either model. However, the only way to directly compare the two models to each other was to use more than two emotions. Using more than two emotions is not problematic because using additional emotions is a more ecologically valid approach. When recognizing an emotion, people have more than two emotions from which to choose. Using three is not perfect, because there are more than three emotions in the real world, but it is at least better than two. Aviezer et al. (2008) asked participants to choose from more than just two emotions, but the only facial expression participants saw was disgust. Presenting only disgust is problematic because using only one facial expression does not help explain how all faces are influenced by context; it only explains how disgust faces are influenced by context. Furthermore, only presenting disgust is a limitation because congruency effects can be asymmetric. For example, Van den Stock et al. (2007) found happy bodies interfere with fear faces, but fear bodies do not interfere with happy faces. Therefore, it is not certain that the same pattern of results would exist if Aviezer et al. (2007) used facial expressions other than disgust.

One of the reasons we chose not to use disgust was because of the difficulty in creating disgust body postures without the use of props. We were specifically interested in seeing what influence body postures had on the perception of emotional facial expressions, not the influence that props have on perception. Our lack of props is another potential reason our pattern of data did not replicate Aviezer et al. (2008); they used props and gestures in their depictions of emotional body postures (e.g., a disgust body was depicted with a man holding a dirty diaper), whereas our postures did not. Perhaps the existence of these extra cues to the emotion being expressed interferes with the perception of emotional facial expressions in an entirely different manner than a simple body posture normally does. Furthermore, at least in the examples shown, two of the body postures in Aviezer et al. (2008) used props (sad was accompanied by a coffin and disgust was accompanied by a dirty diaper) and two (anger and fear) did not, which could have influenced the pattern of results. Perhaps the existence of a coffin to accompany sad body postures greatly increases the intensity of the emotion in the body, which might be why Aveizer et al. (2008) found that sad bodies caused more interference than fear bodies.

Furthermore, Aviezer et al. (2008) only displayed their stimuli from the waist up, whereas our stimuli displayed whole bodies. Perhaps there are additional cues to an emotional expression displayed in the lower half of the body postures that cause a different pattern. A lot of our fear stimuli were displayed leaning back, as if in shock, and the stance of their legs helped convey this. With the use of a full body posture, there is now a larger piece of information in a participant's peripheral vision, which may cause more interference. Overall, the emotional seed model was not supported by our data. Although there are certain explanations as to why this might be the case, our data warrant a reevaluation of this influential model.

In terms of the dimensional model, one reason why the use of props could be problematic is that they may alter the underlying dimensions of valence and arousal, causing the emotions to fall on entirely different regions of the circumplex. If this is the case then the similarity of the emotions is altered and the model would be unable to make accurate predictions.

Unlike Aviezer et al. (2007), we did not use props in our study, but nonetheless our results were not consistent with the dimensional model. One potential reason our results were not consistent with the dimensional model is that there may be greater differences between the similar emotions than we expected. For example, both fear and anger are high in arousal and negative in valence, so we hypothesized that their influence on sad faces would be equal. However, just because they are both negative in valence and high in arousal does not mean they are equal on those two dimensions. It is entirely possible that anger is higher in arousal than fear, thus making fear more similar to sad than anger is to sad. If anger is higher in arousal than fear our pattern of results for sad faces would not be so unexpected according to the dimensional model.

However, it could be possible that our data would better reflect the dimensional model if other underlying dimensions were taken into account. For instance, there could be other dimensions, such as approach/avoidance or attention/rejection (Schlosberg, 1954), that could help us better characterize emotions. If other underlying dimensions do exist, then the fact that the dimensional model is unable to make accurate predictions is not so surprising. Gao et al. (2010) used multidimensional scaling based on similarity ratings to show that three- or four-dimensional structures were optimal for adults. The dimensions represented were pleasure (or valence), potency (strong vs. weak), arousal (high vs. low), and intensity. For the potency dimension, anger is on one end, representing feelings of power, dominance, and impulses to act, whereas fear is on the other end, representing feelings of weakness, submission, and inaction (Gao et al., 2010). For the intensity dimension, neutral expressions are on one end and expressions with increasingly less neutral blends are on the other end. These dimensions might actually make fear and sadness more similar than previously thought, because both would be similar on potency. Consequently, the larger congruency effects with sad and fear paired together compared to when anger was paired with either is better reflective of this model.

Despite possible reasons that our pattern of results did not match either of the two models, it appears that there is something special about fear bodies. In both Experiment 1a and 1b fear bodies caused a decrease in accuracy, increased reaction times by the largest amount, and altered the pattern of errors, which no other body posture did. Furthermore, the results of Experiment 2 support the notion that it is fear bodies specifically, and not just fear in general, that is driving these results. In contrast, the results of Experiment 3 do not support the idea that fearful bodies produce an attentional bias. There is a wealth of literature that suggests that negative emotions narrow attention, and positive emotions broaden attention (Derryberry & Tucker, 1994; Fredrickson, 1998, 2001; Fredrickson & Branigan, 2004). We did not use body postures expressing positive emotions to contrast the negative emotions, so it is possible that body postures expressing negative emotions do capture attention better than positive emotions, but there are small or no differences between the negative emotions. In other words, fearful or angry bodies may capture attention more than happy bodies, but neither fearful nor angry bodies capture more attention than the other. However, if this is true it does not explain why there is a difference in the amount of interference produced by the three negative postures in Experiment 1a and 1b. It seems likely that fearful bodies do not produce greater interference in every situation, but only certain situations, such as when paired with a facial expression.

In Experiment 2, reaction times to fearful bodies did not differ from anger bodies. Participants did respond quicker to sad bodies than either anger or fearful bodies, which might be a product of being the only posture with hands down. Based on these reaction times, fearful bodies should be equally likely as anger bodies to produce interference in

Experiment 1, yet it is fearful bodies that cause the most interference. One explanation is due to the functional significance of fearful bodies. Fearful bodies present an easy to recognize and reliable cue to fear, one that can be detected fairly quickly, even from a distance. Detecting fear from a distance is important because it can help someone avoid a potentially dangerous situation. If the only cue to fear was in the facial expression, it would be much more difficult because even intense exemplars of fear facial expressions are hard to recognize (Russell, 1994; Tottenham et al., 2009). Therefore, fearful bodies are a salient cue that may have become hard to ignore.

Study 2 is an important line of research because it provides data that suggest the two influential models of emotion perception may not be totally accurate in all situations. Perhaps emotional perception is even more complex than either model suggests. Emotion perception might be something that is more fluid, changing depending on the specific emotions, the contexts, the mode of presentation, and even the number of emotions included. Even when focusing solely on how emotional facial expressions are perceived, it seems that both models are only able to make certain predictions; neither model is an all-encompassing explanation of how emotions are perceived in context.

The emotional seed model and the dimensional model fail to account for two major findings in our results. First, neither model can account for why sad and fear interfere with each other the most. According to the emotional seed model, sad should be equally interfered with by both anger and fear, but our results show that sad is disproportionately interfered with by fear. According to the dimensional model, angry bodies should interfere with the perception of fearful faces more than sad bodies, but our results showed sad bodies produced more interference. This might be accounted for by adding potency or approach/avoidance (Schlosberg, 1954) to a modified model. The potency dimension represents feelings of power, dominance, and impulses to act on one end (anger) and feelings of weakness, submission, and inaction on the other end (fear and sad; Gao et al., 2010). According to this dimension, sad and fear are quite similar. Taking into account potency would explain the large effects sad and fear have on each other in our study and would also help explain the confusability between the two emotions shown in Gao et al. (2009).

The second major finding neither model can account for is the large effect that fear bodies have on the perception of sad and anger faces. One reason is because neither model takes into account the functional significance of the emotions. Fear is a cue to danger, which might mean failing to pick out fear is the most costly mistake a person can make. Unfortunately, recognizing fear in facial expressions is relatively difficult compared to other expressions (Russell, 1994; Tottenham et al., 2009). It is even more difficult to recognize fearful faces from a distance, which might be the most important time to recognize fear because it can help inform effective strategies for avoiding potential danger. It may be possible that a bias towards fear bodies has developed to counteract this difficulty in perceiving fear facial expressions, as fear body postures are easier to recognize than fear facial expressions. This would help explain why fear bodies caused so much interference in our study. Therefore, the size of congruency effects may not depend entirely on similarity between emotions as the two models suggest. The difficulty in perceiving an emotion may play a large role. That difficulty could be a product of the distance a person is being viewed from (e.g., it is harder to perceive an expression from a far distance so the body posture is more heavily relied upon) or the difficulty in perceiving an expression (e.g., fear is a difficult expression to perceive so the body posture is more heavily relied upon).

**Limitations**

One potential limitation is that fearful bodies produce more interference in Experiment 1a and 1b because they have raised arms above the head, and this may capture attention, thus biasing participants more towards making a mistake. However, the results of Experiment 1 in Study 1 disqualify this possibility. In Experiment 1, a group of 6-year-olds were unable to recognize sad and fearful body postures in isolation. When tested on our task, these children did not produce any congruency effects, unlike the larger group of 6-year-olds that could recognize these emotions in isolated postures. If the existence of congruency effects was solely a product of raised arms above the head, these children should have produced congruency effects, despite not knowing the emotional information in the body posture.

Another limitation could have been our use of static images. In the real world body postures are fluid and dynamic and a lot of the information conveyed in the posture is through this movement. Using static images only gives a snapshot of an emotion, and the information presented is not as rich as it otherwise could have been.

**Future Research**

One potential follow-up study would be running Experiment 1 using an eye-tracker. An eye-tracking study would allow us to understand whether fearful bodies are causing more interference because they are capturing and holding attention more than other body postures. We know from both Experiment 1 and Experiment 2 that participants had longer reaction times for trials with fearful bodies, but we do not know whether this is because participants spend more time looking at fearful bodies. Perhaps the existence of fear bodies somehow causes participants to look longer or first at the facial expression.

Another potential line of research would be to include disgust in our task. Disgust is another emotion the two models disagree on. The dimensional model suggests that both fear and disgust are negatively valenced and relatively high in arousal, so there should be large congruency effects when these emotions are paired together; the emotional seed model would not predict large congruency effects between these two as they do not share a lot of physical similarity and are, in fact, direct opposites on the model. However, including disgust into our study would require including props with our emotional body postures.

Further exploration of the possibility that people have an attentional preference for fearful body postures is another avenue for future research. One potential follow-up would be to use a visual search paradigm, where fearful bodies are presented among an array of other body postures (e.g., one fearful body posture among an array of angry body postures). If there is an attentional bias, participants should be faster locating the lone fearful body posture, which is called a pop-out effect (Treisman & Gelade, 1980). Although there is research suggesting a pop-out effect exists for negative facial expressions when surrounded by happy facial expressions (see Frischen, Eastwood, & Smilek, 2008 for a review), this study would only use the three negative body postures used in Experiment 3.

**Summary**

In summary, the collective results from Study 2 do not support either the dimensional model or the emotional seed model. Both models do a good job of predicting congruency effects in certain situations, but the complex interaction between face and body ensure that neither model is comprehensive.

## General Summary

This thesis addressed two major questions. First, do young children show the same pattern of congruency effects as older children and adults? We found that this was true; 6-year-old children show congruency effects for highly similar emotions (sad and fear), but 4-year-olds do not show congruency effects for highly dissimilar emotions (happy and sad). This finding is important because it was possible that very young children would always show a congruency effect, even for highly dissimilar emotions, due to an inability to allocate attention (Choi et al., 2008; Irwin-Chase & Burns, 2000; Takio et al., 2009). Conversely, pre-school aged children have been shown to have trouble integrating multiple cues of emotion (Nelson & Russell, 2011), so perhaps young children would never show congruency effects, even for highly similar emotions. Study 1 was the first to show that congruency effects are not something that develop gradually, but rather something that mirrors adults' pattern of effects at the youngest age at which children can recognize the emotions in isolation.

The second question this thesis addressed was which influential model of emotion perception is more accurate in making predictions about the existence and size of congruency effects: the dimensional model or the emotional seed model? My thesis was the first study to compare these two highly influential models of emotion perception, which is important because the two models make different predictions depending on the emotions involved. Our results showed that neither model was particularly strong at making specific predictions with anger, sad, and fear as the emotions. What we did find was a special importance for fearful body postures. We hypothesized that fearful bodies take on extra importance to compensate for the difficulty in recognizing fearful faces.

Due to the fact that people have trouble recognizing fearful faces (Russell, 1994; Tottenham et al., 2009), perhaps over time a bias towards fearful bodies has developed because even from a far distance a fearful posture is still a reliable cue to fear and can convey potentially life-saving information. Although neither the emotional seed model nor the dimensional model was supported by our data, it is important to note that it is very difficult for one model to be totally comprehensive. Both models are strong at making certain predictions (e.g., congruency effects will exist with sad/fear pairings), but fail when making specific predictions about the relative size differences in the effects.

For any future model to improve on both the dimensional model and the emotional seed model, the complex relationship between face and body posture would have to be taken into account (something that is admittedly difficult). Accordingly, no model is truly complete without considering other aspects such as the size of the cues or the distance at which they are being perceived. For example, if a task requires expressions to be perceived from a distance, the reliance on body postures may take on increased importance, further complicating potential models.

In the future, the field of emotional facial perception needs to further explore how faces are perceived in the real world. Studies need to stop presenting participants with static photographs of facial expressions and instead begin using dynamic expressions, which convey much more information as it naturally occurs. In addition, presenting videos of people actually experiencing emotions (e.g., the actual facial expression that occurs when someone is frightened), rather than posing intense exemplars, is a better way to determine how people perceive emotions as they are actually expressed. How a person perceives an expression in the lab when viewing intense exemplars may not adequately relate to how they perceive expressions naturally. In addition, more studies need to explore how people perceive emotions in general, not just from facial expressions. Facial expressions are just one cue to understanding the emotional state of an individual, and restricting people to only attend to faces limits our understanding of how people use different cues to determine the emotional state of another person. Thus, future studies should ask, "how is this person feeling", rather than asking participants to focus on one cue while ignoring any others. The use of eye-tracking technology can also allow researchers to determine where people are looking when asked this question, thus illuminating the most salient cues that people use to determine a person's emotional state.

In summary, this thesis has made novel contributions, both developmentally and theoretically, to the emotional face perception literature and has provided a number of interesting avenues for future research.

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# Appendix 1

Brock University
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Social Science Research Ethics Board

## Certificate of Ethics Clearance for Human Participant Research

DATE: October 18, 2011

PRINCIPAL INVESTIGATOR: MONDLOCH, Cathy - Psychology

FILE: 04-035 - MONDLOCH

TYPE: Faculty Research STUDENT:
SUPERVISOR:

TITLE: The Development of Visual Processing

**ETHICS CLEARANCE GRANTED**

Type of Clearance: MODIFICATION Expiry Date: 6/29/2012

The Brock University Social Sciences Research Ethics Board has reviewed the above named research proposal and considers the procedures, as described by the applicant, to conform to the University's ethical standards and the Tri-Council Policy Statement. Clearance granted from **10/18/2011 to 6/29/2012**.

The Tri-Council Policy Statement requires that ongoing research be monitored by, at a minimum, an annual report. Should your project extend beyond the expiry date, you are required to submit a Renewal form before **6/29/2012**. Continued clearance is contingent on timely submission of reports.

To comply with the Tri-Council Policy Statement, you must also submit a final report upon completion of your project. All report forms can be found on the Research Ethics web page at http://www.brocku.ca/research/policies-and-forms/research-forms

In addition, throughout your research, you must report promptly to the REB:

a) Changes increasing the risk to the participant(s) and/or affecting significantly the conduct of the study;
b) All adverse and/or unanticipated experiences or events that may have real or potential unfavourable implications for participants;
c) New information that may adversely affect the safety of the participants or the conduct of the study;
d) Any changes in your source of funding or new funding to a previously unfunded project.

We wish you success with your research.

Approved: [signature]

Jan Frijters, Chair
Social Sciences Research Ethics Board

**Note:** Brock University is accountable for the research carried out in its own jurisdiction or under its auspices and may refuse certain research even though the REB has found it ethically acceptable.

If research participants are in the care of a health facility, at a school, or other institution or community organization, it is the responsibility of the Principal Investigator to ensure that the ethical guidelines and clearance of those facilities or institutions are obtained and filed with the REB prior to the initiation of research at that site.

# Appendix 2