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Facial and Body Emotion Recognition in Infancy

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FACIAL AND BODY EMOTION RECOGNITION IN INFANCY

THESIS

A thesis submitted in partial fulfillment of the
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By

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ABSTRACT OF THESIS

FACIAL AND BODY EMOTION RECOGNITION IN INFANCY

Adults are experts at assessing emotions, an ability essential for appropriate social interaction. The present study, investigated this ability's development, examining infants' matching of facial and body emotional information.

In Experiment 1, 18 6.5-month-olds were familiarized to angry or happy bodies or faces. Those familiarized to bodies were tested with familiar and novel emotional faces. Those habituated to faces were tested with bodies. The 6.5-month-old infants exhibited a preference for the familiar emotion, matching between faces and bodies.

In Experiment 2, 18 6.5-month-olds were tested with faces and bodies displaying anger and sadness. Infants familiarized to faces showed a familiarity preference; Infants familiarized to bodies failed to discriminate. Thus, infants generalized from faces to bodies, but failed in the reverse. A follow-up study increased the duration of familiarization: 12 additional 6.5-month-olds were exposed to two-30s familiarizations with bodies, and tested with faces. Additional exposure induced matching of emotions.

In Experiment 3, 18 3.5-month-olds were tested using Experiment 1's stimuli and methodology. The 3.5-month-old infants did not discriminate during test trials.

These results suggest 6.5-month-old infants are capable of matching angry, sad and happy faces and bodies. However, 3.5-month-olds are not, suggesting a developmental change between 3.5- and 6.5-months.

KEYWORDS: Infant Development, Facial Recognition, Body Recognition, Emotion

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FACIAL AND BODY EMOTION RECOGNITION IN INFANCY

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Chapter One:

Introduction

As a social species, it is important to be able to make quick assessments of others within our surroundings. Faces are considered to be one of the most important social cues in our environment. Briefly looking at someone's face enables us to make fairly accurate assessments of that person's age, gender, race, focus of attention and emotional state. In particular, the ability to assess other people's emotional states is essential for appropriate social interaction in humans. For example, a smiling person often signifies that it is acceptable to approach, whereas an angry scowl may indicate a person to avoid. Additionally, a fearful facial expression can be beneficial in alerting one to the presence of danger, and the direction of danger based upon the location of the individual's gaze. Thus, being able to make instantaneous evaluations is beneficial for appropriate social interaction. As a result, many researchers have taken an interest in how emotional information conveyed by faces and bodies are processed and the development of this ability.

General Face Processing

Research shows that from the beginning of life, we have a preference for looking at faces. For example, Farroni and colleagues (2005) determined that newborns prefer faces and face-like stimuli to non-face stimuli. Additionally, certain critical aspects of face-processing expertise are evident by 5 months of age (Diamond & Carey, 1986; Leder & Bruce, 2000; Hayden, Bhatt, Reed, Corbly & Joseph, 2007). For example, Hayden et al. (2007) found that 5-month-olds are sensitive to second-order relations within the face (i.e., fine spatial relations such as the distance between eyes), which have

been associated with face-processing expertise in adults. However, face-processing skills continue to develop beyond this age. A study on perceptual narrowing found that under conditions in which 6-month-old infants can discriminate between pairs of monkey faces as well as human faces, 9-month-olds can only discriminate between human faces (Pascalis, de Haan, & Nelson, 2002). These results suggest that with experience, infants become more specialized in discriminating between human faces. In addition to examining infants' abilities to discriminate between two different faces, a great deal of research has been conducted on infant knowledge of facial emotion.

Emotion Processing

Emotion research has received a great deal of attention over the years. In 1971, Ekman was one of the first researchers to investigate the universality of emotion across cultures, leading to the identification of six basic emotions: happy, sad, fear, anger, disgust, and surprise. Adults readily discriminate between these emotions in faces (Sauter, LeGuen, & Haun, 2011; Eisenbarth & Alpers, 2011). Moreover, emotional valence can affect recognition memory: adults are able to recognize faces better when presented with a happy rather than an angry expression (D'Argembeau et al., 2007). These results indicate that in some instances, emotional expressions can affect identity memory for new faces.

Infant researchers found a preference for happy over fearful facial expressions in newborns (Farroni et al., 2010). However, there was no preference for fearful versus neutral expressions. This research suggests there is some evidence of emotion discrimination soon after birth, but there are some limitations to newborns' abilities. Contextual information, such as person familiarity, might play a role in infants' ability to

recognize emotional expressions at 3.5 months of age: Kahana-Kalman et al. (2001) found that when the infant's mother portrayed the expressions, infants looked significantly longer toward the facial expression that matched a simultaneously played vocal expression. Infants presented with emotional expressions of an unfamiliar woman did not match. These results show that, infants as young as 3.5 months of age can recognize happy and sad facial expressions exhibited by a familiar person. By 7 months of age, infants are able to complete a similar task even with unfamiliar people (Soken and Pick, 1999). When shown two videotaped facial expressions paired with a single vocal expression concordant with one of the facial expressions, 7-month-olds were able to discriminate among happy, interested, angry and sad expressions, even when being portrayed by strangers (Soken and Pick, 1999). Additionally, 5-month-olds are capable of matching happy and angry vocal expressions of one infant with the corresponding facial expression of another infant (Vaillant-Molina, Bahrick & Flom, 2013), indicating that infants have advanced knowledge of facial emotion early in life. As illustrated by the previously mentioned research, numerous studies have been carried out examining how adults and infants discriminate between two distinct emotional faces. However, there has been less research investigating infants' knowledge of bodies and body emotion.

Body Processing

Some research suggests that body processing is slower to develop than face processing (Heron & Slaughter, 2008; Slaughter & Heron, 2004; Slaughter, Heron & Sim, 2002). Slaughter et al. (2002) found no preference between pictures of normal versus scrambled bodies in a sample of 12- and 15-month-olds. It wasn't until 18 months of age that infants displayed a preference between the normal and scrambled bodies; yet

12-month-olds demonstrated a preference between the normal and scrambled faces. The findings of this study suggest that infants' knowledge of bodies may be slower to develop than knowledge of faces. However, some body knowledge is exhibited by young infants when tested on point-light displays that portray human motion via dots placed at key joints such as the shoulders, elbows, hips, and knees. For instance, newborn infants prefer point-light stimuli displaying biological motion as compared to non-biological motion (Simion, Regolin & Bulf, 2008; Yoon & Johnson, 2009). Additionally, by 3.5 months of age, infants have some knowledge of human verses non-human bodies. When presented with paired static images of humans and non-human primates, although newborns fail to display a preference, 3.5- and 6-month-olds prefer to look at human images, even when only the body is visible (Heron-Delaney, Wirth, & Pascalis, 2011). With all of these studies, however, there are still numerous questions remaining to be answered, especially regarding bodies and emotion.

Bodies, like faces, communicate emotion, and they are especially useful when a person is distant and emotion cannot be determined from facial expression. Additionally, whole-body expressions can provide information regarding how the individual producing the emotion will act (Van den Stock, Righart, & de Gelder, 2007). For instance, a fearful body may signify the presence of a threat, and indicate whether the individual experiencing the fear intends to handle the situation by fight or flight. Research has shown that adults can identify emotions expressed in body postures and movements with an accuracy comparable to their accuracy in perceiving emotions from faces (Atkinson et al., 2004; Atkinson, Tunstell, & Dittrich, 2007; Coulson, 2004). Happiness, anger, and sadness being the most accurately recognized emotions with surprise and fear having

lower agreement rates, and disgust often failing to be statistically significant (Walters & Walk, 1988; Walk & Homan, 1984). Infants also display body emotion knowledge when viewing bodies. When 6.5-month-olds are simultaneously shown two videos of actors with covered faces, one depicting happiness and the other anger, infants exhibit a preference for the body movement that is congruent to an accompanying emotional vocalization, such as laughter or grunting (Zieber, Kangas, Hock & Bhatt, 2014). In other words, infants match emotional body movements to emotional vocalizations. These findings suggest 6.5-month-olds are able to assess human emotion from both body movements and vocalizations. A subsequent study found that 6.5-month-olds are also sensitive to emotions in static bodies, but 3.5-month-olds are not able to match static or dynamic body emotions to vocalizations (Zieber, Kangas, Hock, & Bhatt, in press). However, although researchers have separately investigated the development of facial and body emotion processing, no research has examined the combined perception of human facial and bodily expressions in infancy.

This lack of whole body emotion research is surprising considering that faces and bodies are not usually encountered as isolated objects in the natural world, but as integrated parts of a whole person. The face and the body jointly contribute in conveying an individual's emotional state. A study by Meeren et al. (2005) presented adults with compound images of faces and bodies displaying either congruent or incongruent emotional information. These researchers found that adults are significantly faster and more accurate at discriminating between fear and anger in a forced choice task when the face and bodily expression are congruent. In addition, when having to make a judgment about a facial expression, perception of the face is biased toward the emotional

expression being displayed by the body. These findings suggest that emotional recognition improves when facial and body information is congruent, while conflicting body emotion interferes with the recognition of facial emotion. Van den Stock et al. (2007) extended these results by investigating fear and happiness, instead of fear and anger. Participants were again presented with compound images of faces and bodies displaying either congruent or incongruent emotional information. Additionally, the faces of the stimuli were morphed using fear and happiness in order to determine whether body information is used differently when facial expressions are ambiguous between the two emotions. The results of this study were consistent with that of the previous study: adults are significantly faster and more accurate at discriminating between fear and happiness when the face and bodily expression are congruent. Furthermore, the whole-body expression is most influential when the facial expression is ambiguous. Therefore, participants are relying on body emotion information in order to categorize an ambiguous facial expression. This finding offers further support for the importance of body emotion when given the task of discriminating a facial expression.

As the previously mentioned research suggests, facial and body emotion information is integrated, with adults being able to match face to body emotion information and vice versa. The developmental origins of this capacity have not been explored previously. To address this issue, I examined infants' matching of facial and body emotional information. Infants were tested on their ability to match an emotional face to the corresponding emotional body as well as their ability to match an emotional body to an emotional face.

Chapter Two:

Experiment 1

In this study, we examined whether 6.5-month-old infants can match a happy or angry face to the corresponding emotional body as well as a happy or angry body to the corresponding emotional face. Faces and bodies alike communicate emotion. Previous research has examined the ability of infants to process emotion from faces and bodies separately (Walker-Andrews, 1997; Zieber, Kangas, Hock & Bhatt, 2014, in press; Vaillant-Molina, Bahrick & Flom, 2013). However, few studies have examined their ability to match emotion from faces to bodies and bodies to faces. Since faces and bodies are an integrated unit in the real world, it is important to note when this ability to recognize emotion as being consistent throughout the face and body develops.

Prior research has concluded that infants as young as 6.5-months of age are able to discriminate between happy and angry emotions from dynamic and static body displays (Zieber, Kangas, Hock & Bhatt, 2014; in press). Therefore, it is possible that by 6.5-months, infants possess the ability to match these emotions between static faces and bodies. We examined this possibility in Experiment 1.

Method

Participants. Eighteen 6.5-month old infants (mean age = 192.9 days, SD = 9.90; 12 female) were recruited through local birth announcements and a local hospital. The participating infants were predominately Caucasian and from middle-class families. Data from two infants were excluded due to side bias, looking greater than 95% to one side (n = 1), and equipment error (n = 1).

Stimuli. The body stimuli were static black and white images from the Atkinson stimulus set (Atkinson et al., 2007). Each figure consisted of a static body displaying a happy or angry emotional pose at the peak of the emotion without visible facial features (see Figure 1). The face stimuli were static black and white faces taken from the Tottenham set (Tottenham et al., 2009). Faces displayed a happy or angry emotion (see Figure 1).

Previous research suggests infants prefer female faces to male faces and process female faces at a more specific level than male faces (Quinn, Yahr, Kuhn, Slater & Pascalis, 2002; Ramsey-Rennels, Langlois, & Marti, 2005). Given this greater degree of expertise on female stimuli, female bodies and faces were used in this study.

Apparatus and Procedure. Infants were tested using a modified infant control procedure (Pascalis et al., 2002). Infants were seated on their parent's lap in a darkened chamber, approximately 45 cm in front of a 50 cm computer monitor. Prior to the start of each trial, the infant's attention was directed toward the center of the screen by alternating colorful shapes. Once their attention was drawn to the center of the screen, the familiarization trial began. The familiarization trial consisted of two identical copies of either an emotional body or an emotional face being shown on the screen simultaneously until the infant accumulated 30 seconds of looking (Pascalis et al., 2005; Scott & Monesson, 2009). Immediately following familiarization, infants were tested on two 10-second test trials. If habituated to a body, infants were tested with a face displaying the corresponding emotion paired with a face displaying a novel emotion during the two test trials. If habituated to a face, infants saw a body displaying the corresponding emotion paired with a body displaying a novel emotion. The initial left-right positions of the novel

body or face were switched across test trials in order to prevent side bias. The familiarization and test stimuli were counterbalanced within each condition. Therefore, half of the infants were familiarized to a body and tested with a face displaying the corresponding emotion paired with a face displaying a novel emotion while the other half were familiarized to a face and tested with a body displaying the corresponding emotion paired with a body displaying a novel emotion.

A video camera, located on top of the computer monitor, and an associated DVD recorder recorded the session. A coder blind to the experiment condition and the left-right position of the stimuli completed offline coding with the DVD player slowed to 25% of the normal speed. The dependent measure was the percent preference for the novel emotional face or body across the two test trials (i.e., the emotion that was not displayed during familiarization). This was calculated in the following manner: the total duration of looking to the novel emotional face or body across the two trials divided by the total looking time to both the novel and familiar emotion faces or bodies across the two test trials; this ratio was then multiplied by 100. A second coder verified coding reliability for 25% of the infants. The Pearson correlation between the two observers was .97.

Results and Discussion

The mean time required to accumulate 30 s of looking during familiarization for faces and bodies did not differ significantly (see Table 1), $t(15) = -.587$, $p = .57$. This suggests that infants found the face and body stimuli equally engaging during familiarization. Additionally, the mean preference scores of infants familiarized to faces versus bodies did not differ significantly; therefore, data were collapsed across familiarization conditions.

An analysis of outlier status (Tukey, 1977; using SPSS version 20.0) revealed that the score of one 6.5-month-old infant was an outlier. The final analysis of test performance was conducted without this score. Infants evidenced discrimination by exhibiting a mean novelty preference score that was significantly below chance performance (50%), $t(16) = -3.65$, $p < .01$, see Table 1. In other words, infants preferred to look at the familiar emotion during the test, indicating matching between faces and bodies. Given that 6.5-month-olds were able to match angry and happy faces to bodies and vice versa, we proceeded to investigate whether this finding could be extended to a second emotional pair, namely sad/angry.

Table 1.
Mean (and Standard Error) of Time to Accumulate 30 s of Familiarization and Percent Preference for the Novel Stimulus

	Habituation Type	N	Mean Time to Accumulate 30s (secs)	Mean Novelty Preference (%)	*t* (versus 50% chance)
Experiment 1:					
6.5-month-olds	Happy/ Angry	17	35.97 (1.78)	44.71 (1.45)	-3.65**
Experiment 2:					
a) 6.5-month-olds	Sad/Angry	17	38.84 (2.15)	47.82 (1.70)	-1.29
	Faces	8	36.23 (3.08)	43.92 (2.04)	-2.98*
	Bodies	9	41.15 (2.96)	51.28 (2.11)	.608
b) 6.5-month-olds	Sad/Angry Bodies	12	1) 36.96 (1.08) 2) 40.89 (3.21)	44.57 (2.68)	-2.03*
Experiment 3:					
3.5-month-olds	Happy/ Angry	18	35.35 (2.29)	47.80 (3.54)	-.620

*$p < .05$, ** $p < .01$, significantly different from chance (50%).

Figure 1.

Examples of the happy and angry stimuli used in Experiments 1 and 3. Infants were initially familiarized to two identical emotional bodies or faces and then tested with a corresponding and novel emotional body or face.

Habituation Image: Test Image:

Chapter Three:

Experiment 2a

This study was carried out in order to replicate Experiment 1's familiarity (i.e., preference for matching emotion) findings as well as investigate a new emotion pair contrast. While Experiment 1 revealed that 6.5-month-olds match happy and angry emotions in bodies and faces, Experiment 2 examined whether infants match sad/angry emotions across bodies and faces. Note that both sad and angry emotions belong to the category of negative emotions. Thus the attempt to examine matching of sad/angry emotions across faces and bodies is noteworthy because, to our knowledge, no prior study has examined whether infants can discriminate between emotions within the negative category displayed by bodies. Such discrimination was necessary for infants to match body emotions to facial emotions in Experiment 2a.

Method

Participants. The participants were 18 6.5-month old infants (mean age = 198.6 days, SD = 8.05; 7 female). Infants were recruited in the same manner as those in Experiment 1. Data from two infants were excluded due to side bias (n = 1) and equipment error (n = 1).

Stimuli. The stimuli in this experiment were taken from the same databases as those used in Experiment 1 (Atkinson et al., 2004, 2007). The body stimuli were static black and white images consisting of a static body displaying a sad or angry emotional pose at the peak of the emotion without visible facial features (Figure 2). The face stimuli were static black and white faces displaying a sad or angry emotion (Figure 2).

Apparatus and Procedure. Infants were tested using the same modified infant control procedure used in Experiment 1, except that infants were tested with sad and angry emotions (Figure 2). The dependent measure was the infants' percent preference for the novel emotion across the two test trials. Counterbalancing of the familiarization to bodies and faces as well as the emotion and the left-right location of the test stimuli were done as in Experiment 1.

Coding of the infants' performance was conducted as in Experiment 1. A second coder verified the coding reliability of 25% of the infants with a Pearson correlation of .99.

Results and Discussion

An analysis of outlier status (Tukey, 1977; using SPSS version 20.0) revealed that the score of one 6.5-month-old infant was an outlier. The final analysis of test performance was conducted without this score. The mean time required to accumulate 30 s of looking during familiarization for faces and bodies did not differ significantly (see Table 1), $t(1,15) = -1.15$, $p = .91$. However, there was a significant difference in mean preference scores between infants familiarized to faces versus bodies, $t(15) = -2.50$, $p < .05$. Infants familiarized to faces displayed matching with a mean preference score significantly below chance (50%) as in Experiment 1, $t(7) = -2.98$, $p < .05$, see Table 1. Infants familiarized to bodies failed to discriminate, exhibiting a mean preference score that was not significantly different from chance performance, $t(8) = .608$, $p = .56$, see Table 1. Thus, while infants generalized from faces during familiarization to bodies during the test, they failed to do the reverse. It appeared that 30 s of familiarization to

body emotional information was not sufficient to elicit discrimination between face stimuli during the test.

Figure 2.

Examples of the sad and angry stimuli used in Experiments 2a and 2b. Infants were initially familiarized to two identical emotional bodies or faces and then tested with a corresponding and novel emotional body or face.

Habituation Image: Test Image:

Chapter 4:

Experiment 2b

This experiment was carried out as a follow-up to Experiment 2a. Results from Experiment 2a revealed that 6.5-month-olds were capable of matching sad and angry faces to the corresponding emotional body. However, the infants failed to match sad and angry bodies to the corresponding emotional face. Previous studies have indicated that body knowledge is slower to develop than face knowledge (Heron & Slaughter, 2008; Slaughter & Heron, 2004; Slaughter, Heron & Sim, 2002). Thus, infants' failure to match from emotional body postures during familiarization to facial emotions during test may have been due to their inability to process body emotion information within the short familiarization time that was provided. Therefore, in this study, we examined whether doubling the duration of familiarization with body stimuli would encourage discrimination among faces.

Method

Participants. The participants were 12 6.5-month old infants (mean age = 193.2 days, SD = 7.26; 7 female). Infants were recruited in the same manner as those in Experiments 1 and 2a. Data from one infant were excluded due to fussiness (n = 1).

Stimuli. The stimuli in this experiment were the same as those used in Experiment 2a (Figure 2).

Apparatus and Procedure. Infants were tested using a similar procedure to that used in Experiments 1 and 2a. However, infants were only familiarized to sad or angry bodies and tested with a face displaying the corresponding emotion paired with a face displaying a novel emotion. Additionally, the infants were given two 30-s familiarization

periods (as opposed to only one in Experiment 2a). The dependent measure was the infants' percent preference for the novel emotional face across the two test trials. Counterbalancing of the familiarization for sad and angry bodies as well as the left-right location of the novel test face stimuli were done as in the previous experiments.

Coding of the infants' performance was conducted as in Experiment 1 and 2a. A second coder verified the coding reliability of 25% of the infants with a Pearson correlation of .95.

Results and Discussion

Infants familiarized to sad or angry bodies for two 30-s trials and tested with sad and angry faces now showed discrimination with a mean preference score significantly below chance performance, $t(11) = -2.03$, $p < .04$, see Table 1. Therefore, infants preferred to look at the familiar emotional face during the test, indicating that with additional familiarization time the infants were able to match sad/angry bodies to faces.

Chapter 5:

Experiment 3

The previous experiments within this study have shown that 6.5-month-olds are capable of discriminating between faces and bodies portraying happy, angry, and sad emotions. In order to document the nature of development of this ability, we proceeded to examine whether 3.5-month-olds match happy and angry faces and bodies.

Method

Participants. Eighteen 3.5-month old infants (mean age = 110.1 days, SD = 7.61; 9 female) participated in this study. They were recruited in the same manner as infants in

the previous experiments. Data from seven infants were excluded due to side bias (n = 6) and stimulus preference (n = 1).

Stimuli. The stimuli used in this experiment were the same as those used in Experiment 1 (Figure 1).

Apparatus and Procedure. Infants were tested using the same procedure used in Experiment 1. The dependent measure was the infants' percent preference for the novel emotion across the two test trials. Counterbalancing of the familiarization to bodies and faces as well as the emotion and the left-right location of the test stimuli were done as in Experiment 1.

Coding of the infants' performance was also conducted as in Experiment 1. A second coder verified the coding reliability of 25% of the infants, resulting in a Pearson correlation of .97 between the two coders.

Results and Discussion

The mean time required to accumulate 30 s of looking during familiarization for faces and bodies did not differ significantly, $t(1,16) = -.837$, $p = .152$.

Infants preference scores between the test stimuli did not significantly differ from chance performance (50%), $t(17) = -.620$, $p = .54$, see Table 1. Furthermore, the mean preference scores did not differ significantly for infants tested with faces versus bodies, $t(1,16) = -.372$, $p = .718$. Thus, overall, the 3.5-month-olds in Experiment 3 failed to exhibit evidence of discrimination between the familiar and novel emotions during the test trials. This finding suggests that there is a developmental change in the ability to match facial and body emotion between 3.5- and 6.5-months.

Chapter 6:

General Discussion

The current findings build upon previous research that has investigated facial and body emotion processing separately, integrating the two sources of emotional information. Facial knowledge of infants has been extensively researched, and studies have shown that infants develop at least some level of face-processing expertise by 5 months of age (Diamond & Carey, 1986; Leder & Bruce, 2000; Hayden, Bhatt, Reed, Corbly & Joseph, 2007). Additionally, infants seem to develop extensive knowledge of facial emotion during the first 5 months. For example, 5-month-olds are capable of matching happy and angry vocal expressions of one infant with the corresponding facial expression of another infant (Vaillant-Molina, Bahrick & Flom, 2013). As for body emotion processing, it has been shown that 6.5-month-olds are proficient in matching body information portraying happy and angry emotions to the corresponding vocalizations (Zieber et al., 2014; in press). Therefore, it is known that infants are capable of intermodal matching of emotion between faces and vocalizations as well as between bodies and vocalizations. However, faces and bodies are integrated parts of a whole, and the current studies' findings bring to light the ability of infants to recognize emotion as consistent throughout the entire being, face and body included.

The 6.5-month-olds in the current research matched emotions going from faces to bodies as well as from bodies to faces. Contrary to prior research indicating that body knowledge does not develop until sometime after the first year of life (Slaughter & Heron, 2004; Slaughter et al., 2002), the current findings indicate that infants do have knowledge of bodies, specifically emotion body knowledge by 6.5-months of age. Many

of the studies that indicated poor knowledge of bodies during the first year of life (e.g., Slaughter & Heron, 2004; Slaughter et al., 2002) tested infants on male bodies and on knowledge of the structure of body (i.e., the arrangement of body parts). In contrast, infants in the current studies were tested on female body (and face) images and on emotions expressed in these images. These differences may have accounted for the earlier development of body knowledge exhibited in the current research.

Additionally, the current studies suggest that the ability to match emotional facial and body information develops between 3.5 and 6.5months of age. That is, while 6.5-month-olds in Experiment 1 matched happy and angry faces and bodies, identically tested 3.5-month-olds failed to match in Experiment 3. This developmental change in the matching of emotional bodies to faces is consistent with the finding by Zieber et al. (2014, in press) that 6.5-month-olds match body emotions to vocalizations but 3.5-month-olds fail to do so. Future research needs to investigate the nature of this developmental change. The failure of young infants to match body emotions to faces and vocalizations may be due to a failure to encode emotion from bodies. As previously stated, research conducted by Slaughter and her colleagues have concluded that body knowledge is slower to develop compared to facial knowledge (Slaughter & Heron, 2004; Slaughter, Heron-Delaney, & Christie, 2012). Thus, young infants may not have processed emotion information in bodies. Another possibility is that young infants are capable of processing emotion from bodies and faces (and voices) separately but are unable to match the information across modalities.

It is thought that the development of emotion knowledge is aided by experience with people and emotional situations in which displays of various emotions as well as

different sources of emotion (i.e., face, body, vocalization) are present (Lewis, 2008; Walker-Andrews, 1997). Therefore, the additional experience of 6.5-month-olds with emotional faces and bodies, as well as more experience seeing the two incorporated simultaneously, could be responsible for the developmental change that occurs from 3.5- to 6.5-months of age. It is important to note that the experience with emotional bodies and faces is not only limited to the observation of others, but could also include increased self-awareness of infants' own bodies and faces.

In Experiment 1, 6.5-month-olds matched happy and angry faces with the corresponding body as well as bodies to the corresponding emotional face. This suggests that infants have knowledge of emotion being consistent between the face and body. However, it is important to note that the emotions used in that experiment, happy and angry, belonged to opposite emotional categories (i.e., positive and negative). Therefore, it was important to explore whether this finding would hold true for other emotions, especially those belonging to the same affect category.

To this end, Experiment 2a investigated whether 6.5-month-olds were capable of matching sad/angry faces and bodies. Infants matched when familiarized to sad and angry faces and tested with sad and angry bodies. However, they failed to match when going from bodies during familiarization to faces during the test. It could be argued that this face familiarization--body test versus body familiarization--face test asymmetry was due to the poorer encoding of emotions from bodies compared to faces. However, infants in the face-body condition must have been able to process emotions from bodies during the two 10-s test trials; otherwise, they would not have been able to match body displays to appropriate facial emotions from familiarization. Thus, the exact reasons for the

asymmetry are not clear. However, recall that additional familiarization time in Experiment 2b enabled infants to match going from bodies to faces. Thus, infants are able to match sad and angry in both directions, provided enough time is afforded during familiarization with bodies.

The fact that in one case (sad/angry contrast going from body familiarization to face test), it took more familiarization time for 6.5-month-olds to exhibit matching brings up the question of whether even 3.5-month-olds will be able to match if provided with additional familiarization time. Future studies should examine this possibility.

The current research does have limitations. The low number of participants (n = 18) per experiment raises some concern. Additionally, only 9 participants were tested on each of the emotions (happy, angry, sad). However, the overarching goal of the current studies was to investigate whether infants could match emotions going from faces to bodies and bodies to faces, not to compare matching performance across the different emotions within each study.

In conclusion, 6.5-month-olds are able to not only discriminate between happy, angry and sad facial and body emotions, but they were also able to match corresponding facial and body emotions. However, this ability is not evident at 3.5-month of age. These findings indicate that within the first year of life, infants are not only able to derive information about people's emotional states from faces and bodies, but are able to integrate the information from both sources as well. This suggests that sophisticated emotion processing capabilities develop between 3.5 and 6.5-months of age.

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