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Do young infants prefer an infant-directed face or a happy face?

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Abstract

Infants' visual preference for infant-directed (ID) faces over adult-directed (AD) faces was examined in two experiments that introduced controls for emotion. Infants' eye movements were recorded as they viewed a series of side-by-side dynamic faces. When emotion was held constant, 6-month-old infants showed no preference for ID faces over AD faces, but a second group of infants looked significantly longer at AD faces conveying happy emotion over sad ID faces conveying sad emotion. Together, these findings suggest that infants' visual preference for ID faces is mediated, at least in part, by the presence of happy emotion. The relations between happy emotion and ID faces are discussed.

Keywords

attention, infancy, perception, social cognitions

The human face has long been considered to be an important source of information available in infants' social environment and plays a critical role in communication between infants and adults (e.g., Bowlby, 1969; Stern, 1974; Vine, 1973). Infants' visual preferences for faces have been well-documented and can be observed shortly after birth. For example, newborn infants turn their eyes and heads to track a moving facelike schematic pattern significantly more than they track the same stimulus in a scrambled arrangement (Goren, Sarty, & Wu, 1975; Maurer & Young, 1983). When newborns are shown facelike schematic patterns with features arranged either naturally or unnaturally, they tend to orient to the naturally-arranged patterns (Johnson, Dziurawiec, Ellis, & Morton, 1991; Simion, Valenza, Umilta, & Dalla Barba, 1998; Valenza, Simion, Macchi Cassia, & Umilta, 1996). Several hypotheses have been proposed to explain newborns' preference for faces (e.g., Morton & Johnson, 1991; Simion, Valenza, Macchi Cassia, Turati, & Umilta, 2002), but the underlying mechanisms responsible for such phenomena remain unclear.

As young infants become more experienced with faces, primarily by interacting with their caregivers, they develop preferences for particular types of faces. For instance, when presented with a novel male face and a novel female face, 3- to 4-month-old infants prefer looking at the face that matches the gender of their primary caretakers (Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002). Similarly, 3-month-old infants prefer to look at faces from their own ethnic group, as opposed to faces from other ethnic groups (Bar-Haim, Ziv, Lamy, & Hodes, 2006; Kelly et al., 2005, 2007). Recently, Kim and Johnson (2012) demonstrated young infants' visual preference for infant-directed (ID) over adult-directed (AD) faces. While infants' listening preference for ID speech has been widely demonstrated (e.g., Cooper & Aslin, 1990; Fernald, 1985), it was not clear whether infants would show similar responsive behaviors towards ID faces. When 3- and 5-month-old infants were presented with side-by-side displays of dynamic faces produced by a female model, recorded while she interacted with her infant (ID) and her husband (AD) about identical topics, infants as young as 3 months looked longer at the ID faces.

The ID-face samples used in the Kim and Johnson (in press) study were perceived to be significantly happier than the AD counterparts according to the adult ratings obtained for each stimulus. This may be because the goal was to obtain ID and AD faces that were as natural and ecologically valid as possible: While interacting with her infant and husband, the female model who produced the stimuli was asked to describe identical topics to both listeners, but was not asked to control the emotional expressions. It is possible, therefore, that differences in affect between ID and AD faces could have contributed to infants' preferences.

To our knowledge, no published study has explored the relation between emotion and "directedness" (infant-directed vs. adult-directed) in ID faces. ID speech, unlike typical AD speech, presents an exaggerated indication of speaker affect, allowing emotion to be easily identified in ID speech (Fernald, 1989, 1992). However, when AD speech contains emotional expressions, the acoustic features of those AD speech samples are similar to those used in typical ID speech (Trainor, Austin, & Desjardins, 2000). Infants' preference for ID speech seems to depend on the level of vocal emotion expressed in speech. Singh, Morgan, and Best (2002) presented 6-month-olds with both ID and AD speech stimuli that were matched for affect, and infants showed no preference for ID speech. When AD speech stimuli conveyed more positive vocal emotion than ID speech, infants preferred listening to the AD speech, suggesting that it is the positive emotion conveyed in speech, rather than its infant-directedness, that attracts infants' attention.

Moreover, infants are thought to be sensitive to emotional expressions in faces early in life (e.g., Fantz, 1961; Jeffrey & Cohen, 1971). Nelson and Horowitz (1983), for example, demonstrated that 2-month-old infants discriminate a happy face from a

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neutral face presented in a holographic stereogram. Similarly, 3-month-olds can discriminate happy faces from sad and surprise expressions (Young-Browne, Rosenfeld, & Horowitz, 1977) as well as smiling from frowning facial expressions in still photographs (Barrera & Maurer, 1981). Finally, Soken and Pick (1999) investigated how infants respond to positive and negative dynamic facial expressions using a preferential looking paradigm, and found that 7-month-olds were sensitive to multiple kinds of emotional expression, discriminating among happy, interested, angry, and sad expressions.

Therefore, in a pair of experiments, we investigated the role of facial emotion on infants' preference for ID faces by examining infants' responses to faces varying on two dimensions: emotion and directedness.

Experiment 1

Experiment 1 examined the possibility that infants' preference for ID faces is attributable to the positive emotion present in ID faces. We presented infants side-by-side displays of two types of dynamic, silent faces: happy ID faces and happy AD faces. Because the positive emotion in ID speech contributes to infants' preference for the particular type of speech and because infants are known to be sensitive to positive emotion in facial expressions, we hypothesized that infants would show no preference when both ID and AD faces were equated on happiness.

Method

Participants

Twenty-two full-term 6-month-olds (12 girls, 10 boys, Mage = 6.0 months, range = 5.4–6.4 months) were recruited from birth records provided by the county. Parents were first sent a letter of invitation to participate in the experiment; interested parents returned a postcard and were later contacted by telephone. Six additional infants were observed but excluded from the analysis due to fussiness (2) or equipment failure/experimenter error (4). Parents were provided with a small gift for their infants but were not paid for participation.

Materials

Infants viewed a pair of videotaped events. Each event showed a woman's face as she engaged in a live face-to-face interaction with a member of her own family—either her husband or her 18-month-old infant. The model and family members viewed a video monitor showing the person with whom they were conversing during the live interaction (cf. Murray & Trevarthen, 1985). One woman served as the model for all stimuli. The model was asked to describe the same happy events to both infant and husband. Prior to recording sessions, the model was given a few minutes to recollect happy memories (e.g., the birth of her child), then was asked to describe the event to both listeners on separate occasions for approximately the same duration. The recordings of the model's facial expressions were parsed into multiple 10-second segments to be used as visual stimuli.

The segments were also rated by 16 undergraduate students for directedness and emotion. The directedness of face clips was rated as infant- or adult-directed using an 11-point Likert scale, a value of 5 denoting a face clip as "definitely produced when she was interacting with an infant" and a value of −5 as "definitely produced when she was interacting with an adult." An 11-point Likert scale was also used to rate the face clips as happy or sad, a value of 5 denoting a face clip as "very happy" and a value of −5 as "very sad." In general, the ID face clips were judged to be infant-directed and AD face clips were judged as adult-directed, $t(15) = 5.814$, $p < .001$, but the emotion ratings of both face types were judged to be more similar, $t(15) = 1.389$, $p = .185$, which confirmed that for adults at least, the ID and AD face samples were seen as portraying happiness (see Figure 1).

A total of 12 face segments were selected to create six side-by-side stimuli with Adobe Premiere; six face clips with the highest scores in directedness (the most ID-like) and the highest in emotion (the happiest) were selected as happy ID faces ($M = 1.26$, $SD = .92$), and six face clips with the lowest scores in directedness (the most AD-like) and the highest in emotion (the happiest) were selected as happy AD faces ($M = -1.98$, $SD = 1.73$). Each visual stimulus measured 25 × 22.5 cm (23.5 × 21.2° visual angle) and was separated by a gap of 1.5 cm (1.4°). Each face measured approximately 14 × 10.5 cm (13.3 × 10.0°). Moreover, the ID face clips generally contained more up-and-down movements than the AD counterparts, but both faces were labeled for the most part. We also drew the areas of interests (AOIs) generously not only to accommodate movement of the model during the interaction, but also to accommodate possible eye tracker inaccuracies. See Figure 2 for an example.

Procedures

Eye movements were recorded with a Tobii T60 XL eye tracker at 60 Hz with a spatial accuracy of approximately .5–1°. Infants were tested individually, seated on a parent's lap approximately 60 cm away from a 24-inch computer monitor. To calibrate each infant's point of gaze, a dynamic target-patterned ball undergoing repeated contraction and expansion around a central point was presented briefly at five locations on the screen (the four corners plus the center) as the infant watched. The Tobii eye tracker provides information about calibration quality for each point; if there were no data for one or more points, or if calibration quality was poor, calibration at those points was repeated. Prior to each trial, a small attention-getting stimulus was briefly shown on the screen to reorient infants' point of gaze to the center of the screen. On each trial, both happy ID and AD faces were presented side-by-side for 10 s. Each infant was exposed to a total of 12 trials; six unique sets of stimuli were presented twice, ID faces were on the left for half of the trials, and on the right for the other half of the trials. The order of stimulus presentation was randomized.

Results and discussion

Every infant who participated in this experiment completed all 12 trials. On average, infants contributed an average of 80.08 seconds of total dwell time on the faces (range = 48.88–119.14). Infants produced significantly higher total dwell time in the first six trials ($M = 43.59$, $SD = 10.25$) than in the last six trials ($M = 36.49$, $SD = 12.28$), $t(21) = 2.694$, $p = .014$. However, due to high variability of raw dwell time between individuals, the raw dwell time was converted to the proportion of dwell time on the ID and AD faces, which was our index of visual preference. Despite producing more dwell time in the first six trials than the last six trials, the mean proportion of dwell time on the ID and AD faces was equivalent between the first and the last six trials, $t(21) = .080$, $p = .937$.

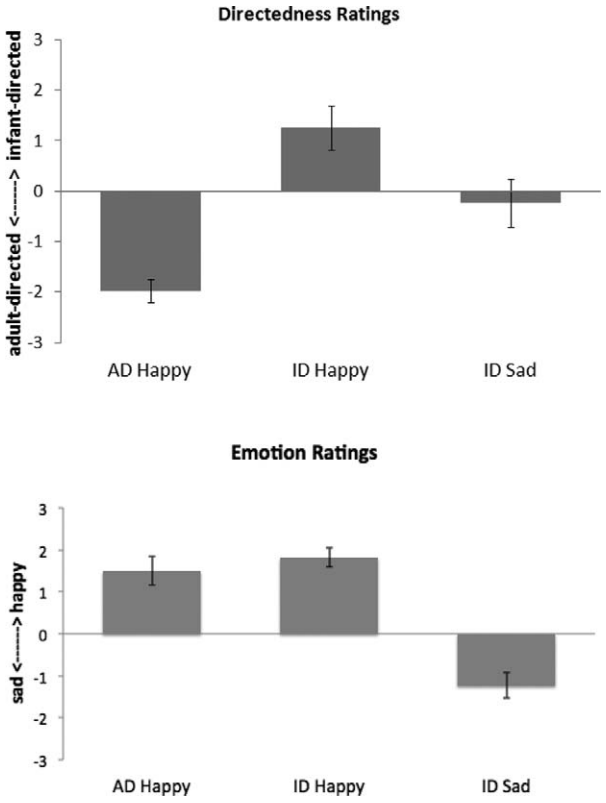

Figure 1. Results showing adults' ratings of directedness (adult- vs. infant-directedness) and emotion (happy vs. sad) for all faces shown to infants in Experiments 1 and 2. Error bars = *SEM*.

The mean proportion of dwell time on each face was computed per infant prior to analysis. Although ID and AD faces made up approximately 25% of the total surface area of the screen, infants on average fixated within the faces approximately 90% of the time. Thus, only eye movements that took place within the faces, recorded by the AOIs superimposed on the faces using Tobii Studio software (see Figure 2), are reported.

The results of Experiment 1 are shown in Figure 3. A paired-samples *t*-test revealed no significant difference in dwell time between happy ID faces and happy AD faces, $t(21) = 1.611$, $p = .122$. Infants' average proportions of dwell times were .471 for happy ID faces ($SD = .085$), and .529 for happy AD faces ($SD = .085$). As predicted, infants showed no preference for ID faces when the positive emotion of ID and AD faces were held constant, suggesting that the positive emotion in faces may have contributed to infants' preference for ID faces in the Kim and Johnson study (2012). The infant-directedness, above and beyond its emotional content, did not draw infants' attention, even though ID faces were perceived to be undoubtedly *infant*-directed according to the adult ratings.

Experiment 2

Experiment 1 shows that infants' preference for ID faces over AD faces does not extend to scenarios in which both faces express the same positive emotion, suggesting that infant-directedness alone does not elicit infants' visual preference for ID faces. Moreover, it also highlights the importance of positive emotion in faces, such that the positive emotion conveyed in faces may play a significant role in attracting infants' attention. In Experiment 2, we further investigated this issue by showing infants the faces that are the opposite of each other on both emotion and directedness: *happy* faces directed to *adults* and *sad* faces directed to *infants*.

We reasoned that preferential looking toward happy AD faces would suggest infants' greater affinity for the positive emotion in faces than for the infant-directedness, whereas preferential looking toward sad ID faces would suggest infants' greater affinity for the infant-directedness than for the positive emotion. Alternatively, a preference for sad ID faces over happy AD faces could also indicate a negativity bias, a tendency to attend more to the negative emotion over the positive emotion (see Vaish, Grossmann, & Woodward, 2008). Although it has been demonstrated that infants show a negativity bias (e.g., de Haan, Belsky, Reid, Volein, & Johnson, 2004; Kotsoni, de Haan, & Johnson, 2001; Ludemann & Nelson, 1988; Nelson & Dolgin, 1985), such a bias is more prevalent in infants older than 7 months (see Vaish, Grossmann, & Woodward, 2008). In contrast, infants younger than 6 months seem to prefer the positive emotion over the negative emotion (e.g., LaBarbera, Izard, Vietze, & Parisi, 1976; Wilcox & Clayton, 1968).

Method

Participants

Twenty-two full-term 6-month-old infants (11 girls, 11 boys, Mage = 5.9 months; range = 5.4–6.5 months) were recruited from birth records provided by the county, using the same procedures as described in Experiment 1. None of the infants who participated in Experiment 1 participated in Experiment 2. Six additional infants were observed but excluded from the analysis due to fussiness (4) or equipment failure/experimenter error (2).

Materials and procedures

Materials and procedures were identical to those used in Experiment 1 with one exception: happy ID faces were replaced by sad ID faces. To obtain sad-face stimuli, the same model was asked to talk about a few particularly sad topics (e.g., passing of her grandfather) to her child. After segmenting the recordings into multiple 10-second clips, they were rated by the same group of undergraduate students to confirm infant-directedness and sadness. As shown in Figure 1, the ID and AD face clips were judged to be significantly different in directedness, $t(15) = 3.099$, $p = .007$, and the emotion ratings of both face types were also judged to be different, $t(15) = 12.321$, $p < .001$.

Results and discussion

Every infant participated in this experiment completed all 12 trials, and infants on average contributed an average of 77.65 seconds of total dwell time on the faces (range = 40.56–106.83). As in Experiment 1, infants produced significantly higher total dwell time in the first six trials ($M = 43.14$, $SD = 9.57$) than in the last six trials ($M = 34.51$, $SD = 13.18$), $t(21) = 3.842$, $p = .001$. Despite producing more dwell time in the first six trials than the last six trials, however, the mean proportion of dwell time on the ID and AD faces was equivalent between the first and the last six trials, $t(21) = .134$, $p = .895$.

The results of Experiment 2 are shown in Figure 4. A paired-samples *t*-test revealed significantly longer dwell times on happy AD faces than on sad ID faces, $t(21) = 2.223$, $p = .037$. Infants'

Figure 2. Examples of happy infant-directed face (left) and happy adult-directed face (right), and areas of interest within which infant scanning patterns were recorded.

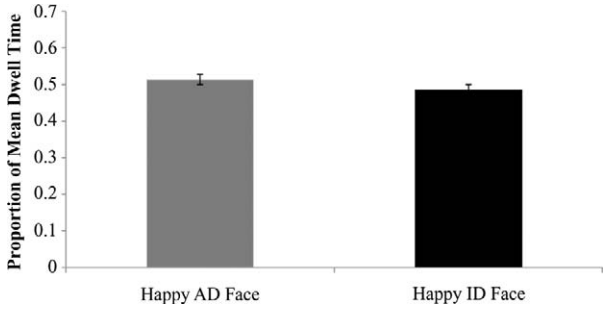

Figure 3. Data from 6-month-olds in Experiment 1, showing the proportion of mean dwell time on each type of face stimulus (happy AD face and happy ID face). Error bars = *SEM*.

average proportions of dwell times were .531 for happy AD faces ($SD = .066$) and .469 for sad ID faces ($SD = .066$). Infants were drawn more to happy AD faces, therefore, presumably because of the expressions of positive affect. In contrast, ID faces were not as effective in attracting infants' attention when conveying negative affect.

Another possible interpretation of infant performance (as suggested by a reviewer) centers on the "potency" of the emotion versus directedness manipulations. Talking about birth versus death might create quite distinct levels of emotional intensity, whereas talking to an infant versus an adult would not necessarily create differentiations in directedness as potent as those for emotion. This consideration raises the question of whether it is emotion versus directedness or a more potent (salient) versus less potent (salient) manipulation that gave rise to performance. Notably, the adult ratings speak in favor of the potency explanation: The difference between ratings of infant vs. adult directedness (i.e., $t = 3.099$) was smaller than the difference between happy vs. sad emotion ($t = 12.321$).

General discussion

In the present study, 6-month-old infants showed no preference for ID faces over AD faces when both faces were matched for emotional content (Experiment 1), and they looked reliably longer at AD faces expressing happiness relative to ID faces expressing sadness (Experiment 2). Taken together, we tentatively interpret these results as evidence that happiness conveyed in faces, rather than infant-directedness per se, contributes to infants' visual preference for ID faces. Moreover, the pattern of results found in these studies closely resembles how 6-month-old infants respond to ID and AD speeches of varying vocal emotion (Singh et al., 2002). Expressions of emotion in ID communicative behaviors, whether speech or facial expressions, appear to play a principal role capturing infants' attention. To our knowledge, this study is the first to discover a key component of ID faces to which infants respond.

We were interested in infants' interpretation of the emotional expressions in both ID and AD faces. Evidence suggests that spontaneous ID speech is "happier" than AD speech (Singh et al., 2002; Trainor et al., 2000), and similarly, spontaneous ID faces are perceived as happier than AD faces (Kim & Johnson, 2012). However, the ID and AD face stimuli used in Experiment 1 were rated equally happy (see Figure 1). Controlling for emotion was necessary to tease apart the effect of the infant-directedness from that of happy expressions, and the differences between ID and AD faces when both express the same emotion may be rather subtle: ID faces are characterized by wider smiles and eye constriction stemming from raised cheeks, presumably resulting from heightened emotional content (Messinger, Mahoor, Chow, & Cohn, 2009). Such descriptions of ID faces closely resemble happy faces in general. Although engaging in more face-to-face interactions may help infants better discriminate ID faces from merely happy faces, such an ability may be rather challenging to achieve given that both faces share many perceptual similarities. Thus, the absence of preference shown in Experiment 1 poses the possibility that infants might not be able to discriminate the faces solely on the basis of the directedness when emotion is held constant. A further investigation on how infants respond to a comparison between sad ID faces and sad AD faces would provide more insight on this issue.

On the other hand, infants looked reliably longer at happy AD faces to sad ID faces in Experiment 2, suggesting that infants had no problem discriminating between the faces that differed in both emotion and directedness. In particular, it appeared that the

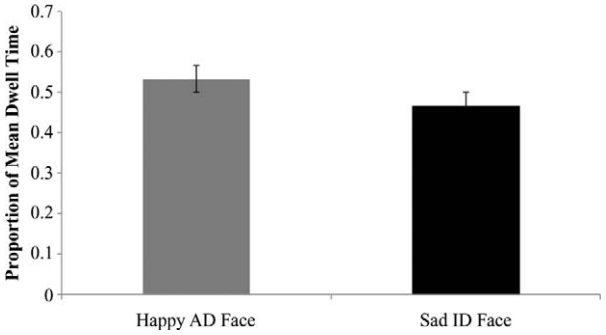

Figure 4. Data from 6-month-olds in Experiment 2, showing the proportion of mean dwell time on each type of face stimulus (happy AD face and sad ID face). Error bars = *SEM*.

difference of emotion between the ID and AD faces was more apparent than that of directedness (see Figure 1). It is possible that the directedness of the faces became less recognizable once the speech is lost from the videos, which led the infants to simply respond to the emotions expressed in the faces regardless of their directedness. This view explains why the preference for ID faces over AD faces did not persist when controlling for emotion (Experiment 1), and why infants preferred *happy* AD faces over *sad* ID faces (Experiment 2). However, according to the adult ratings on the face stimuli, the absence of speech from the faces seemed to have affected only the directedness of ID faces expressing sadness; while happy ID faces were rated as unequivocally infant-directed, sad ID faces were rated slightly adult-directed, despite the fact that both were recorded from the same mother-infant interactions. Therefore, it is more likely that infants responded to the emotional expressions of the faces in Experiment 2 because sad ID faces failed to convey the proper infant-directedness to infants, while both faces expressed clearly contrasting emotions. Happiness, therefore, may be an essential characteristic of infant-directedness under more real-world conditions.

Nevertheless, the notion of infant-directedness, the characteristic, intrinsic properties of ID communicative behavior itself warrants further investigation. Besides emotional content, there are other properties of infant-directedness that have yet to be systematically examined (e.g., slower pace, more repetition, and decreased complexity). Interestingly, when adults rated the face and voice stimuli, few had difficulty distinguishing ID faces and happy AD faces. Many reported that they used a slower tempo and/or more repetitions as cues to identify something as infant-directed. Thus, a more objective analysis of infant-directedness coupled with systematic investigations of infants' sensitivity to its individual properties will advance our knowledge regarding infant-directedness and its relation to multiple kinds of infant-directed communications. Nevertheless, it is unclear how exactly infants perceived the face stimuli used in the present study,

Finally, ID behaviors may serve an important role in infants' discrimination of emotional states in others. Kaplan, Jung, Ryther, and Zarlengo-Strouse (1996) found that 4-month-olds exhibited increased visual attention for a neutral stimulus following a pairing of ID speech with a static happy face; AD speech had little effect, implying that the infants learned to associate ID speech with positive facial expressions. Four-month-olds also learned associations between "consoling" ID speech and a static sad face, but not a happy face, suggesting that they formed selective associations between distinct emotions conveyed in speech and face (Kaplan, Zarlengo-Strouse, Kirk, & Angel, 1997). ID behaviors, through their arousing effects in infants, could serve a functional role in assisting infants to respond to referential communication directed to them (Senju & Csibra, 2008). Through these interactions, infants become increasingly sensitive to the context-specific nature of speech, facial expression, and other social behaviors, including both ID and AD behaviors, and perhaps come to better understand their own role as social participants.

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Declaration of Conflicting Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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