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One-month-old infants show visual preference for human-like feature

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Infants' behaviors toward humans differ from those toward objects since early development. Previous studies have mainly investigated the role of motion for the distinction between human and non-human objects, although physical appearance is another crucial factor. The present study investigated one-month-old infants' responses to the still-image of human faces and non-human objects including face-like pattern (doll and object), using this infant-control preferential looking procedure. The results revealed the infants' preference for human faces over objects including face-like patterns but no such preferences for humans over dolls. The infants preferred faces resembling human faces in the absence of motion information. Such preferences for human-like features supplement evidence on the first step of early social cognition, which is important in human communication.

Keywords
infants, preference, social cognition, animacy

Introduction

The first important step toward understanding other individuals' mental states should be to detect the presence of other humans (Meltzoff, 2007). Infants might have certain representations of humans as well as particular principles on how to interact with them in a manner different from physical objects. For instance, 4-month-old infants show different responses respectively toward humans and objects even after they are hidden from the infants in a game of hide and seek (Legerstee, 1994). Such differences between the perception of humans and that of objects, especially in infancy, have been featured in studies of "animacy."

Previous studies have placed emphasis on motion as one of the underpinnings of infants' distinction between animates and inanimate objects (e.g., Spelke, Philips, & Woodward, 1995). Rakison and Poulin-Dubois (2001) summarize that the animate-inanimate distinction in infancy is rooted in the onset of motion, line of trajectory, form of causal action, pattern of interaction, and type of causal role. That is, the pattern of human motion, contrary to that of object motion, is self-propelled, has irregular lines of trajectory, is sometimes caused from a distance, and can be contingent; hence, humans can be agents.

Physical appearance is another crucial factor for animate-inanimate distinction, which should be identified at a glance. Previous studies on responses to physical appearances of animacy have cited newborns' attention toward human face-like patterns, including the stimulus with three high-contrast blobs corresponding to the approximate location of the eyes and mouth, rather than scrambled or blank faces as evidence (e.g., Johnson & Morton, 1991). A recent study discovered that infants prefer faces only under positive polarity, which implies that the eye and mouth regions are darker, with a lighter surrounding region (Farroni et al., 2005). Face-relevant biases are sufficient to elicit a preference for real faces in the natural environment (Johnson, 2005). Thus, previous studies have clarified the factors that should contribute to infants' preferences for face-like patterns. Nevertheless, we do not have the evidence on whether such infants' preferences for face-like patterns reflect the preference for some specific patterns or the preference for animacy, especially, human faces. Despite the importance in the ability to detect and attend to human faces for social cognitive development, whether human faces come to be special since early period is still an open question.

The present study investigated infants' responses to face/face-like pattern in perspective of animacy in the absence of the effect of motion. In order to reveal the importance of human-like features, the present study conducted two kinds of tasks—doll (human-like) faces versus human faces, and inanimate objects containing face-like patterns versus human faces. If the infants preferred human faces, they would look at the human faces longer than at the doll faces and objects containing face-like patterns. However, if they preferred faces similar to human faces, they tended to look at the human faces longer than at inanimate objects with face-like patterns but would not show largely different responses toward the doll and human faces. On the other hand, if infants equally prefer "face-like patterns" that meet certain conditions such as three high-contrast blobs regardless of animacy, there would not be any difference among

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the stimuli in the infants' looking time.

Methods

(a) Participants

Fifty-five infants were recruited from a medical check-up at one month of age, Osaka University Hospital. They were randomly assigned to one of the two tasks; the task of Doll versus Human faces or the task of Object versus Human faces.

In the task of Doll versus Human faces, 27 infants were examined, but 9 were excluded from the analysis because of fussing and/or falling asleep during the test session (4) or due to a strong side bias (5). Finally, 18 infants (10 boys) were included in the final sample. Their mean age was 28.22 days (range: 24-35 days). All of them are healthy term babies (range: 37 weeks – 41 weeks 1 day) and had an Apgar score of 8-9 at 5 minutes. They were all Japanese and had a birth weight between 2,576 and 3,978 g.

In the task of Object versus Human faces, another 28 infants were examined, but 8 were excluded from the analysis because of fussing and/or falling asleep (5) or due to a strong side bias (3). Thus, 20 infants (12 boys) were included in the final sample. Their mean age was 28.05 days (range: 24-31 days). All of them are healthy term babies (range: 37 weeks – 40 weeks 5 days) and had an Apgar score of 9 at 5 minutes. Their birth weight was between 2,520 and 3,748 g. Nineteen participants were Japanese and one was Indian.

Informed consent was obtained from caretakers of all the participants. This study was approved by the Institutional Review Board for Clinical Research at Osaka University Hospital.

(b) Apparatus

Two adjacent 19-inch computer monitors were placed at a 30-cm distance from the infants, in the compartment in the Department of Pediatrics, Osaka University Hospital. A flickering red light-emitting diode (LED) was placed in between the monitors. A digital video camera was placed above the monitors to record the looking behaviors of the infants.

(c) Materials

In the task of Doll versus Human faces, facial photographs of dolls and humans were used as stimuli. All human models were Japanese showing a neutral facial expression and mounted on a uniform white background. In order to control for the preference for a specific face, 8 facial photographs (4 for doll) were prepared. In the task of Object versus Human faces, photographs of the objects including face-like pattern and human faces were used as stimuli. Eight photographs (4 for object) were prepared.

Figure 1 shows the sample. The displayed stimuli of human faces were similar in size to the real human face, and we made the doll and object stimuli a size of human stimuli as much as possible.

Figure 1. Illustration of the stimuli. A: a human face; B: an object containing a face-like pattern; C: a doll face.

(d) Procedure

The participants sat on their mothers' laps in front of the two monitors. Each trial began with the flickering LED between the monitors. As soon as the infant's attention fixated on the light, an experimenter who monitored the infant's gaze through the video camera turned off the LED, and soon the two stimuli appeared simultaneously on each monitor. We used the infant-control preferential looking technique (Farroni et al., 2005): When the infant shifted his/her gaze away from each display for more than 10 seconds, the stimuli were removed, and the LED light was turned on. All the participants were presented with two trials in which the positions of the stimuli were reversed.

(e) Measurement

The total looking times for the stimuli were measured from the video records. An independent coder coded 10% of the data for a reliability check as did one scorer. The average inter-scorer reliability stood at 0.93 for the task of Doll versus Human faces, and 0.91 for the task of Object versus Human faces.

Results

The total looking times for human and doll stimuli were 49.75 ± 31.11 s (mean ± SD) and 46.14 ± 26.92 s, respectively (Fig.2). A simple t-test showed that there was no difference in the time infants looked at the human and doll stimuli, $t(17) = 0.50$, $p = .62$.

The total looking time for the human and object stimuli were 59.98 ± 32.65 s and 36.35 ± 21.16 s, respectively (Fig.3). A simple t-test revealed that infants looked longer at the stimuli of human faces than at those of objects, $t(19) = 2.78$, $p = .01$.

Discussion

One-month-old infants did not attend specifically to humans. A longitudinal study investigating infants' responses to humans and dolls from 3 to 25 weeks reported that infants, after 9 weeks of age, looked significantly longer at dolls in a face-to-face situation (Legerstee, Pomerleau, Malcuit, & Feider, 1987). Our results are compatible in that one-month-old infants respond to dolls as much as they do to humans, although there are some methodological differences between the previous

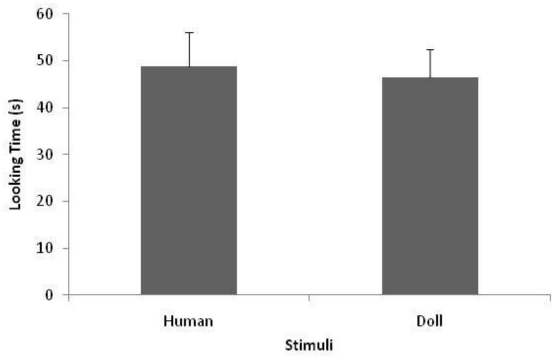

Figure 2. The looking time for the stimuli of a human and a doll; each bar indicates the standard error (SE).

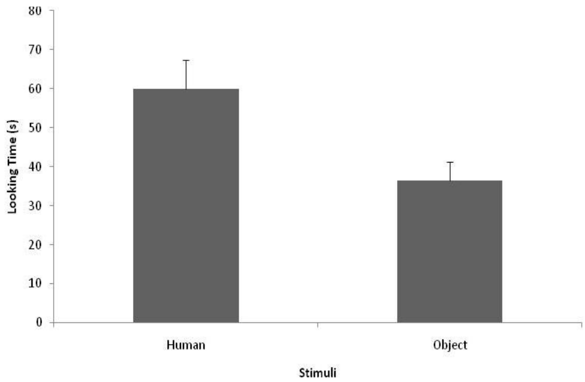

Figure 3. The looking time for the stimuli of a human and an object containing a face-like pattern; Each bar indicates the standard error (SE).

and present study. Irrespective of whether infants view doll faces as "human" or human-like faces, human-like features as well as human features capture the attention of one-month-old infants. Adults can recognize the differences between human and doll faces including the difference of eye morphology, which should be essential in developmentally and evolutionary perspective (e.g., Farroni, Csibra, Simion, & Johnson, 2002; Kobayashi & Hashiya, in press). The visual acuity of infant increases during the first 6 months (Dobson & Teller, 1978) and thus, the results might come from one-month-old infants' lower visual acuity. When and how infants come to show differential responses to human and human-like features should be investigated in future, in conjunction with the development of visual acuity.

Significant preferences for human faces over objects containing face-like patterns might suggest that infants change their looking behaviors according to the degree of similarity to humans, and not only respond to the three high-contrast blobs. It should be noted that it was not practical, though desirable, for the present study to match all these factors; the shape or location of the components as well as the outline of the stimuli could not remain identical. A combination of the several factors might lead to the detection of and preference for humans; the degree of discrepancy from humans may be strongly related to the distinction between animate and inanimate objects. In order to clarify the factors determining whether the demonstrated stimuli are similar to humans, further research about which part in stimuli seen by infants will be effective.

Taken together, the present results should be interpreted as infants' preferences for faces that resemble human faces, in the condition without the effect of motion. One theory on infants' face processing hypothesized two processes (Morton & Johnson, 1991). A kind of innate mechanism (CONSPEC) controls orientation to face-like patterns. It is assumed to be located in the subcortical superior-colliculus-pulvinar pathway. This primitive subcortical circuit, responding to three blobs, would account for the orientation of newborns' gazes toward faces. A separate plastic cortical system (CONLERN) is simply a system that acquires and retains specific information about the visual characteristics of humans. It builds a representation that enables the infant to discriminate the human face from other stimuli, which would account for the facial preferences seen in older infants. Thus, neonatal abilities are due to the former and that by 2 months of age infants' preference is hypothesized to be controlled by the latter. Such development on face processing should affect looking behavior of our participant. It might be difficult for one-month-old infants to differentiate between human and human-like faces due to immature face processing. Specific responses to face-like patterns should be refined to responses to human-like faces and human faces, as the ability of face processing develops.

Although our findings showed that one-month-old infants already preferred human-like features, the present study could not suggest the exact period when human faces becomes special to young infants. Developmental origins of specific responses to humans and its developmental processes is an empirical question to be examined further. Furthermore, much attention has been given to the fact that responses to animacy are now accepted as one of the milestones for the early screening of autism. Infants who were later diagnosed with autism demonstrated atypical patterns of social development, such as attending less to humans (Werner, Dawson, Osterling & Dinno, 2000). Longitudinal investigation on responses to humans is one effective direction of future research.

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