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An Investigation of the Still-Face Effect in the Context of Peek-a-Boo Play

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Abstract: This paper presents the preliminary findings of an investigation of the still-face effect in Japanese 5-month-old infants in the context of peek-a-boo play. In order to examine the contribution of contingent facial information in the still-face effect, the mothers' eyes or mouth were hidden from the infants during the still-face experiments. The preliminary results suggest that when information related to the mother's eyes was not available to the infant, both the infant's gaze and smile towards their mother decreased, whereas when the information related to the mother's mouth was not available to the infant, then the infant's gaze but not smile decreased during the still-face period. The importance of the eyes and mouth in producing the still-face effect is dependant on the infant's response measures.

1. Introduction

The still-face effect has been recognized as an indicator of young infants' social, emotional and cognitive ability since it was first reported by Tronick, Adamson, Als and Brazelton (1975). The still-face effect is a phenomenon that occurs in infants' behaviors when faced with a change in their mothers' interactive attitude. Specifically, the still-face effect is observed when the mother changes from showing an attentive and responsive face to an immobile and sober face. This sequence of observations is set experimentally in three consecutive episodes of face-to-face interactions between a child and his/her caregiver, normally the mother. In the first episode, a mother-infant dyad interacts normally, as they do at home; often the mother calls her child's name with a smiling face or makes onomatopoetic sounds to obtain her child's attention, and the child smiles back at her. After a minute of these natural interactions, the mother suddenly becomes immobile and makes a sober face; this marks the beginning of the second still-face episode. During this episode, the infant initially attempts to regain reciprocal interaction patterns from the mother by showing attention to her, and when this attempt is not successful, the infant shifts their attention from the mother and shows a withdrawn facial expression. In the third episode, the mother tries to re-engage the infant by interactions similar to those of the first episode. The entire set of three episodes last for three minutes. The infants' behavioral changes were observed in terms of the duration of gaze and affective expressions such as smiling and vocalizations towards their communicative partner. In the still-face effect, it is common to observe decreases in the infant's gaze and

positive affects, such as smiling.

Infants as young as 2 months of age are sensitive to the changes in a communicative partner, and expect other people to behave according to social contingency in interactive contexts (Adamson & Frick, 2003). Utilizing this still-face paradigm, researchers can observe and evaluate infants' social understanding in relation to other people. However, the precise reason why such a dramatic phenomenon on the part of an infant happens during the still-face phase is not simple. Tronick, Als, Adamson, Wise and Brazelton (1978) suggest that the still-face effect was caused by the violation of the rules governing the mutual regulation of social interaction; infants expect the mother's simultaneous communication and attempt to achieve such expected goals by regulating emotional displays. There have been many studies that have investigated the still-face effect; their results appeared to show that infants have rudimentary expectations about the nature of face-to-face interactions in which a partner remains responsive and plays a reciprocal role in such interactions (Ellsworth, Muir, & Hains, 1993; Muir & Hains, 1993; Rochat & Striano, 1999). However, the kind of information derived from a communicative partner that triggers the infant to perceive that a violation of mutual regularity has occurred, in other words the succinct cause of the still-face effect, is not clear. So far, the still-face effect has been elicited by their caregivers (including fathers) and also by strangers (Gusella, Muir, & Tronick, 1988; Hains & Muir, 1996). It appeared that even when video clips of a virtual adult displaying a still-face episode were shown to the infants' (Hains & Muir, 1996), then similar effects were found.

When a live video link was used to enable a mother to communicate with her child via a video monitor and speakers, it allowed picture and sound manipulation to occur, such as hiding parts of the face or introducing a delay in the voice. In order to identify the role of voice and facial information in producing the still-face effect, Gusella *et al* (1988) investigated the contribution of each by manipulating the maternal face and voice, respectively. They found that when the mothers' interactive face became still, regardless of whether or not interactive voice was present, the infants consistently presented the still-face effect. The more prominent effect of facial information over vocal information was further examined by Striano and Bertin (2004) with an additional condition of vocal information without facial information. This condition was added to Striano and Bertin's study, as the still-face plus interactive voice condition used in Gusella's study might have been perceived as strange by the infants. Even this refined condition, that would naturally make sense to the infant, still led to the same results. Thus, it is possible that changes in face rather than the voice of the communicative partner provided the salient information to the infants in order for them to detect the loss of social contingency.

However, which aspect of facial information is crucial for the infant to detect a disturbance of social contingency has yet to be identified. The main purpose of the present study is to identify whether or not any differential effects are found between the information

derived from the eyes or mouths, in inducing the still-face effect. It may also be that a caregiver's face as a whole provides rich information that enables infants to detect social interaction with a communicative partner. Given the findings from the current infant research literature, infants are sensitive to people's gaze. That is, directing to or averting a gaze from an infant as early as 4 months of age (Samuels, 1985; Vecera & Johnson, 1995) has an effect. On the other hand, there is little infant research related specifically to their perception of people's mouths. If infants are more sensitive to people's eyes rather than mouths, they may not produce the still-face effect when the information from eyes is not available to them.

This present study also investigates the possibility of introducing the format of peek-a-boo play to the still-effect paradigm. The abovementioned research used video link images of the caregivers and their infants so that manipulation of information deriving from the caregiver's interactions, such as distortions of contingency could be made. The main reasons for adopting the format of peek-a-boo play are that 1) it is possible to manipulate information derived from either the eyes or mouth of the caregiver in a natural context; and 2) it is possible to control individual differences in the social interaction episodes across dyads and avoid the caregiver touching the infant. As for touching the infants during the still-face paradigm, previous studies have found that even when physical touch was present, the still-face effect was produced when the mothers made a sober face during the still-face episode. This suggests that the physical touching of infants does not seem to be important in producing the still-face effect. However, it is expected that when caregivers were instructed to play peek-a-boo it is possible to avoid the inconsistency of physically touching the infants for all caregivers.

In summary, the present study examines the separate contribution of the caregiver's eyes and mouth in producing the still-face effects in a naturalistic context.

2. Method

Participants

18 infants (12 boys, 6 girls) and their mothers participated in the study. However, two girls did not complete the three episodes because they became upset during the still-face period. Thus the data for the analyses were made on 16 infants (Age: M＝170 days, SD＝46 days).

Procedure

The experiment took place in a 3m × 4m space made from white partitions to form a room. In this space an infant's chair and floor cushion for the mothers were placed face-to-face at approximately 50 cm apart. One digital video recorder and a mirror were set in the appropriate positions to enable the simultaneous video capture of both the infant and mother. The infants' behaviors were recorded directly by the digital video recorder and the mothers' face and behaviors were obtained by recording the images from the mirror. Each mother-infant dyad was introduced to the room where the experimental set was located. Each dyad was instructed to complete one

session of three episodes. Either the control, eyes hidden or mouth hidden condition was selected. For the hidden conditions, the mother used her hand to hide either her eyes or mouth. After the brief instructions were given to the mother, the infant was seated in the chair. The mother sat face-to-face with her infant and wore a headphone that was used to signal to the mother when to change the interactional episode. This headphone was connected to a digital sound player that was designed to play music for 60 seconds during the peek-a-boo interaction episodes, and the ticking sound of a metronome for 60 seconds during the still-face episode. Once the infant and mother were settled, the experiment started.
The mother was instructed: 1) to play peek-a-boo while she could hear the music 2) to make a sober face as soon as she could hear the metronome sound, and 3) to resume peek-a-boo play when the music resumed.

Coding

The infants' behaviors that are considered to reflect the still-face effect are gaze and smile at the caregivers. These behaviors were chosen because previous studies suggest that these were most frequently and reliably observed behaviors. The operational definitions for rating these behaviors were adopted from Striano and Bertin (2004) as below:

Gaze: any infant's look at the caregiver

Smile: infant's cheek raised and at least one corner of the mouth turned up. Although a previous study (Striano & Bertin, 2004) included the infants' positive and negative vocalizations as measures, neither variable indicated the still-face effect. Thus vocalization types were not used as variables in the present study. Infants' behaviors were rated second by second from the video tapes. For each of the three 60-second episodes the duration of the infant's behaviors were measured.

3. Results

Figure 1 shows a mean percent of gaze as a function of condition (eyes hidden, mouth hidden and normal) and interactional episode (peek-a-boo 1, still-face, peek-a-boo 2). The still-face effect for infant's gaze was analyzed with Friedman test in which interactional episodes (peek-a-boo 1, still-face, peek-a-boo 2) were treated as repeated measures. Separate Friedman tests were conducted for the three conditions (*normal, eyes hidden, mouth hidden*). For the 16 infants that complete the episodes, 7 dyads were in the control group, 4 dyads were in the eyes hidden group and 5 dyads in the mouth hidden group. The results indicated that there were significant decreases of total duration of infants' gaze in the still-face episode compared with those in both the peek-a-boo episodes for all conditions (*control*: $\chi^2=10.57$, n=7, df=2, p=.005; *eyes hidden*: $\chi^2=6.53$, n=4, df=2, p=.038; *mouth hidden*: $\chi^2=8.96$, n=5, df=2, p=.015). These significant results were followed by the pair wise comparisons using Scheffe's test. The results showed that significant differences were found in the total duration of infants' gaze between the episodes of peek-a-boo 1 and still-face for all conditions (*control*: $\chi^2=7.14$, df=1, p=.03, *eyes hidden*: $\chi^2=5.6$, df=1, p=.059; *mouth hidden*: $\chi^2=8.1$, df=1, p=.017) and between those of still-face and peek-a-boo 2 for the control only

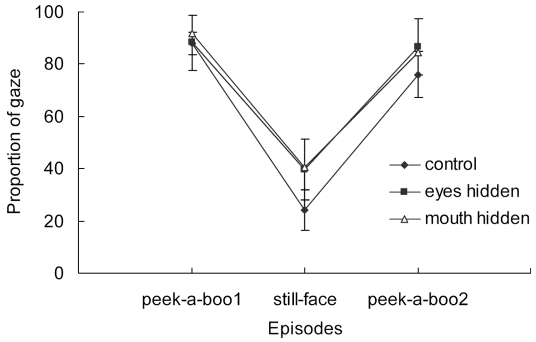

Figure 1. Percentage of infants' gaze and standard error as a function of the condition and interactional episode.

(χ^2=8.6, df=1, p=.013).

The still-face effect with respect to infants' smile was analyzed for each condition with a Friedman test for which interactional episodes were treated as repeated measures. The mean percentage of infants' smile and standard error as a function of condition and interactional period is presented in Figure 2. These results indicate that there were significant decreases in the total duration of infants' smile in the still-face episode compared with the peek-a-boo episodes for both the *control* and *eyes hidden* conditions (*control*: χ^2=8.64, n=7, df=2, p=.011; *eyes hidden*: χ^2=6.00, n=4, df=2, p=.05). These significant results were due to the significant differences in the total duration of infants' smile between the episodes of peek-a-boo 1 and still-face for the *control* (χ^2=8.96, df=1, p=.01) and between the episodes of still-face and peek-a-boo 2 for the *eyes hidden* condition (χ^2= 6.00, df=1, p=.05). However, there was no significant difference in the same measure between the episodes of peek-a-boo and still-face in the *mouth hidden* condition (*mouth hidden*: χ^2=3.86, n=5, df=2, n.s.).

4. Discussion

This study investigated the role of contingent facial information with respect to the eyes and mouth in producing the still-face effect in a naturalistic context. Infants experi-

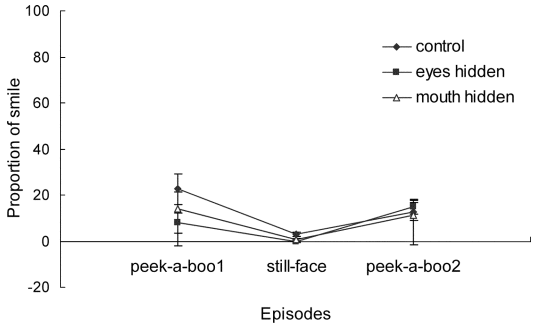

Figure 2. Percentage of infants' smile and standard error as a function of the condition and interactional episode.

enced peek-a-boo interactions either normally; with the mother's eyes hidden; or with the mother's mouth hidden; all of which were interrupted by a 60 second still-face episode. The result of the present study is still preliminarily as the number of infants who participated in this study is too small to allow us to conduct parametric tests. However, some of the results indicated the possibility of different still-face effects when either information from eyes or mouth is absent.

All dyads found the adoption of peek-a-boo play to be straightforward, which lead to natural interactions. This resulted in a rather higher mean percent of infant's gaze during the natural interactional periods compared with those seen in the previous study by Striano and Bertin (2004). In the present study, the mean percentage of infants' gaze during the peek-a-boo interaction periods for all conditions was above 80%, whereas the same measure in Striano and Bertin's study ranged from 55% to 70% dependent on the conditions during the natural interaction periods. Also, the mean percentage of smiling was slightly higher at over 20% than the previous studies that peaked at 15%. It is possible that the interactions involving the peek-a-boo format enabled the mothers to be more relaxed and to act naturally, which in turn made their infants focus on their mothers' actions constantly without averting their attention from it.

With respect to producing the still-face effect, the control condition showed significant difference in both the infants' gaze and smile between the peek-a-boo and still-face period. This result indicates that the still-face made by the mothers was registered by the infants as something different from the preceding peek-a-boo play, which led to a reduction of the infants' gaze and smile. Thus it is possible to suggest that a more structured way of instruction, such as a peek-a-boo format, instead of mothers' self-led interactions with their infants can be introduced to the still-face paradigm.

The main query of the present study was which part of the communicative partner's face is more important in realizing the infants' still-face effect. This was investigated whereby the mother interacted with their infants while either their eyes or mouth were hidden from the infants throughout the still-face experiment. Due to the small number of the participants, it was difficult to carry out the analysis of variance (ANOVA), which allows a direct comparison between the effects of the eyes hidden or mouth hidden conditions. Nevertheless, the results of the still-face effects showed different results between the eyes hidden and mouth hidden conditions.

For the measure of infant's gaze, both the eyes hidden and mouth hidden conditions along with the control produced the still-face effect. On the other hand, the measure of smiling differentiated the still-face effect between the two conditions. The eyes hidden condition in which the information relating to the mother's eyes were absent during the experiment still produced the still-face effect, whereas the mouth hidden condition did not. These results indicate that eyes and mouth may have a different role in inducing the infant's smile. When the caregiver's eyes were hidden during the peek-a-boo period, infants

had an access to the movement of the mother's mouth and would have understood the on-going interactions. Thus when the infants saw the mother's still-face with eyes hidden, they registered the difference in the mothers' interaction between the peek-a-boo and still-face periods.

On the other hand, when the mothers' mouth was hidden, while the mothers interacted with peek-a-boo play, the infants did not have access to the mouth opening feature in mothers, which is particularly salient in the peek-a-boo play. Therefore it might have been difficult for the infants to understand the mother's interaction, and that the infants' smile was not induced due to the lack of a partner's mouth feature. For the mouth hidden condition, this might have been one of the reasons for the absence of the infants' smile, but it did not significantly reduce the measure of visual gaze. However, as mentioned above, the results are still preliminary and need to be interpreted with caution. Although the present study failed to find a statistically significant still-face effect in the mouth hidden condition for the measure of infant's smile, the total duration of infant's smile decreased during the still-face episode. Thus further analysis is necessary with a larger sample size to enable firmer conclusions to be drawn.

In the present study, the still-face effect was measured by the two types of infants' behaviors, which were gaze and smile at the caregivers. Of particular interest was that the gaze and smile measures do not always draw the same results. These two measures both derive from the infants' reaction to the still-face, but how such a reaction is represented in the different modalities may not be the same. Particularly when the caregivers' facial information is partially presented to the infants, what is available to the infants and how salient that information is in the given context seems to play a crucial part in the still-face reaction. If the available information is not enough for the infants to detect any changes between the peek-a-boo and still-face periods, the expected reaction might occur. The present study indicated some differential roles for the eyes and mouths during the course of the still-face experiment with respect to gaze and smile measures. In this respect, as Muir and Lee (2003) argue, it is important to use multiple response measures in the still-face paradigm in order to examine the infants' sensitivity to various types of communicative signals.

In summary, although direct comparisons between the effects of the eyes hidden and mouth hidden conditions were not possible, current preliminary results suggest that the importance of the caregivers' facial information of eyes and mouths differ depending on the response measure.

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