Auditory-visual perception of talking faces at birth: a new paradigm

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Abstract

Newborn infants prefer faces to all other visual displays. All previous studies of face recognition in newborns used schematic faces, photographs or static real faces. In our study, we used video films to explore, for the first time, recognition of talking faces, in newborns. Our results suggest that video films of talking faces are very salient stimuli for newborns and can enhance face recognition a few hours after birth.

Index terms : newborns, face recognition, videos, talking faces, cross-modal

1 Introduction

Among the visual stimuli that we encounter, faces are very special. They can give us diverse information about people such as their identity, gender, and emotional states. That's why a face can be considered as a powerful communication unit [1]. Besides, face processing by adults is very different from processing of any other visual object [2].

At birth, infants prefer looking at face-like stimuli to looking at any other visual stimulus [3,4]. They are sensitive to several internal face elements: for example, they prefer faces with open eyes to faces with closed eyes, or faces with direct gaze to faces with oblique gaze [5,6]. Moreover, much research has found a strong preference at birth for the mother's face as opposed to a female stranger's face [7,8,9,10]. All these findings suggest rapid learning about faces within the first hours of life, and at least a rudimentary representation of faces at birth.

All the previous studies on face recognition at birth used face-like stimuli, photographs or static real faces [11,12,13]. These studies presented faces only in the visual modality, by controlling other modalities such as the sense of smell or the auditory mode. However, faces, like many other stimuli we experience, are intermodal in that they provide information about more than one sensory modality. It is possible that intermodality plays an important role in determining face recognition. Moreover, face preference at birth may be based on an intermodal learning, especially since it has been shown that 2-day-old infants are very good at learning visual-auditory associations [14].

To our knowledge, only one study has investigated this question [13]: it has been shown that newborns were not able to recognize their mother's face if not exposed first to her voice (from the birth to the test). The conclusion drawn by the author was that a prior experience with both the mother's voice and her face was necessary for the development of face recognition, and that consequently intermodal perception was evident at birth [13].

In the present study, we attempted to answer three questions. First, can the results of Sai [13] be extended to any face? Second, are talking faces seen on video films salient for newborns and do they enhance recognition? Finally, is the association and synchronisation of lip movements and voice sound necessary for intermodal face processing?

Moreover, this new protocol using video films, if effective, could solve many methodological problems encountered by previous studies of face recognition at birth. For example, it allows for exploration and control of the main sensory modalities that might help in learning a face.

2 Experiment 1

2.1 Methods

2.1.1 Participants

Ten full-term newborn infants, six males and four females, participated to this experiment (mean age = 46h30 ± 18, range = 26-75, mean birth weight = 3132g ± 500, mean birth length = 48.5cm ± 3). All newborns were healthy and had an APGAR score above 9 after ten minutes.

2.1.2 Stimuli

For this first experiment, we filmed two females in their twenties, who differed significantly in term of eye and hair colour and hairstyle. They looked at the newborn and talked to him or her for one minute and a half. Moreover, we recorded them silent with a positive expression (See Figure 1). We have ensured that the lighting and sound intensities were identical for both stimuli.

Figure 1: Stimuli

2.1.3 Apparatus

The study was conducted in a quiet room inside the Bichat maternity in Paris (France). The infants sat in a chair specially designed to support a neonate (inclined at 30°). The infant faced 40 cm of a DELL 19 inch colour monitor. Two loudspeakers were arranged on each side of the chair (See Figure 2).

Figure 2*:* Apparatus

A camera, fixed above the monitor, recorded the newborns behaviours, so that they could be seen directly by the experimenter in the experimental room and also decoded later at the laboratory (See Figure 4).

2.1.4 Procedure

In a familiarization phase, we presented to newborns during 90s a female talking to them. Then, in a test phase, the videos of the familiar face *versus* a new female face were presented twice in an alternated manner. Both faces were silent, with a positive expression and moved in a natural way (See Figure 3). When the infant shifted his or her gaze from the display for more than two seconds, the computer program switched to the next video. The maximum length of each video in the test phase was 60s.

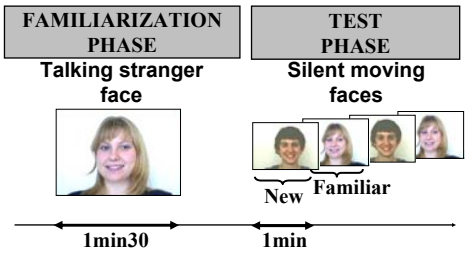

Figure 3*:* Procedure of Experiment 1

They were four experimental conditions: half of the newborns saw each face in the familiar phase. Then, in the test phase, the two faces (the familiar and the novel) were presented in a counterbalanced order. A computer program generated randomly faces in both phases.

An experimenter blind to the conditions sat behind the monitor and recorded the newborn's gaze.

Figure 4*:* Infant's gaze coding screen

2.2 Results

In the familiarization phase, the mean looking time percentage was 83% (± 18). Neither face was more attractive than the other (*t* test: p = .19).

In the test phase, newborns looked at the familiar face as much as at the novel one ($F(1,14) = 1.42^{e-2}$, p = .91).

Interobserver agreement between the direct coding at the maternity and the differed coding at the laboratory was significant (Spearman test, r = 0.90, p < .01).

2.3 Discussion

In contrast to our expectation, no preference for the familiar face (and no discrimination between the two faces) was evidenced. An explanation could be that videos of faces are too attractive for newborns to reveal a significant visual preference for the familiar face. Newborns seem to be very sensitive to movies of faces: many of them never shifted their gaze from the videos, in the familiarization phase and in the test phase.

To reduce test trial looking times, we conducted a second experiment in which we replaced moving faces in the test phase by static faces (photographs), like Sai [13] did in her observations.

3 Experiment 2

3.1 Methods

3.1.1 Participants

Sixteen full-term newborn infants, nine males and seven females, participated to this study (mean age = 59h ± 25, range = 18-103, mean birth weight = 3424g ± 509, mean birth length = 49.4cm ± 1.84). All newborns were healthy and had an APGAR score above 9 after ten minutes.

3.1.2 Stimuli

In the familiarization phase, the stimuli were the same as those used in Experiment 1. In the test phase, static faces (photographs) replaced the video films. In these photographs, the two females had a positive expression (see Figure 1). We hypothesized that static faces would be less attractive than videos films, and would reveal better recognition of the familiar face, as in Sai's experiments [13].

3.1.3 Procedure

The procedure was the same as that used in the Experiment 1 (See Figure 5).

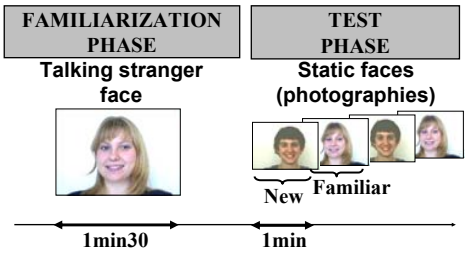

Figure 5*:* Procedure of Experiment 2

3.2 Results

In the familiarization phase, the mean looking time percentage was 77.60% (± 16.61). There was no face more attractive than the other (t test: p = .65).

In the test phase, newborns looked significantly more at the familiar face than at the novel one ($F(1,14) = 8.82$ p < .01).

Interobserver agreement was significant (Spearman test, r = 0.92, $p < 2.2^{e-16}$).

3.3 Discussion

In contrast to the first experiment, the findings of this second experiment revealed a clear preference for the familiar face. Our results support and extend Sai's findings [13]: soon after birth, a talking face is easily recognizable, after a short familiarization period (90s) and if it is seen on video.

One question still remains: Is speech necessary to recognize faces or can a silent video face be also recognized easily? Experiment 3 aimed to answer to this question. In the previous experiments with photos or static faces, discrimination between faces was evidenced. Accordingly, we modified the familiarization phase, and presented to the newborns the two silent females who moved in a natural manner. If newborns do not differentiate one face from another in the phase test, this would confirm the salience of talking faces on face recognition and the importance of speech in this process at birth.

4 Experiment 3

4.1 Methods

4.1.1 Participants

Sixteen full-term newborn infants, ten males and six females, participated to this study (mean age = 61h ± 25, range = 18-98, mean birth weight = 3299g ± 356, mean birth length = 49cm ± 1.8). All newborns were healthy and had an APGAR score above 9 after ten minutes.

4.1.2 Stimuli

For this experiment, the stimuli in the familiarization phase were the same females as those used in Experiments 1 and 2, but this time these two females were silent with a positive expression. They moved in a natural manner. The familiarization phase still lasted 90s. In the test phase, we showed the same static faces (photographs) as those used in Experiment 2.

4.1.3 Procedure

The procedure was the same as in Experiments 1 and 2 (See Figure 6).

4.2 Results

In the familiarization phase, the mean looking time percentage was 88.4% (± 8.5). There was no face more attractive than the other (*t* test: p = .32).

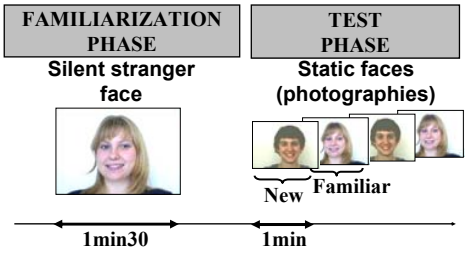

Figure 6*:* Procedure of Experiment 3

In the test phase, newborns looked at the familiar face as much as at the novel one ($F(1,14) = 3.52$ p = .08).

Interobserver agreement was significant (Spearman test, r = 0.88, $p < 2.2^{e-16}$).

To understand our results, we compared the newborn's exploration duration of the familiarization phases of Experiments 2 and 3. The results showed that newborns looked significantly more at faces in the Experiment 3 (*i.e.* silent faces) than in Experiment 2 (*i.e.* talking faces) ($F(1,14) = 5.48$ p < .03).

4.3 Discussion

Contrary to the results of previous studies on face recognition using photographs of faces [15], newborns in Experiment 3 did not discriminate between the two faces in the test phase. This result is probably due to the presence of moving faces during the familiarization phase. One hypothesis can be the fact that these moving faces could possibly lower the processing of the internal features of the face by newborns, as suggested Biringen, who obtained the same results (*i.e.* an absence of recognition with moving faces) with two-month old infants [16].

An interesting result is that newborns looked significantly more at silent faces in the familiarization phase (Experiment 3) than at talking faces (Experiment 2), but that doesn't allow a clear discrimination between the faces in the Experiment 3. So, it seems that silent faces are not sufficient to enhance recognition, and that talking faces are really salient for newborns.

5 Conclusions

Our results provided evidence that soon after birth, infants are very sensitive to talking faces seen on video films. A very interesting result is the absence of preference for any face (familiar or novel) in the test phase when these stimuli are moving. A preference for the familiar face appears only if the faces are seen static in the test phase. This result shows the salience of moving faces in video films for newborns. They are so attractive that newborns cannot analyze the internal and external features of each face.

These results extend those of Sai [13] (*i.e.* newborns can recognize not only their mother's talking face, but any talking face) and provide the opportunity for using a new technique with newborns.

In fact, using video films can be very efficient and

provides a wide range of possibilities. For example, many factors can be easily and more precisely controlled.

Nonetheless, several questions remain: when newborns watch a speaking face, does its recognition stem from the lip movements alone or the heard speech? Is synchronization between the visual and auditory stimuli necessary? These questions are the object of our next two experiments (in progress).

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