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Suprasegmental information affects processing of talking faces at birth

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ABSTRACT

From birth, newborns show a preference for faces talking a native language compared to silent faces. The present study addresses two questions that remained unanswered by previous research: (a) Does the familiarity with the language play a role in this process and (b) Are all the linguistic and paralinguistic cues necessary in this case? Experiment 1 extended newborns' preference for native speakers to non-native ones. Given that fetuses and newborns are sensitive to the prosodic characteristics of speech, Experiments 2 and 3 presented faces talking native and nonnative languages with the speech stream being low-pass filtered. Results showed that newborns preferred looking at a person who talked to them even when only the prosodic cues were provided for both languages. Nonetheless, a familiarity preference for the previously talking face is observed in the "normal speech" condition (i.e., Experiment 1) and a novelty preference in the "filtered speech" condition (Experiments 2 and 3). This asymmetry reveals that newborns process these two types of stimuli differently and that they may already be sensitive to a mismatch between the articulatory movements of the face and the corresponding speech sounds.

1. Introduction

From birth onwards, humans interact almost constantly with each other. One of the main daily interactive situations occurs in the context of face-to-face verbal interactions. Recent studies showed that newborns are already sensitive to this particular situation: they identify someone who previously talked to them in a native language but not someone looking at them silently (Coulon, Guellaï, & Streri, 2011; Guellaï & Streri, 2011; Guellaï, Coulon, & Streri, 2011; Sai, 2005; Streri, Coulon, & Guellaï, 2013). Therefore, speech modulates socio-cognitive processes such as face recognition at birth. In the present paper, we question whether the familiarity with the language heard plays a role in this process and if the suprasegmental information alone is sufficient to facilitate face processing by newborns.

Despite a weak visual system (Braddick & Atkinson, 2011), newborns already compute facial configurations (Cassia, Turati, & Simion, 2004; Goren, Sarty & Wu, 1975; Johnson & Morton, 1991; Mondloch et al., 1999; Valenza, Simion, Cassia, & Umiltà, 1996).

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Some studies showed that newborns are also able to learn and recognize photographs of unfamiliar faces. After a short habituation period (generally less than 1 min: Gava, Valenza, Turati, & de Schonen, 2008; de Heering et al., 2008; Turati, Bulf, & Simion, 2008; Turati, Cassia, Simion, & Leo, 2006) or after an interval of several minutes (Pascalis & de Schonen, 1994), newborns preferred to look at a new face rather than at the face seen during the habituation period. These results provide evidence for successful memorization and discrimination of unfamiliar faces by newborns.

Other studies showed that when newborns are presented with their mother's face and that of a stranger in a forced choice paradigm, results are different: newborns elicit a familiarity preference as they prefer to look at their mother's face rather than at a stranger's (Bushnell, Sai, & Mullin, 1989; Field, Cohen, Garcia, & Greenberg, 1984; Pascalis, de Schonen, Morton, Deruelle, & Fabre-Grenet, 1995). How could this asymmetry be explained?

In the infancy literature, one of the most common hypotheses is that a familiarity preference is generally observed when infants are shortly exposed to the stimuli and a novelty preference follows a "complete" encoding of the stimuli (Slater, 1995). Therefore, results of previous studies on face recognition at birth would suggest that newborns did not complete the encoding of their mother's face even after several hours of exposure to her (i.e., 49 h for Bushnell et al., 1989, 48 h for Field et al., 1984, and 78 h for Pascalis et al., 1995). This possibility is unlikely given that the mother represents the most frequently available external stimulus in the newborns' environment (Bushnell, 2001, 2003; Sai, 2009). Another possibility is that the familiarity preference observed for the mother's face is linked to the fact that in the second set of studies, observations have always been performed a few hours after birth, which implies that newborns and mothers had interacted during this period. Therefore, the interactions that occurred between mothers and infants prior to the test session might have modulated facial encoding. In particular, mothers talked to their baby, and the speech component could be, in this case, a marker of identity.

Indeed, newborns' attention is driven by vocal communication signals, from human and non-human primates, and is especially tuned to speech (Vouloumanos, Hauser, Werker, & Martin, 2010; Vouloumanos & Werker, 2007). For example, when presented with their mother's voice and with a stranger's, newborns elicit a strong preference for their mother's (DeCasper & Fifer, 1980). They also prefer listening to their native language when contrasted to non-native languages (Mehler et al., 1988; Moon, Cooper, & Fifer, 1993) and are able to discriminate between them (Nazzi, Bertoncini, & Mehler, 1998; Nazzi, Floccia, & Bertoncini, 1998; Sansavini Bertoncini, & Giovanelli, 1997; Ooijen, Bertoncini, Sansavino, & Mehler, 1997). For these reasons, speech component could play an important role in face recognition from birth.

To the best of our knowledge, only a few studies investigated this question. Burnham (1993) tested, in 1-, 3-, and 5-month-old infants, whether recognition of the mother's face, as opposed to a female stranger's face, was facilitated by the addition of speech information, compared to a condition with silent faces. The relative salience of lip movements and voice information was also tested. Results revealed no significant effect of lip movements on visual fixation scores. On the contrary, the speech component appeared to facilitate memorization and recognition of the mother's face. More recently, Sai (2005) encouraged the mothers of newborns to talk to their infants immediately after birth, while another group was asked not to interact with them verbally. In the test session (i.e., which occurred in average 7 h after birth), the mother's face and a stranger's face were presented side-by-side in live. The newborns looked longer at and oriented more to their mother's face rather than to the stranger only if their mother had previously talked to them. In the silent condition, no difference was observed. The author concluded that experience with both the mother's voice and her face during the first hours after birth enhanced newborn's encoding of their mother's identity. However, because fetuses hear their mother's voice and prefer it at birth (DeCasper, Lecanuet, Busnel, Granier-Deferre, & Maugeais, 1994; DeCasper & Spence, 1986), it is possible that in Sai's experiments (2005) newborns whose mother interacted with them verbally were reinforced, and that this reinforcement helped them to encode and memorize their mother's face. This possibility has been called into question by recent studies that showed the importance of speech component in unfamiliar face processing and recognition at birth using for the first time videos of dynamic faces (Coulon et al., 2011; Guellaï et al., 2011). During a familiarization phase, newborns could watch the video of a woman's face who was either talking to them in French, or whose lips were moving without speech sounds, or who was silently moving with static lips with or without speech sounds, or who was presented under photographs. Then, in the test phase, they saw the same face or a new one twice alternately. Analysis of mean looking times during the test phase evidenced that newborns looked more at the person seen during the familiarization phase only if this person previously talked to them. When the face is completely static (i.e., in photographs), they elicited a novelty preference at test such as it has been evidenced in previous studies using photographs or schematic representations of unfamiliar faces (Gava et al., 2008; de Heering et al., 2008; Pascalis & de Schonen, 1994; Turati et al., 2006, 2008; Guellaï et al., 2011).

Interestingly, not only the speech component is important in this situation but also another crucial communicative cues: direct gaze (Guellaï & Streri, 2011). Whereas newborns are sensitive to the gaze of others and prefer to look at the photograph of a face with open versus closed eyes (Bakti, Baron-Cohen, Wheelwright, Connellan, & Ahluwalia, 2000) or with direct versus averted gaze (Farroni, Csibra, Simion, & Johnson, 2002), in interactive situations, direct gaze alone (without verbal interaction) is not a sufficient cue in guiding newborns' identification of previously unfamiliar faces. In these cases, newborns are able to identify others with two socially meaningful cues perceived together in a dynamic interactive face: speech and direct gaze.

Overall these studies showed that newborns elicit a familiarity preference for those persons who engaged them in interactive situations and that they can already build knowledge about potentially interesting partners.

In these studies, newborns were exposed to faces talking a familiar language. It is not clear to what extent speech component can be a marker of identity. In one hand infants' attention could be driven by the verbal situation itself. Therefore, newborns would prefer a person who is talking to them no matter which language is used. On the other hand, newborns