Why Faces Are Not Special to Newborns: An Alternative Account of the Face Preference

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ABSTRACT—*Newborns' visual preference for faces might be regarded as a proof of the existence of a specific innate bias toward this class of stimuli. However, recent research has shown that this putatively face-specific phenomenon might be explained as the result of the combined effect of nonspecific perceptual constraints that stem from the general properties of visual processing shortly after birth. General, nonspecific biases may tune the system toward certain aspects of the external environment, allowing, through experience, the emergence of increasingly specialized processes devoted to faces.*

KEYWORDS—*face preference; newborns; cognitive specialization; perceptual constraints*

In daily life, a glance at a face may provide an observer with an impressive amount of different types of information that are of great help in social and cognitive interactions with the surrounding environment. Within milliseconds, the observer can accurately and effortlessly determine the person's age, sex, and mood, whether the person is familiar or not, what his or her identity is, the direction of his or her gaze, and so on. How do these remarkable face-processing capacities emerge? Some authors suggest that, because of the relevance of faces in human life, natural selection led to the evolution of innate face-specific devices that are available prior to any postnatal experience and enable the individual to interact successfully with the world. In contrast, other authors hold that the extensive and prolonged experience that almost everyone commonly has with faces gradually renders people exceptional experts in recognizing individual faces.

An important contribution toward resolving this long-standing issue may come from the study of an intriguing phenomenon observed a few hours after birth, when visual experience with faces is still minimal. When presented with facelike and nonfacelike patterns, newborns spontaneously look longer at and orient more frequently toward the configuration that represents a face (Fig. 1). Early reports of newborns' preference for faces (Fantz, 1963) were subsequently supported by studies that, with a few exceptions, demonstrated this phenomenon with both static and moving stimuli, and both schematic and veridical images of faces (Johnson & Morton, 1991; Macchi Cassia, Turati, & Simion, in press; Valenza, Simion, Macchi Cassia, & Umiltà, 1996). What induces newborns to look longer at a face? Is there an innate face-specific mechanism devoted to this purpose? Or, on the contrary, does newborns' face preference stem from the general properties of perceptual processing?

HISTORICAL BACKGROUND AND THEORETICAL FRAMEWORK

Real faces possess a series of nonspecific perceptual characteristics, such as the complexity of the face configuration and the high contrast of its inner features, that by themselves would strongly attract newborns' attention. However, until recently, the general modes of processing of nonface visual stimuli did not seem sufficient to fully explain the preference that infants devote to faces. The most influential model of newborns' visual preferences (the linear system model; Banks & Ginsburg, 1985) succeeded in explaining preferences for a variety of visual configurations but failed to entirely account for newborns' preference for facelike patterns (Kleiner, 1993; Valenza et al., 1996). This state of the art strongly supported the possibility that innately specified mechanisms dedicated to faces are present at birth.

According to a model proposed independently by Johnson and Morton (1991) and de Schonen and Mathivet (1989), newborns' tendency to prefer faces is mediated by primitive subcortical[1] circuits whose only purpose is to orient newborns' gaze toward faces. By ensuring that infants have visual experience with this class of stimuli, these subcortical structures favor the gradual emergence of specialized cortical circuits that subserve face processing in adults. This position combines the idea that evolution adaptively provided human newborns with a device specifically tuned to faces with the view that visual experience plays a prominent role in the normal development of

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[1]Brain structures (circuits) situated beneath the outer layer of the brain, the cerebral cortex, are referred to as subcortical. Circuits in the cerebral cortex are referred to as cortical.

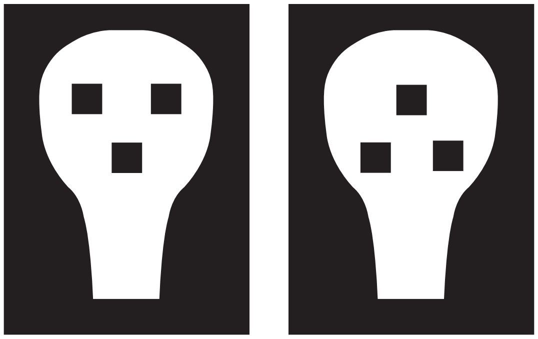

Fig. 1. The schematic configurations (facelike stimulus on the left, nonfacelike stimulus on the right) used in studies on newborns' face preference (Johnson & Morton, 1991; Valenza, Simion, Macchi Cassia, & Umiltà, 1996).

adults' highly sophisticated face-processing abilities. In fact, the model excludes the existence of a face-specific cortical system that is active from birth and proposes that this system gradually develops as a result of extensive visual experience with faces. Nevertheless, at the same time, the model posits that such experience is guaranteed by virtue of an innate face-specific, content-determined subcortical bias.

The model proposed by Johnson and Morton (1991) and de Schonen and Mathivet (1989) is rooted in a cognitive neuroscience perspective that considers domain-specific cognitive structures as emerging gradually from the interaction between tiny innate constraints and the structure of the input provided by the species-typical environment (Elman et al., 1996). In accord with this approach, the model says that brain specialization and domain specificity are the product of gradual developmental processes, rather than already present at birth. However, although the cognitive neuroscience perspective highlights the absence of domain-specific processes and structures in early cognitive development, the model posits, in the case of faces, a specific representational bias at a lower neural level, that is, in subcortical rather than cortical tissue. Cognitive neuroscience models of the development of other domain-specific cognitive abilities, such as language, do not need to posit such specific representational biases.

Recent developmental models of linguistic competence deny the presence of an innate, prespecified system for language. Rather, it appears that the auditory system is designed to maximally amplify and detect those changes in the auditory input particularly relevant for the development of linguistic processing at a certain age (Werker & Vouloumanos, 2001). In this manner, nonspecific constraints of the perceptual system, interacting with the systematic variations present in the surrounding environment, allow increasing neurocognitive specialization of linguistic processes. General experienceexpectant sensory and learning mechanisms are considered sufficient to explain the development and attunement of this domain-specific cognitive competence.

Recent studies suggest that the development of face-processing skill follows a similar trajectory. That is, the face-processing system narrows with development, being progressively tuned to human faces. For example, it has been shown that 9-month-olds and adults are able to discriminate between human faces but not monkey faces, whereas 6-month-olds recognize facial identity when tested with both human faces and monkey faces (Pascalis, de Haan, & Nelson, 2002). This loss of ability with age parallels the well-known course of speech perception. During the first year of life, infants preserve the capacity to discriminate phonetic variations from their native language, but lose the ability to discriminate phonetic differences in unfamiliar languages. In other words, young infants are able to distinguish fine phonetic differences not used in their native language, but with development, their discrimination abilities progressively focus exclusively on the phonetic differences of their native language. These findings suggest that the progressive tuning of the perceptual and cognitive systems to specific types of information may be a general trend in the development of early cognition.

AN ALTERNATIVE PROPOSAL ON NEWBORNS' PREFERENCE FOR FACES

In light of these considerations, the research group I collaborate with in Padua, Italy, undertook a series of studies with the goal of investigating the perceptual biases that cause the human face to be a frequent focus of newborns' visual attention. Our goal was to ascertain whether such biases are domain-specific or general, and to determine how they guide and shape the emerging face-learning abilities. We maintained that the presence at birth of general, nonspecific constraints on visual processing might be sufficient to trigger the emergence of the functional specialization for faces observed later in development. Specifically, the domain-specific face system may arise from innate domain-general predispositions that tune the system toward certain aspects of the external environment, allowing, through experience, the development of increasingly specialized processes.

Newborns' Preference for Domain-General Structural Properties

In our research program, we began to look for domain-general structural properties that faces might share with nonface geometric stimuli. The rationale was that if we were able to demonstrate that such nonspecific structural properties are preferred when they appear in nonface stimuli, it would be reasonable to presume that the same perceptual properties also play a role in newborns' preference for faces. In particular, our attention was focused on two different perceptual properties that are typical of faces. The first, termed *up-down asymmetry*, refers to the presence of more patterning in the upper than in the lower part of the configuration (Simion, Valenza, Macchi Cassia, Turati, & Umiltà, 2002). The second, termed *congruency*, refers to the existence of a congruent spatial relation between the spatial disposition of the inner features and the shape of the outer contour, with the greater number of inner elements located in the widest portion of the configuration (Macchi Cassia, Valenza, Pividori, & Simion, 2002). Both these properties characterized the facelike patterns used in almost all the experiments in which newborns' face preference was demonstrated (Fig. 1), but may also be found in nonfacelike stimuli.

In our first study, newborns were presented with three pairs of stimuli, each composed of a top-heavy configuration (i.e., more elements in the upper part than in the lower part) and a bottom-heavy configuration (i.e., more elements in the lower part than in the upper part; see Fig. 2). In all comparisons, newborns oriented more frequently to and looked longer at the stimuli with a higher density of elements in the upper part. These results suggested that up-down asymmetry is one of the structural properties that governs newborns'

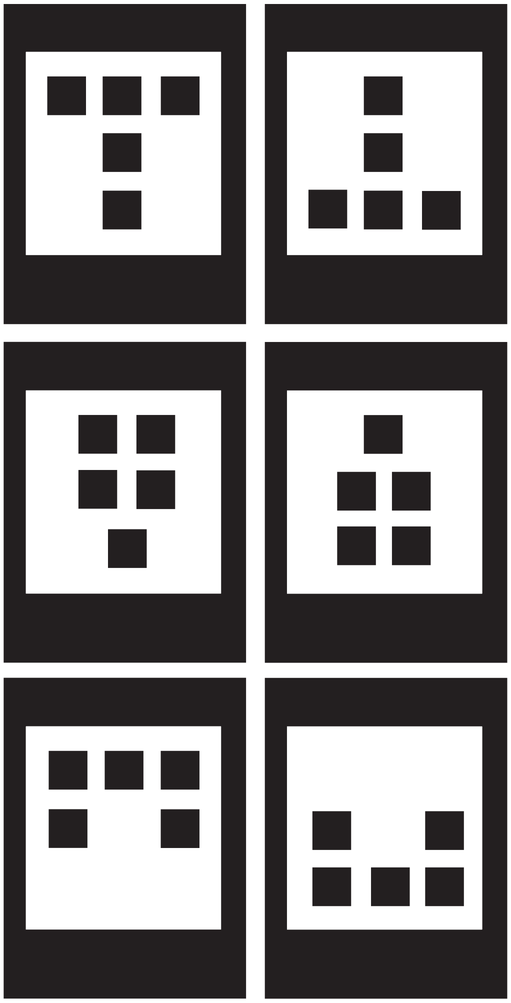

Fig. 2. **Nonfacelike stimuli used to study infants' preference for up-down asymmetry (Simion, Valenza, Macchi Cassia, Turati, & Umiltà, 2002).**

visual preferences in simple nonface, geometric configurations (Simion et al., 2002). In line with the model developed by Acerra, Burnod, and de Schonen (2002), results of a recent study indicate that congruency is also able to induce a visual preference at birth. When congruent and noncongruent nonface configurations were presented to infants, they reliably preferred the congruent pattern (Macchi Cassia et al., 2002).

These outcomes strongly suggest that newborns' putatively specific preference for faces might be explained as the result of the cumulative effect of nonspecific perceptual biases present shortly after birth, because preferences for at least two general structural properties contained in the typical facelike patterns are evident in the case of configurations that do not look anything like faces but share these same perceptual properties. However, it might be the case that newborns' face preference is in fact driven by the specific structure of faces, and that other, general perceptual constraints determine visual preferences in the case of nonface objects. In other words, the fact that preferences in nonface visual stimuli may be due to nonspecific structural properties that these stimuli share with faces does not totally exclude the possibility that qualitatively different processes are responsible for newborns' preferences in the case of faces.

Specific Versus Nonspecific Factors Inducing Newborns' Preference for Faces

In order to disentangle this issue, we carried out a series of experiments using a set of nonface stimuli with the same number of inner elements and the same head-shaped contour usually displayed in facelike configurations (Fig. 3; Turati, Simion, Milani, & Umiltà, 2002). We were thus able to determine the role of up-down asymmetry in inducing newborns' preference for faces by directly comparing infants' reactions to a facelike configuration and a top-heavy nonface pattern (Fig. 3, top panel). In this comparison, newborns did not show any visual preference. In a second comparison, a pattern with the inner elements positioned in a facelike arrangement but lower than in a face was contrasted with a top-heavy pattern in which the elements were in the upper portion but did not form a face configuration (Fig. 3, bottom panel). Newborns preferred the top-heavy pattern, even though it did not represent a face. This pattern of results has been replicated recently with images of real faces (Macchi Cassia et al., in press).

The results of these experiments indicate that the specific facelike spatial arrangement of the elements within the pattern did not affect

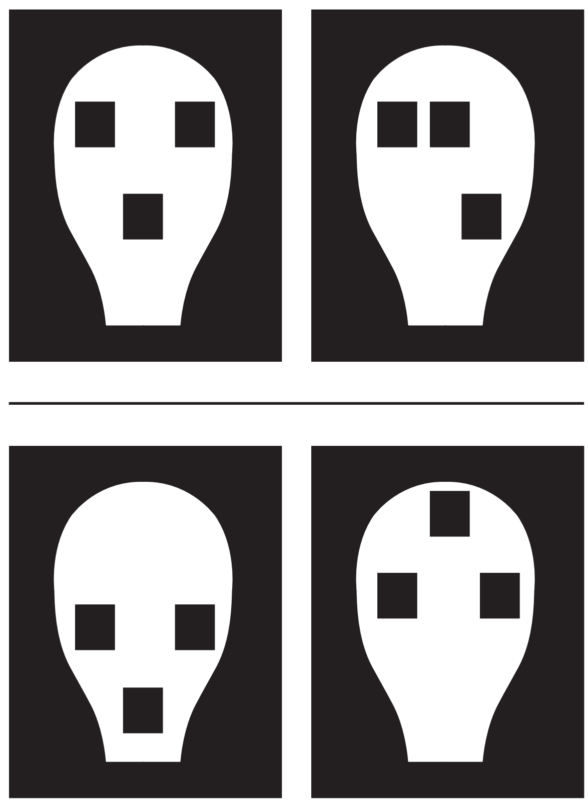

Fig. 3. **Stimuli used to study the role of specific versus nonspecific factors in newborn's face preference (Turati, Simion, Milani, & Umiltà, 2002). In one comparison, a facelike pattern was paired with a nonfacelike stimulus with the same number of elements in the upper portion (top panel). In a second comparison, a nonfacelike configuration with the elements placed in the upper portion of the pattern was contrasted with a configuration that had inner elements positioned in a facelike arrangement, but placed in the lower portion of the pattern (bottom panel).**

newborns' visual behavior, which was instead governed by the up-down asymmetry in the inner features. These results firmly support the idea that nonspecific preferred structural properties may account for newborns' preferential visual response to face stimuli. Thus, in order to explain the first steps in the development of specialization for face processing, it does not seem necessary to assume the existence of a specific innate cortical or subcortical bias toward faces. The earliest basis of face specialization appears to lie in the general functioning of the visual system, which constrains newborns to attend to certain broad classes of visual stimuli that include faces.

HOW DOES NEWBORNS' FACE PREFERENCE AFFECT FACE-LEARNING ABILITIES?

An important and scarcely investigated issue related to the phenomenon of newborns' face preference concerns its impact on face-learning abilities at birth and in the first months of life. On the one hand, innate predispositions toward faces might enhance and potentiate learning, facilitating face recognition and discrimination. On the other hand, the face preference might restrain and limit the type of information that newborns process within faces. Specifically, the presence of the preferred structure that schematically defines a face might constrain newborns to process the overall face pattern holistically, without attending to the distinctive features that distinguish individual faces. Note that this latter possibility is tenable also if newborns' face preference is induced by nonspecific structural properties. It is possible that the nonspecific preferred structural information that biases newborns' visual attention toward facelike patterns interferes with the discrimination and recognition of the inner elements within the overall configuration.

To address this issue, we tested newborns' ability to detect salient changes and extract perceptual commonalities related to the inner elements of facelike configurations (Turati & Simion, 2002). The results showed that newborns were able to discriminate one facelike pattern from another by relying on the shape of their inner features. This indicates that newborns' face-learning abilities are not different from their abilities to learn nonface configurations. Once again, newborns' face-processing capacity seems to be governed by general, rather than specific, rules that apply indifferently to face or nonface stimuli. Thus, newborns' face preference does not directly affect their face-learning processing right at birth. Nevertheless, newborns' preference for faces might give rise to a cascade of events, acting as a bias that provides infants with the opportunity to learn more and more about faces in the first months of life. This extensive experience with faces may allow the gradual development of increasingly specialized face processing.

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