Vision Research xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Vision Research

journal homepage: www.elsevier.com/locate/visres

The adult face-diet: A naturalistic observation study

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ARTICLE INFO

No of reviewers – 1

Keywords:
Face-diet
Exposure
Experience
Other-race effect
Face inversion effect
View-point invariance
Three-quarter view advantage
Face size
Naturalistic observation
Environment
Evolution
First-person perspective

ABSTRACT

Experience plays a fundamental role in the development of visual function. Exposure to different types of faces is an important factor believed to shape face perception ability. Contents of daily exposure to faces, i.e., the face-diet, of infants have been documented in previous studies. While face perception involves a protracted development and continues to be malleable well into adulthood, an empirical study of the adult face-diet has been lacking. We collected first-person perspective footage from 30 adults during the course of their daily activities. We found that adults' exposure to faces is longer and more diverse compared to that of infants. Frequency of exposure were highest for familiar (75%), own-race (81%), and three-quarter pose (44%) faces. Faces in the adult face-diet were relatively large (median 6°) suggesting fairly close viewing distances. Face sizes were significantly larger for familiar (median 7.1°) compared to unfamiliar (median 4.9°) faces, reflecting the closer viewing distances that characterize social interaction. These results are consistent with the view that face recognition processes are tuned to the ecologically relevant values of face attributes that are encountered most frequently in the real-life context to optimize face perception abilities.

1. Introduction

Face perception plays a key role in an individual's ability to form and maintain social interactions. Carrying out a face-to-face conversation is difficult without being able to interpret a friend's facial expressions; and failing to recognize a new colleague you met previously at a social event prevents a new connection to be made. The role of face recognition is undeniable in navigating one's social environment. Recognizing faces differs from most other visual object recognition tasks since it involves individuating exemplars that share the same configuration (two eyes above the nose above the mouth) based on subtle differences e.g., between features and relative distances between features. Human observers are considered to be experts in face perception as they maintain sensitivity to such subtle differences that distinguish different identities while remaining robust across significant changes among images of the same identity, e.g., due to changes in viewing conditions such as lighting and viewpoint. Despite the apparent complexity of this task, large numbers of faces encountered in a lifetime are remembered and recognized by human observers with seemingly little difficulty.

How human observers develop face expertise continues to be a topic of controversy. Some evidence is suggestive of innate and genetic contributions (see McKone, Crookes, Jeffery, & Dilks, 2012; McKone, Kanwisher, & Duchaine, 2007, for reviews). For example, Farah and colleagues describe the case of a classic presentation of acquired prosopagnosia resulting from brain damage suffered only one day after birth (Farah, Rabinowitz, Quinn, & Liu, 2000) suggesting that the neuroanatomical structures devoted to face processing may be genetically predetermined independent of visual experience. Furthermore, multiple studies show that newborns orient toward faces and face-like forms prior to any significant opportunities for visual experience (Goren, Sarty, & Wu, 1975; Johnson, Dziurawiec, Ellis, & Morton, 1991), suggesting a built-in predisposition for responding to faces. In addition, twin studies of face recognition show that this specialized ability is heritable providing evidence for a genetic basis for face processing (Wilmer et al., 2010; Zhu et al., 2010).

On the other hand, it is clear that innate face knowledge cannot fully explain human face recognition abilities. Conclusive evidence for this comes from the so-called other-race effect—a robust finding of diminished recognition and memory for other-race faces, compared to those of own-race (Hayward, Rhodes, & Schwaninger, 2008; Meissner & Brigham, 2001; O'Toole, Deffenbacher, Valentin, & Abdi, 1994; Rhodes, Hayward, & Winkler, 2006; Rostamirad, Barton, & Oruc, 2009; Walker & Tanaka, 2003). The other-race effect is not a consequence of genetic determinants of ethnicity. For example, Korean children adopted by Caucasian European families between the ages of three to nine acquired

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https://doi.org/10.1016/j.visres.2018.01.001
Received 29 August 2017; Received in revised form 3 January 2018; Accepted 12 January 2018

Please cite this article as: Oruç, I., Vision Research (2018), https://doi.org/10.1016/j.visres.2018.01.001

the reverse other-race effect, i.e., difficulties with recognizing East Asian faces (Sangrigoli, Pallier, Argenti, Ventureyra, & de Schonen, 2005). The fact that face expertise is fundamentally shaped and limited by chance events such as place of birth firmly establishes the key role played by visual experience.

Development of various visual processes involve sensitive periods during which appropriate visual input is required for normal development (see Lewis & Maurer, 2005, for a review). Similarly, early visual exposure may play a key role in the development of face expertise. Several studies show permanent deleterious effects of early visual deprivation from dense congenital cataracts on expert face processing (de Heering & Maurer, 2014; Geldart, Mondloch, Maurer, De Schonen, & Brent, 2002; Le Grand, Mondloch, Maurer, & Brent, 2001, 2003, 2004). Importantly, brief post-natal visual deprivation periods appear to be sufficient to engender these permanent deficits despite many years of visual experience following cataract reversal.

Finally, several lines of research point to continued impact of visual exposure to faces well beyond an early critical period. Evidence suggesting that early visual experience is not sufficient to support normal face processing is provided by studies on the case of MM who was blind between the ages of 3 and 43. Subsequent to restoration of his vision, MM's face perception remained severely and permanently impaired in contrast to his relatively intact motion and simple form processing (Fine et al., 2003; Huber et al., 2015). Face recognition goes through a protracted developmental course extending to late childhood and adolescence (e.g., Carey, Diamond, & Woods, 1980; de Heering, Rossion, & Maurer, 2012). Further evidence of late maturation comes from a large scale study by Germine and colleagues (2011) who report peak recognition memory for faces occurs in early 30 s. A study on adults of Korean origin adopted as children by European families between the ages of 3 and 9 show that the other-race effect can be reversed in late childhood (Sangrigoli et al., 2005) indicating that although the other-race effect is in place within the first year of life (Kelly et al., 2007), significant plasticity of the face-specific visual processes is still observed well into late childhood. In addition, visual training in adulthood has been shown to significantly reduce the face inversion effect (Laguesse, Dormal, Biervoye, Kuefner, & Rossion, 2012) and the other-race effect (Tanaka, Heptonstall, & Hagen, 2013). Overall, these results suggest that face recognition processes remain malleable in adulthood and continue to be shaped based on the visual experience of the observers.

Face-diet, a term coined by Rhodes and colleagues, refers to the collection of faces encountered as part of one's day-to-day visual experience (Rhodes, Jeffery, Watson, Clifford, & Nakayama, 2003). Despite the central role face-diet plays in shaping face recognition processes, empirical studies of the face-diet have been lacking until very recently. Five recent studies examining the face-diet of infants aged 1–24 months have contributed to advancing our understanding of infants' real-life exposure to faces (Fausey, Jayaraman, & Smith, 2016; Jayaraman, Fausey, & Smith, 2015, 2017; Sugden, Mohamed-Ali, & Moulson, 2014; Sugden & Moulson, 2017). Yet, a comprehensive empirical assessment of the adult face-diet has yet to be undertaken. It is uncertain how much can be extrapolated from what is known regarding the infant face-diet since daily activities of adults, and consequently their visual experiences, may vary drastically from those of infants.

Adults typically engage in a larger variety of activities compared to infants related to various functions such as their occupation, procurement of basic necessities, entertainment, physical activities, self-care, and social activities. For example, an adult may travel by bus to their workplace, go to a restaurant for lunch, visit a coffee shop in the afternoon, run errands or go shopping in the market, and attend a fitness class at a community centre within the time frame of a typical day. These activities bring with them a greater variety of social encounters with not only family members (as is typical with infants) but also with those of varying familiarity such as friends, colleagues, acquaintances, shop keepers, fellow commuters, or strangers passing by on a street. Physical factors, such as mobility and the size of one's body in relation to those of others in the environment, can also impact characteristics of one's visual input. Adults are able to move about freely and have the ability to orient toward, approach, as well as distance themselves from others and view faces around a level line of sight.

In the present study, we examined the adult face-diet to determine exposure statistics with regards to attributes such as viewing distance, pose, gender, ethnicity and familiarity. For this purpose, we equipped 30 adult participants with an eyewear-embedded camera and recorded first-person perspective footage while the participants carried on with their regular daily activities. In light of these results we compare the adult face-diet to that of infants reported in the literature and reveal the ways in which these two differ. In addition, we consider whether and to what degree statistics of adult face exposure can account for robust behavioural findings in the face recognition literature. Finally, we discuss potential implications of our results that engender new hypotheses regarding key factors in the development of face expertise for future study.

2. Methods

2.1. Eyewear-embedded camera

The footage was acquired using a high-resolution 75° field-of-view eyewear-embedded camera, Pivothead Durango (http://www.pivothead.com/). The camera was set to time-lapse mode to capture still images at the rate of 1 shot/30 s at 3-megapixel resolution. We replaced the shades with clear lenses and connected the glasses to a pocket-sized external battery (Pivothead Power Pro Refuel 8000), which the participants carried near or on their person (see Fig. 1).

2.2. Participants

Thirty adults (14 females; mean age = 31.9 ± 8.4 years, range 20–54) participated in the study. Out of the 30 participants: 28 were Caucasian, one was African and one was Asian; 14 were female; 18 participants recorded footage on a workday. In terms of occupation, the participant group consisted of four researchers, five engineers, one youth leader, two teachers, eleven students, one unemployed, one accountant, one administrative coordinator, one managing director, one customer services specialist, one bookkeeper, and one lab manager. Average footage recorded per participants was just over 7 h and 26 min (range: 2 h 35 m–13 h 23 m) for a total duration of 209 h and 57.5 min (25,195 frames).

Fig. 1. Eyewear-embedded camera. Eyewear-embedded camera was used to capture still images at the rate of 2 shots/min throughout the course of one day. A pocket-sized external battery was connected to the camera, which was carried on or near the participant's person.