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Mini-review

The breakdown of social looking

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ABSTRACT

Individual differences in social looking are commonly believed to reflect one single heritable dimension tightly linked to autism. Yet, recent data suggest that in human infants, looking to eyes (rather than mouth) and preference for faces (versus non-social objects) reflect distinct genetic influences, and neither appear to have a clear-cut relation to autism.

People vary substantially in terms of which areas of a scene they fixate and how much they attend to social stimuli (Kennedy et al., 2017; Broda and de Haas, 2024; Constantino et al., 2017). Investigating the aetiology of such differences in infants, a recent eye tracking study of more than 500 5-month-old twins conducted in our lab demonstrated that both eye preference (looking to eyes rather than the mouth; Fig. 1**a**) and face preference (looking to faces rather than non-social objects; Fig. 1**b**) to a large extent reflect genetic variation (Portugal et al., 2024; Viktorsson et al., 2023). This indicates a biological basis for young infants' individual level of attention to social stimuli, and the part of the stimuli they focus on. The correlation between eye and face preference was weak, and multivariate twin analyses indicated that the two phenotypes were linked to independent genetic factors (Fig. 1**c**) (Portugal et al., 2024). This suggests that, at least in infancy, different social looking behaviours reflect different underlying processes, perhaps with distinct evolutionary histories (Shakeshaft and Plomin, 2015). This conclusion contrasts with the view that individual differences in many different types of social looking in childhood reflect one single dimension – *social visual engagement* (Constantino et al., 2017).

Relatedly, it has been suggested that differences in social looking in infancy represent an endophenotype for autism (Constantino et al., 2017; Mosconi et al., 2023; Constantino, 2019) – a highly heritable condition defined by atypical social communication. However, the multidimensional genetic nature behind two archetypical social gaze phenotypes in infancy shown in Fig. 1**c** raises a new question: Which of these are linked to autism? Arguably, existing studies of infant social looking and its relation to autism do not indicate a clear association for neither of them. For example, in the recent infant twin studies (Portugal et al., 2024; Viktorsson et al., 2023), no significant correlation with a polygenic score for autism was found. Further, there were no significant association between either eye or face preference and later socio-communicative ability or autistic traits. Although there were correlations with parent-reported vocabulary development at 14 months, these correlations were not significant when language was re-assessed at 24 months. In other words, the near-exclusive mouth looking observed in ~ 7 % of the infant population cannot be regarded as a sign of pathology or atypical development (Fig. 1**a**). One study of infants at elevated likelihood of autism has suggested that group-level differences in eye-versus-mouth looking emerge gradually over the first year of life among autistic children (Jones and Klin, 2013). Another study found reduced looking to people and faces (but not to others' eyes) at 6 months of age in infants later diagnosed with autism (Chawarska et al., 2013). Yet, other studies of infants at elevated likelihood of autism, including ones using live eye tracking to assess infants' gaze during real social interaction towards the end of their first year, have failed to find a strong link between reduced eye or face preference and later autism diagnosis (Rudling et al., 2023; Nystrom et al., 2019; Chawarska et al., 2012, see also Elsabbagh et al., 2013). Taken together, more work is needed to understand link between different types of social looking in infancy and this neurodevelopmental condition.

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Individual eye-versus-mouth preferences have been assumed to reflect processes that are domain specific (social) (Constantino et al., 2017; Viktorsson et al., 2023). However, a recent study of adults reported that eye-versus-mouth preference has a high correlation with vertical looking preferences within non-social stimuli (Broda and de Haas, 2024). This highlights the possibility that eye-versus-mouth preferences early in life too may reflect differences in domain general visual processing style, which future studies should address. In fact, this could explain why eye-versus-mouth preferences generalize over different types of face stimuli and contexts (the eyes tend to always be above the mouth) (Constantino et al., 2017; Viktorsson et al., 2023) and why these preferences were found to be largely uncorrelated with face-versus-object preference in the above-mentioned infant twin study (for face-versus-object preference, vertical and horizontal position of the two categories were counterbalanced) (Portugal et al., 2024).

It could be argued that the dissociation between face and eye preference found in the infant twin study (Fig. 1**c**) could be linked to the face-versus-object stimuli being static while the eye-versus-mouth stimuli being dynamic. However, the very high (r ~ .9) correlation across still and dynamic versions of stimuli used to assess eye-versus-mouth preference does not support this explanation (Viktorsson et al., 2023). In the still variants, the actors simply looked into the camera with a neutral facial expression; in the dynamic variants, they moved naturally using visual and vocal signals to engage the child (e.g., singing phrases from children's songs) (Viktorsson et al., 2023).

Also in humans' closest living relatives, chimpanzees and bonobos, there are notable individual differences in face preference and eye preference (Brooks et al., 2021; Kano et al., 2015), and in adult captive chimpanzees, individual differences in mutual gaze are linked in part to genetic factors (Hopkins et al., 2020). It is possible that some of the driving forces behind individual differences in social looking in humans have a parallel in in other species.

In early childhood, high temporal stability of eye preference has been reported (Constantino et al., 2017), but long term stability beyond that is, to my knowledge, not known. Evidence suggest generalisability of eye preference from screen-based eye tracking to live contexts in adulthood

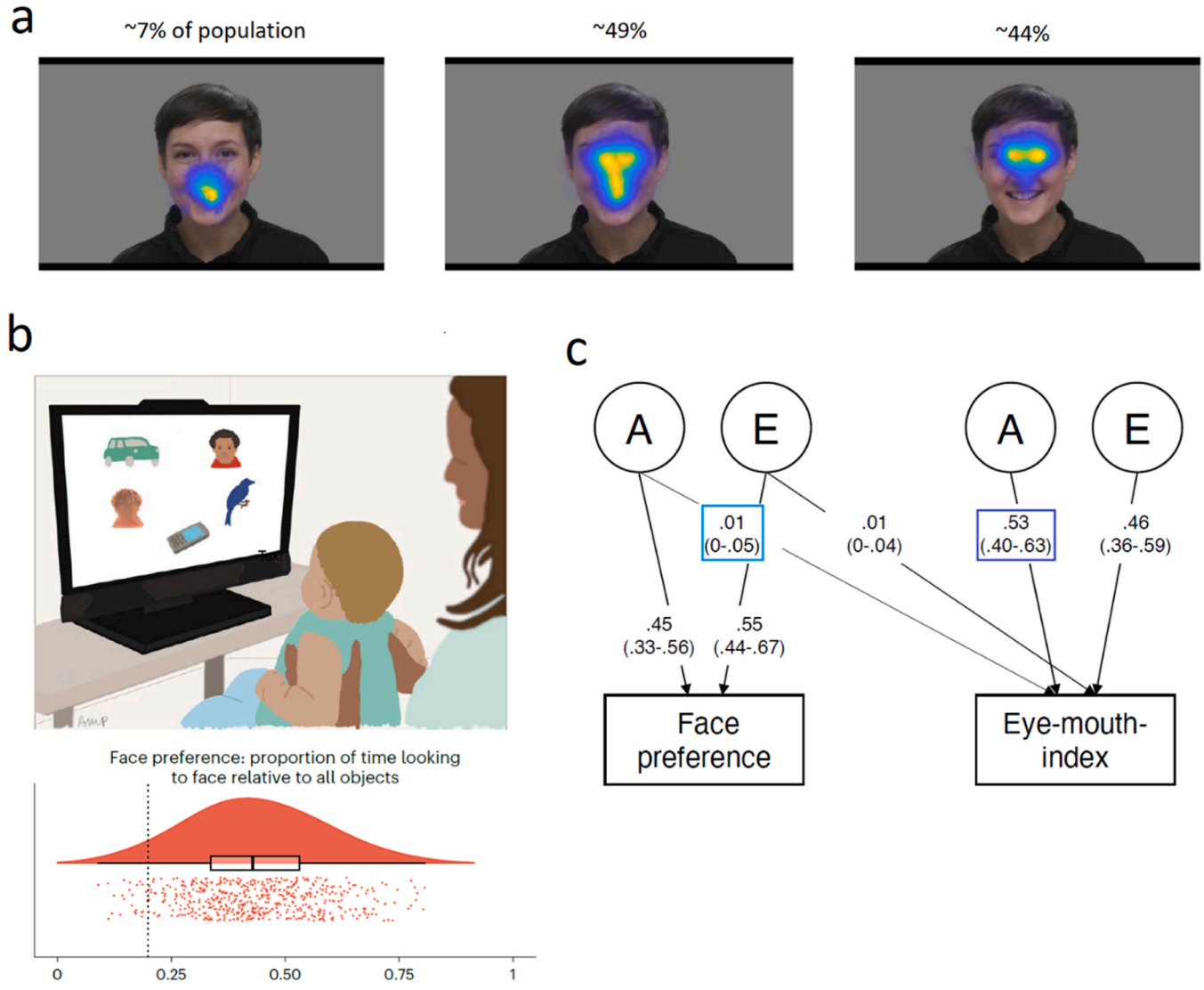

Fig. 1. Social looking behaviours in infancy show high inter-individual variation and reflect at least two underlying etiological dimensions. a) Although nearly 50 % of five-month-old infants have a clear eye preference when looking at faces (right panel), there is a large variation, and a non-negligible minority look almost exclusively at the mouth (left panel). **b**) Degree of preference for faces is also highly variable between infants. The vertical line reflects chance preference. **c**) Both face preference and eye preference are heritable phenotypes. Yet, the genetics linked to face preference were not related to eye-versus-mouth looking (light blue), and unique genetic influences were associated with eye-versus-mouth looking (dark blue; figure shows Cholesky bivariate decomposition; A = additive genetic influences, E = unique environmental influences; phenotypic correlation between the two phenotypes was .11, p = .025). Figures and data are reproduced and adapted with permission from Portugal et al. (2024), Viktorsson et al. (2023); Illustration in b) by A.M. Portugal.

(Peterson et al., 2016) and childhood (Falck-Ytter et al., 2015). To my knowledge, no study has reported on the generalizability of face (versus object) preferences from lab-based to real-world settings, which is important to establish.

Initially unrelated traits may get correlated over development (Van Der Maas et al., 2006). Therefore, although largely unrelated in infancy, face and eye preference may potentially show a higher association (phenotypically and etiologically) later on (Falck-Ytter et al., 2010). Longitudinal twin studies spanning early infancy to later in childhood including both social and non-social stimuli would help us address this, as well as investigating the degree of domain specificity in these putatively social measures (Broda and de Haas, 2024).

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Declaration of interests

The author declares no conflicts of interest.

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