● **LETTER**

REPLY TO COOK AND OVER:
Social learning and evolutionary mechanisms are not mutually exclusive

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We thank Cook and Over (1) for their response to our recent article, where we find that unique experiences drive individual differences in impression formation (2). Overall, our theoretical positions are similar: We suggest that social associative learning underlies this core finding (2), and Cook and Over (1) clearly agree. Here, we take the opportunity to address a critical misunderstanding, namely that evolutionary and social learning mechanisms are mutually exclusive. We propose that both processes shape impression formation.

To clarify, previous models of consensus facial impressions are not purely evolutionary. For example, in Sutherland et al.'s model (3), both evolution and media-based stereotypes are suggested to account for age-based attractiveness impressions. In fact, the data-driven approach used to build this model demonstrates that glasses cue intelligence (3). Clearly, impressions based on glasses are not an evolved adaptation! Subsequently, a wealth of literature has demonstrated that impressions vary by social group (4–6), stereotyping (7, 8), and cultural dialect (9, 10). In our current work (2), we also clearly demonstrate the power of individual experience in explaining idiosyncrasy in impression formation.

Compared to our hybrid model that incorporates both social learning and evolution, a pure social learning model underestimates the complexity of impression formation. To take the authors' example, why does the media consistently portray "good guys" or "bad guys" with similar facial attributes across cultures (e.g., physically strong men as dominant)? Social learning cannot easily account for this example nor other findings in facial impression research. For instance, Cook and Over (1) suggest that impressions should be measured in samples that are non-Western, educated, industrialized, rich, and democratic: Indeed, Zebrowitz et al. (9) carried out an elegant study with the Tsimane' people, a culturally isolated group in Bolivia. Although there were cultural dialects, overall, these remarkably different cultures formed highly similar impressions, suggesting that at least some contingencies between cues and impressions are evolutionarily predisposed. More recently, Sutherland et al. (10) theorized that impressions show variform universality between British and Chinese judges. Other evidence for an evolutionary account also comes from developmental research. Neural sensitivity to facial trustworthiness is observed in infancy (11), suggesting that extensive social experience is not required for impression consensus.

Critically, an evolutionary perspective draws attention to one of the most interesting questions in impression formation research: Why do we form impressions? For example, a leading theoretical account, the overgeneralization hypothesis (5), proposes that people base their impressions on adaptive cues, such as emotional expressions, that are overgeneralized. For instance, a person with a neutral face that looks happy may be perceived as trustworthy. Here, since impressions are the by-products of adaptive processes, accuracy is not required for impressions to be shaped by evolution. Moreover, by linking impression formation to natural or sexual selection, an evolutionary perspective can explain why certain impressions, including trust or attractiveness, are especially important (3).

In summary, we propose that evolutionary mechanisms prepare an organism for social learning. Together, these processes allow people to engage in impression formation in order to navigate through complex social worlds.

www.pnas.org/cgi/doi/10.1073/pnas.2009587117

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1 R. Cook, H. Over, A learning model can explain both shared and idiosyncratic first impressions from faces. *Proc. Natl. Acad. Sci. U.S.A.* **117**, 16112–16113 (2020).

2 C. A. M. Sutherland *et al.*, Individual differences in trust evaluations are shaped mostly by environments, not genes. *Proc. Natl. Acad. Sci. U.S.A.* **117**, 10218–10224 (2020).

3 C. A. M. Sutherland *et al.*, Social inferences from faces: Ambient images generate a three-dimensional model. *Cognition* **127**, 105–118 (2013).

4 J. R. Collova, C. A. M. Sutherland, G. Rhodes, Testing the functional basis of first impressions: Dimensions for children's faces are not the same as for adults' faces. *J. Pers. Soc. Psychol.* **117**, 900–924 (2019).

5 L. A. Zebrowitz, M. Kikuchi, J. M. Fellous, Facial resemblance to emotions: Group differences, impression effects, and race stereotypes. *J. Pers. Soc. Psychol.* **98**, 175–189 (2010).

6 S. Y. Xie, J. K. Flake, E. Hehman, Perceiver and target characteristics contribute to impression formation differently across race and gender. *J. Pers. Soc. Psychol.* **117**, 364–385 (2019).

7 C. A. M. Sutherland, J. A. Oldmeadow, A. W. Young, Integrating social and facial models of person perception: Converging and diverging dimensions. *Cognition* **157**, 257–267 (2016).

8 D. Oh, R. Dotsch, J. Porter, A. Todorov, Gender biases in impressions from faces: Empirical studies and computational models. *J. Exp. Psychol. Gen.* **149**, 323–342 (2020).

9 L. A. Zebrowitz *et al.*, First impressions from faces among US and culturally isolated Tsimane' people in the Bolivian rainforest. *J. Cross Cult. Psychol.* **43**, 119–134 (2012).

10 C. A. M. Sutherland *et al.*, Facial first impressions across culture: Data-driven modeling of Chinese and British perceivers' unconstrained facial impressions. *Pers. Soc. Psychol. Bull.* **44**, 521–537 (2018).

11 S. Jessen, T. Grossmann, Neural evidence for the subliminal processing of facial trustworthiness in infancy. *Neuropsychologia* **126**, 46–53 (2019).

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