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ARTICLE

A first impression of the future

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Abstract
We offer a response to six commentaries on our target article 'Understanding trait impressions from faces'. A broad consensus emerged with authors emphasizing the importance of increasing the diversity of faces and participants, integrating research on impressions beyond the face, and continuing to develop methods needed for data-driven approaches. We propose future directions for the field based on these themes.

KEYWORDS
first impressions, person perception, trait perception

BACKGROUND

We thank the authors of six commentaries for a stimulating and engaging discussion. We almost entirely agreed with the responses, with most commentaries quite rightly pointing out where we did not go far enough in our initial review. Excitingly, several commentaries drew on ground-breaking papers published since our review, just 6 months ago, highlighting how quickly this field is growing. While it is impossible to cover all points, we note clear themes emerging from the discussion, including the value of increased diversity, attention to impressions beyond static face images (including bodies, voices and temporal factors), and new methods, which may help overcome issues inherent in a data-driven approach.

Embracing diversity

Given the substantial cultural differences evident across the world and often-discussed findings such as the 'other-race' effect, it was natural that early studies of first impressions began with cautious approaches involving faces and participants of the same cultural and ethnic background. More recent work has begun to broaden this approach and we are pleased to see commentators' agreement with our call for increased diversity in the faces used as stimuli, especially in terms of age and ethnicity. We completely agree with Mondloch et al. (2023) when they 'urge researchers to also include faces from across the lifespan' and

thank them for highlighting studies which show that perceptions of at least some social groups – children and older adults – are focused on social rather than physical capability (Collova et al., 2019; Twele & Mondloch, 2022).

Mondloch et al. (2023) also agree with us that it is important now to move beyond studies that include only White faces and impressions derived from Western participants. They suggest that artificial intelligence techniques (AI) can be used to generate more diverse faces, as do O'Toole and Hu (2023) and Todorov et al. (2023). While such approaches will be valuable, it remains the case that AI itself will still be constrained by its training data; an AI model that has never seen images of people from Aboriginal and Torres Strait Islander cultures would struggle to generate plausible faces representing these groups, a model that has only been trained on Black faces would be unlikely to create realistic White or Asian faces and so forth. Training data may also represent traits differently; for example, trustworthiness judgements may be more important for controlled, neutral face photos taken in the lab, whereas attractiveness may be more important when photos are from social media and online dating profiles created by users themselves (Keles et al., 2021). As Todorov et al. (2023) note, and highlighted in our initial review, impression ratings and even face image choices could also be influenced by the judges' stereotypes. We, therefore, emphasize that it is critical that AI models are representative of diverse populations for targets and judges and based on input from diverse research communities.

Beyond the face

Every field starts somewhere, and certainly, our own perspective has been shaped by a long history of face research outwith impression formation. We agree with the commentators that impression formation research now needs to integrate impressions from faces with other types of judgement, including bodies and voices, as well as the wider perceiver context.

O'Toole and Hu (2023) note that most social encounters (at least, offline) involve seeing a whole person, body as well as face. We concur with their key point that visual trait impressions often necessarily represent a combination of facial and bodily information. Beyond visual stimuli, Lavan (2023) notes the importance of voices in forming impressions and highlights the integration of vocal and facial impressions as a crucial future direction. The processing, integration and time course of multimodal impression formation is a fascinating topic. Potentially, whole-person research will be transformative for the field, and it may contradict some conclusions that hold true only for encounters limited to just the face (which can still be important; for example, when viewing online profile pictures).

Aside from impressions due to the attributes of the target, Todorov et al. (2023) remind us of the importance of understanding individual differences in *perceivers'* impressions. We agree with their suggestion that understanding these individual differences is 'one of the most important, most underappreciated and least developed areas of research on first impressions'. They rightly observe that little is known about the mechanisms leading to stable idiosyncratic differences, although we did point to recent twin studies showing that underlying mechanisms were largely environmental and idiosyncratic in origin, and thus likely the result of unique social experiences in the world, with a smaller genetic contribution which must also be understood and modelled.

Mondloch et al. (2023) also raise the importance of understanding developmental influences, but we are somewhat puzzled by their suggestion that we characterized 'the development of facial impressions as evidence of evolutionary origins rather than as evidence of cultural or individual learning'. Rather, we believe that learning is highly crucial to the development of impressions, and indeed, the importance of cultural and individual learning has motivated our own empirical research (Siddique et al., 2022; Sutherland, Burton, et al., 2020). To reiterate, contemporary biological approaches note that evolution is inherently bound with learning. The newborn, seeing faces for the first time, is surely learning extremely quickly. We also entirely agree with Mondloch et al. (2023) that it is likely that impression formation becomes increasingly sophisticated through development and evidence suggesting that newborns or

infants are sensitive to cues that underlie valence or attractiveness need not indicate that they are forming explicit impressions of such traits per se. Looking beyond the face, Lavan (2023) also points out that voice trait perception research can benefit from thinking about cultural and individual learning.

Building on the importance of individual differences, Adolphs and Lin (2023) also suggest that in the real world, perceivers' goals will modify the trait impressions made from faces. They note that much of the research on trait impressions has been limited to a goal-neutral paradigm that may influence the resulting dimensional structure. This observation leads to the intriguing idea that goal-directed processing may help us understand when traits diverge or align, for example, in the case of sociability and morality, which is an interesting and plausible hypothesis. Relatedly, O'Toole and Hu (2023) point to the importance of goal-directed processing in relation to cultural variation, with particular reference to independent and interdependent cultural goals. We additionally note here that evidence also exists for the altered use of impressions in decision-making in neurodiverse populations (Ewing et al., 2015; Hooper et al., 2019; Sutherland, Rhodes, et al., 2020).

Adolphs and Lin (2023) further suggest that fMRI and electrophysiological measures could be used to understand how goal-directed processing of impressions unfolds in the brain over time. We agree that such research is vital. Recently, the first author investigated this question by comparing electrophysiological signals measured over the visual cortex in response to trustworthy and untrustworthy faces, either during incidental viewing, while imagining playing a trust game, or while engaged in an explicit impression formation goal (Swe et al., 2022). Interestingly, Bayesian analyses found moderate to strong evidence for equally robust neural responses across the incidental and goal-directed contexts, suggesting that some aspects of processing facial appearance, at least when recorded over the visual cortex, may be relatively unaffected by explicit goals. Future work may very well find other brain areas or responses to other aspects of impression formation that are more clearly goal-driven. We echo Adolphs and Lin's (2023) conclusion that likely multiple top-down and bottom-up factors combine dynamically to form impressions, leading to exciting questions for future research.

Advances in methods

A persistent theme of the commentaries is that while data-driven approaches have transformed the field, they remain subject to limitations that can be addressed through new or improved methods. For example, Mondloch et al. (2023) note that data-driven methods are only as robust as the decisions made during analysis, such that 'researchers must be mindful that each decision can influence the characterization of underlying dimensions'. We agree; anyone who has been faced with a set of unconstrained descriptions will recognize the subjectivity inherent in such a method. They suggest a novel method for analysing unconstrained descriptions using dictionaries built from the stereotype content literature. We certainly see the possibilities in combining this top-down method with a bottom-up, data-driven approach, especially if care is taken over the choice and construction of the dictionaries themselves. A further useful suggestion from Mondloch et al. (2023) is to contrast impressions across conditions in which different types of faces (e.g. male or female) are blocked or interleaved.

Jones et al. (2023) suggest new methods for evaluating and comparing data-driven models. For example, one could employ regularized regressions, perhaps in combination with Bayesian inference to decide which predictors to retain, as well as using root-mean-squared-error (RMSE) to directly compare models. We also echo their suggestion to increase the use of out-of-sample testing. Similarly, Todorov et al. (2023) point out the advantages of being able to estimate the reliability of each participant's responses by taking more than one response to the same stimulus.

Finally, we noted already the potential of AI in generating stimuli and modelling the relation between cues and impressions (O'Toole & Hu, 2023; Todorov et al., 2023) as well as raising critical considerations around ensuring diversity in AI.

CONCLUSIONS

In conclusion, the commentaries, and our response, point very much towards the future. While great strides have been made in the last decade, future work can fruitfully aim to better integrate work with faces with other types of social stimuli as well as to better understand the role of the perceiver. New methods and research questions will bring further exciting opportunities, including a greater understanding of diversity in impressions through culture, individual differences, and lifespan.

AUTHOR CONTRIBUTIONS

Clare A.M. Sutherland: Conceptualization; writing – original draft; writing – review and editing. **Andrew W. Young:** Writing – review and editing.

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CONFLICT OF INTEREST STATEMENT

There are no conflicts of interest to declare.

DATA AVAILABILITY STATEMENT

Data availability statement is not applicable to this work.

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