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Assessing the accuracy of perceptions of intelligence based on heritable facial features

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ABSTRACT

Perceptions of intelligence based on facial features can have a profound impact on many social situations, but findings have been mixed as to whether these judgements are accurate. Even if such perceptions were accurate, the underlying mechanism is unclear. Several possibilities have been proposed, including evolutionary explanations where certain morphological facial features are associated with fitness-related traits (including cognitive development), or that intelligence judgements are over-generalisation of cues of transitory states that can influence cognition (e.g., tiredness). Here, we attempt to identify the morphological signals that individuals use to make intelligence judgements from facial photographs. In a genetically informative sample of 1660 twins and their siblings, we measured IQ and also perceptions of intelligence based on facial photographs. We found that intelligence judgements were associated with both stable morphological facial traits (face height, interpupillary distance, and nose size) and more transitory facial cues (eyelid openness, and mouth curvature). There was a significant association between perceived intelligence and measured IQ, but of the specific facial attributes only interpupillary distance (i.e., wide-set eyes) significantly mediated this relationship. We also found evidence that perceived intelligence and measured IQ share a familial component, though we could not distinguish between genetic and shared environmental sources.

1. Introduction

Judgements of intelligence are made quickly and can have profound impact in various social situations. For instance, in educational settings, pre-conceived perceptions of intelligence can influence a student's academic performance (Brophy, 1983; Dunkel & Murphy, 2014; Jussim, 1989; but see Jussim & Harber, 2005). In an employment setting, interviewers are likely to seek to confirm pre-conceived intelligence evaluations, which can affect their judgement during hiring decisions (Judice & Neuberg, 1998). Perceptions of intelligence have also been found to influence leadership decisions (Spisak, Blaker, Lefevre, Moore, & Krebbers, 2014).

Perceptions of intelligence can be made based on numerous traits, such as language use (Reynolds & Gifford, 2001), body symmetry (Prokosch, Yeo, & Miller, 2005), and also facial features. Previous work investigating facial traits associated with perceptions of intelligence have implicated face height, interpupillary distance (distance between the eyes), nose size, and chin pointedness (Kleisner, Chvatalova, & Flegr, 2014), as well as eyelid openness, and mouth curvature (Talamas, Mavor, Axelsson, Sundelin, & Perrett, 2016). However, it is unclear whether these or any other facial traits are associated with actual intelligence. While some studies suggest that intelligence judgements of unfamiliar individuals based solely on facial attributes are accurate (i.e. better than chance; Carney, Colvin, & Hall, 2007; Zebrowitz, Hall, Murphy, & Rhodes, 2002), others find no relationship (Borkenau & Liebler, 1995), or that facial attributes can hinder overall accuracy (Olivola & Todorov, 2010). Other research has indicated that the relationship may be more complicated, such as being sex-dependent (Kleisner et al., 2014; Murphy, Hall, & Colvin, 2003), or age-dependent (Milonoff & Nummi, 2012). If the association between

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perceptions of intelligence and actual intelligence is very small, the studies to date may have been underpowered, which could explain the mixed results (see Zebrowitz et al., 2002 for a meta-analysis).

If we assume that individuals are able to judge intelligence better than chance based on facial appearance, the exact mechanism that drives this accuracy is unclear. One possibility is that intelligence is an indicator of underlying genetic quality (Haselton & Miller, 2006; Miller, 2000), which would also be associated with physical attributes, such as attractiveness (Prokosch et al., 2005; Zebrowitz & Rhodes, 2004). Such an association could be explained if the development of intelligence (and attractiveness) relies on the ability to convert energy into fitness-enhancing traits during development (Kokko, Brooks, Jennions, & Morley, 2003; Kokko, Brooks, McNamara, & Houston, 2002). Indeed, intelligence is associated with health measures (Arden, Gottfredson, & Miller, 2009), greater pathogen resistance (Eppig, Fincher, & Thornhill, 2010, 2011), and lower mutation load (Howrigan et al., 2016; Yeo, Gangestad, Liu, Wassink, & Calhoun, 2011). However, it is also possible that the accuracy of intelligence judgements is merely learnt rather than being an evolved mechanism, as previous research has found that it develops in women not at sexual maturity, but later in life (Milonoff & Nummi, 2012).

Another possibility is that intelligence and attractiveness are genetically linked, which could occur if intelligent individuals consistently mate with facially attractive partners (Kanazawa & Kovar, 2004; but see Denny, 2008; Penke et al., 2011). Some premises for this notion are supported; for instance, women rate faces manipulated to appear more intelligent as more attractive (Moore, Law Smith, & Perrett, 2014) and may also find cues to intelligence more attractive when fertile (Haselton & Miller, 2006; but see Gangestad, Thornhill, & Garver-Apgar, 2010). However, other research has found no association between facial attractiveness and intelligence (Feingold, 1992; Langlois et al., 2000; Mitchem et al., 2015), or have even suggested that facial attractiveness hinders accuracy of intelligence judgements (Talamas, Mavor, & Perrett, 2016). Pertinently, we previously found no significant genetic correlation between facial attractiveness and intelligence in the sample used in the present study (Mitchem et al., 2015). For a more nuanced discussion of the link between facial attractiveness and IQ, see Mitchem et al. (2015).

Perceptions of intelligence could also be based on more transitory facial cues (as opposed to stable characteristics). For instance, Talamas, Mavor, Axelsson, et al. (2016) suggest that perceptions of intelligence are driven by overgeneralisation of cues to tiredness, which can change quickly and can affect cognitive performance (Pilcher & Huffcutt, 1996). Indeed, facial attributes associated with tiredness (i.e., eyelid openness and mouth curvature) have been associated with perceptions of intelligence (Talamas, Mavor, Axelsson, et al., 2016). Pupil size has also been associated with intelligence, as it is thought to reflect internal mental processes (Tsukahara, Harrison, & Engle, 2016).

Regardless of the underlying mechanism, here we attempt to identify morphological cues that individuals use to make intelligence judgements based on facial information. In a large ($N = 1660$), genetically informative sample, identical and non-identical twins and their sibling had their facial photographs rated on perceived intelligence and IQ measured. If observers are able to judge intelligence accurately, we should find an association between perceived intelligence and IQ. If such a correlation exists, we will test whether various facial attributes mediate this relationship, including stable morphological facial attributes, such as face height, interpupillary distance and nose size (Kleisner et al., 2014), more transitory cues, such as eyelid openness and mouth curvature (Talamas, Mavor, Axelsson, et al., 2016), as well as predicted IQ based on overall face shape. We will also test whether perceived intelligence shares a genetic component with IQ.

2. Method

2.1. Participants

Participants were 1660 individual twins and their siblings from 833 families who took part in either the Brisbane Adolescent Twin Studies (BATS; Wright & Martin, 2004) or the Boulder Longitudinal Twin Study (LTS; Rhea, Gross, Haberstick, & Corley, 2013). Twins from the BATS ($N = 1173$) had photographs taken as close as possible to their 16th birthday ($M = 16.03$ years, $SD = 0.46$ years) while their siblings ($N = 105$) had photographs taken close to their 18th birthday ($M = 17.81$ years, $SD = 1.08$ years). Twins from the LTS ($N = 382$) were older than those from the BATS when facial photographs were taken ($M = 22.21$ years, $SD = 1.29$ years).

2.2. Photographs

For twins who were part of the BATS, photographs were taken between the years 1996 and 2010. For the earliest waves of data collection, photographs were taken using film cameras and then later scanned into a digital format. For later waves, photographs were taken using digital cameras. For twins from the LTS, digital photographs were taken between 2001 and 2010. Participants from the LTS were asked to adopt a neutral facial expression, while no instructions were given to participants from the BATS. All photographs were taken under standard indoor lighting conditions.

These photographs were rated on a number of traits, such as facial attractiveness, facial masculinity, and trustworthiness. For the analyses presented here, we focus on ratings of perceived intelligence (for more detail on the rating process, see Mitchem et al., 2015). For perceived intelligence, photographs were presented in a random order to one of two groups of undergraduate research assistants (21 in total; 12 Females, 9 Males; 19–30 years, median = 22 years). The two groups were based on availability as ratings were collected over multiple academic semesters. Ratings were made on a 7-point scale (1 = low in a trait, 7 = high in a trait). Mean perceived intelligence ratings between male and female raters were positively correlated ($r = 0.41$, $p < 0.001$); therefore, ratings from male and female raters were combined for further analyses. Cronbach's alpha between raters who rated the same faces was 0.60 for group 1 (7 raters) and 0.82 for group 2 (14 raters), while the intra-class correlation (i.e., the proportion of total variance in ratings that is between-faces compared to within) across all perceived intelligence ratings was 0.19.

2.3. Facial metrics

In order to calculate the various facial metrics scores, we used the coordinates of 31 landmarks that were placed on each facial photograph. Two research assistants who did not give trait ratings identified 31 landmarks on each face (see Fig. 1. for the locations of the landmarks). These research assistants were trained on the anatomical location of the landmarks for several sessions. The coordinate for each landmark was then calculated as the mean pixel location of the two raters.

We note that these photographs of participants were not originally taken for shape analysis. As such, the photographs vary in ways that could alter shape information not to do with anatomical shape (e.g., the participant's head angle facing the camera, or the participant's facial expression). Photographs were rotated to be upright prior to being rated, and overly askew faces were removed from analysis.

To calculate facial metrics, we used concepts from geometric morphometrics, which is the statistical analysis of shape (Zelditch, Swiderski, Sheets, & Fink, 2004). This was done by first running a Generalised Procrustes Analysis (GPA) to standardise the landmark coordinates and remove translation, rotation, and scale effects, essentially leaving only shape information. Two types of facial metrics were