Culturally learned first impressions occur rapidly and automatically and emerge early in development.

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The data that support the findings of this study are openly available at Open Science Framework (https://osf.io/hkpsa/?view_only=a017f3c67ce845fda31836bc375b78ee).

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Research highlights

- Adults estimate that individuals who wear glasses are more intelligent.
- These first impressions from glasses occur rapidly and automatically.
- By the age of 6, but not 4, children also infer that individuals who wear glasses are more intelligent.
- Thus, automaticity, rapid access, and early emergence are not evidence that first impressions have an innate origin.

Abstract

Previous research indicates that first impressions from faces are the products of automatic and rapid processing and emerge early in development. These features have been taken as evidence that first impressions have a phylogenetic origin. We examine whether first impressions acquired through learning can also possess these features. First, we confirm that adults rate a person as more intelligent when they are wearing glasses (Study 1). Next, we show this inference persists when participants are instructed to ignore the glasses (Study 2) and when viewing time is restricted to 100 milliseconds (Study 3). Finally, we show that six-year-old, but not 4-year-old, children perceive individuals wearing glasses to be more intelligent, indicating that the effect is seen relatively early in development (Study 4). These data indicate that automaticity, rapid access, and early emergence are not evidence that first impressions have an innate origin. Rather, these features are equally compatible with a learning model.

Keywords:

First Impressions; Faces; Cultural Learning; Intelligence; Trait Inference Mapping

Introduction

Adults spontaneously attribute a wide range of traits to strangers based solely on their facial features. These 'first impressions' include judgements about trustworthiness, honesty, competence, intelligence, aggression, and likeability (Oosterhof & Todorov, 2008; Sutherland et al., 2013; Todorov, Olivola, Dotsch, & Mende-Siedlecki, 2015). These first impressions appear to exert a powerful influence over behaviour. For example, individuals who look competent are more likely to be elected to public office (Ballew & Todorov, 2007; Todorov et al., 2015). Individuals who appear untrustworthy are less likely to be offered positions in interview settings (Olivola, Eubanks, & Lovelace, 2014) and are more likely to face harsh sentences in criminal justice situations (Wilson & Rule, 2015). Interestingly, while some of these first impressions may contain a 'kernel of truth' (Bonnefon, Hopfensitz, & De Neys, 2017), others bear little resemblance to the actual personalities of the individuals being judged (Rule, Krendl, Ivcevic, & Ambady, 2013).

Despite their pervasive influence, it is unclear where these first impressions come from. One possibility is that spontaneous trait inferences from faces are the product of an innately specified mechanism. Natural selection may have favoured such a mechanism because it enabled our ancestors to quickly detect potential cooperative partners and potential leaders (Schaller, 2008; Van Vugt & Grabo, 2015; Zebrowitz & Zhang, 2009).

Alternatively, first impressions may arise chiefly through learning. According to the Trait Inference Mapping (TIM) framework (Over & Cook, 2018; Over, Eggleston, & Cook, 2020), first impressions are the result of mappings between points in face-space and trait-space, acquired ontogenetically as a product of correlated face-trait experience. Once acquired, these mappings allow excitation to spread automatically from face representations to trait representations. While some face-trait mappings may be acquired through direct experience with individuals, TIM proposes a central role for cultural learning. Cultural devices such as storybooks, films, television, literature, propaganda, art and iconography, pair particular facial features (e.g., big nose, crooked teeth, pallid complexion) with particular character traits (e.g., evil disposition). By providing a common source of correlated face-trait experience, these devices allow face-trait stereotypes to spread throughout a community.

It has been argued that evidence from three sources broadly favours a nativist view of first impressions, over the learning account. Firstly, spontaneous trait inferences show high-levels of consistency within Western observers, and similar first impressions have been documented in other cultures including China (Sutherland et al., 2018; Zebrowitz et al., 2012). Secondly, traits are inferred quickly and automatically, seemingly with minimal cognitive effort. Adults form consistent first impressions from faces even when those faces are presented for as little as 100 milliseconds (Bar, Neta, & Linz, 2006; Todorov, Pakrashi, & Oosterhof, 2009; Willis & Todorov, 2006). This is the profile one might expect of a mechanism favoured by natural selection; for example, if someone has aggressive or nefarious intentions, it serves an organism to detect those intentions quickly (Schaller, 2008). Finally, proponents of the nativist view point to the fact that first impressions emerge early in development (Cogsdill, Todorov, Spelke, & Banaji, 2014; Ewing, Sutherland, & Willis, 2019; Jessen & Grossmann, 2017). For example, developmental research has demonstrated adult-like levels of consensus in first impressions of trustworthiness/niceness, dominance/strength and competence/intelligence in Western children by at least 5 years of age (Charlesworth, Tiarra, Hudson, & Banaji, 2019). This has led authors to the conclusion that "extended cultural learning is not necessary for adult-like appearance biases to emerge" and that findings are "more consistent with evolutionary-based accounts." (Ewing, Sutherland & Willis, 2019)

We contend that the foregoing findings, while often cited as evidence in favour of the nativist view, are in fact equally compatible with the cultural learning account (TIM; Over & Cook, 2018; Over, Eggleston, & Cook, in press). For example, exposure to correlated face-trait experience through cultural devices (e.g., story books, films, TV) may cause face-trait inferences to manifest consistently both within and between cultures. Similarly, it is known that learned behaviours can become rapid and automatic (e.g., Stroop, 1935), and can appear even in infancy (Kinzler, Dupoux, & Spelke, 2007; Moon, Cooper, & Fifer, 1993).

In the present paper, we describe a series of experiments that sought to test directly whether first impressions that are acquired through experience: 1) can manifest consistently within adults; 2) can occur automatically, i.e., involuntarily; 3) can be seen following brief stimulus exposure; and 4) can be observed early in development. To test these hypotheses, we took advantage of the fact that participants' first impressions of a stranger's intelligence are sometimes influenced by whether or not the stranger is wearing glasses. The earliest known glasses date from 1286 (Ilardi, 2007). Because glasses are a product of recent human history, it is indisputable that, where observed, the inference of intelligence from glasses must be acquired through experience (Over & Cook, 2018). The data for all studies are available at the OSF (https://osf.io/hkpsa/?view_only=a017f3c67ce845fda31836bc375b78ee)

Study 1

In Study 1, we sought to replicate previous findings from cultures such as the US (Fleischmann, Lammers, Stoker, & Garretsen, 2019) and Scandinavia (Hellström & Tekle, 1994) that individuals wearing glasses are judged more intelligent.

Methods

Participants

Forty participants were recruited via the online platform Prolific (www.prolific.ac.uk). Sample size was decided in advance, and pre-registered, based on previous research in this area. All participants reported English as their first language. No-one was excluded from analyses. One participant was excluded because they selected the same rating on 100% of trials (per the exclusion criteria pre-registered via ASPredicted) leaving 39 for analyses (M_{age} = 32.51, SD_{age}

= 13.59; 16 female, 22 male, 1 non-binary). Of the 39 participants included in the analyses, 37 identified as White and 2 as Multiracial. All participants received a monetary compensation of £1.30 for approximately 10 minutes participation.

Materials and procedure

Twenty four images of Caucasian faces (12 Female) were taken from the Chicago Face Database (Ma, Correll, & Wittenbrink, 2015)**.** This particular database was selected as it is able to provide full colour face images of neutral expression under standardised photographic conditions, including consistent lighting, clothing and position. Glasses were added to these stimuli using Adobe Photoshop. This resulted in 48 (24 altered, 24 unaltered) images that were combined to create two counterbalancing conditions (Figure 1). Participants were assigned to one of these two conditions so that the faces wearing glass in condition A were not wearing glasses in condition B and *vice versa*. The order in which the faces were presented was randomised for each participant.

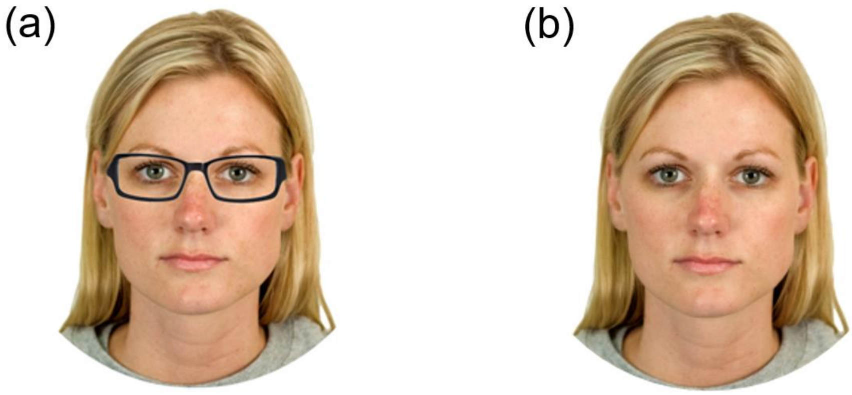

Figure 1. Example stimulus from studies 1-3, shown with (a) and without (b) glasses.

Ratings of intelligence were gathered using an online survey designed in Qualtrics (http://qualtrics.com). Participants were informed that they would complete a study investigating how people form first impressions of others. They were the told that their task was to view photographs of people and rate how intelligent they appeared. On each trial, participants were shown a face and asked "How intelligent do you think this person is?" The task was self-paced: participants gave their responses on a 9-point Likert Scale with each face remaining on the screen until participants clicked a continuation arrow to proceed to the next trial. At the end of the procedure, participants were asked to complete a short demographic questionnaire recording gender, ethnicity, age and whether or not they had a prescription for glasses. After participants had completed all parts of the questionnaire they were thanked and debriefed.

Results

Following our pre-registered analysis plan (https://aspredicted.org/nu6fg.pdf), ratings of intelligence (Figure 2a) were analysed using a Mixed ANOVA with Face Type (glass, no glasses) as a within-subjects factor, and Counterbalancing Condition (set A, set B) as a between-subjects factor. The analysis revealed a significant main effect of face type [$F(1,37) = 93.08$, $p < .001$, $\eta p^2 = .72$], whereby glasses wearers ($M = 6.31$, $SD = 0.74$) were rated as more intelligent than those without glasses ($M = 5.12$, $SD = 0.82$). There was no main effect of Counterbalancing Condition [$F(1,37) = .05$, $p = .819$, $\eta p^2 = .001$], nor did we observe an interaction between Counterbalancing Conditions and Face Type [$F(1,37) = .07$, $p = .793$, $\eta p^2 = .002$]. All *p*-values described throughout are two-tailed.

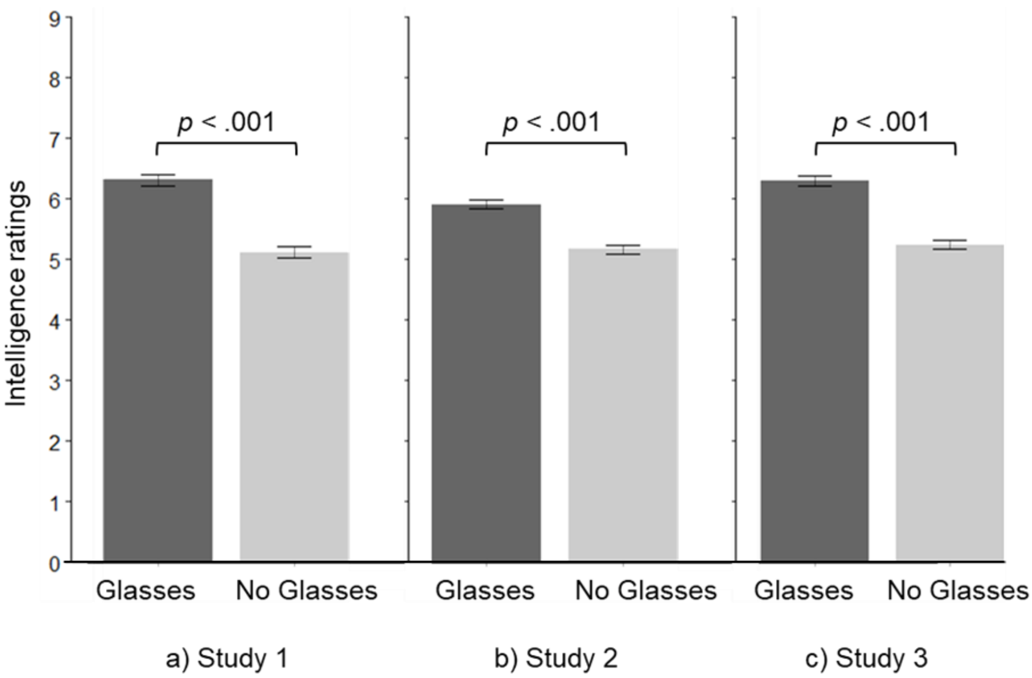

Figure 2. Mean (±SEM) intelligence ratings Studies 1-3.

Study 2

In Study 2, we tested whether first impressions of intelligence are inferred automatically from the presence of glasses. If the inference of intelligence is automatic, the glasses effect should still be seen when participants are explicitly instructed to ignore the glasses and base their judgements only on physical facial cues (Alguacil, Tudela, & Ruz, 2015; De Gelder & Vroomen, 2000; Mileva, Tompkinson, Watt, & Burton, 2017).

Methods

Participants

A further forty participants were recruited via www.prolific.co.uk following our pre-registered plan (M_{age} = 34.93, SD_{age} = 9.97; 27 female, 12 male, 1 non-binary). Thirty-seven identified as White, 1 as Asian, 1 as Black, and 1 as "Other". No participants were excluded from analysis.

*Materials and procedure*Participants were given the following instructions before starting the trials; "You are going to see a series of photographs of different people. Some of the individuals depicted will be wearing glasses and some will not. Glasses can make people look more intelligent. We want you to focus only on the structure of the face. Please <u>ignore</u> the glasses." Where trials presented a target face wearing glasses, participants also received the following reminder: "Remember: Ignore the glasses." As a check to see if participants had been paying attention throughout a final question was added asking "What feature were you asked to ignore?" Participants could respond by typing their answer (all but one participant correctly identified glasses as the cue they were supposed to ignore). With the exception of the instruction to ignore the glasses, the procedure was identical to that of Study 1.

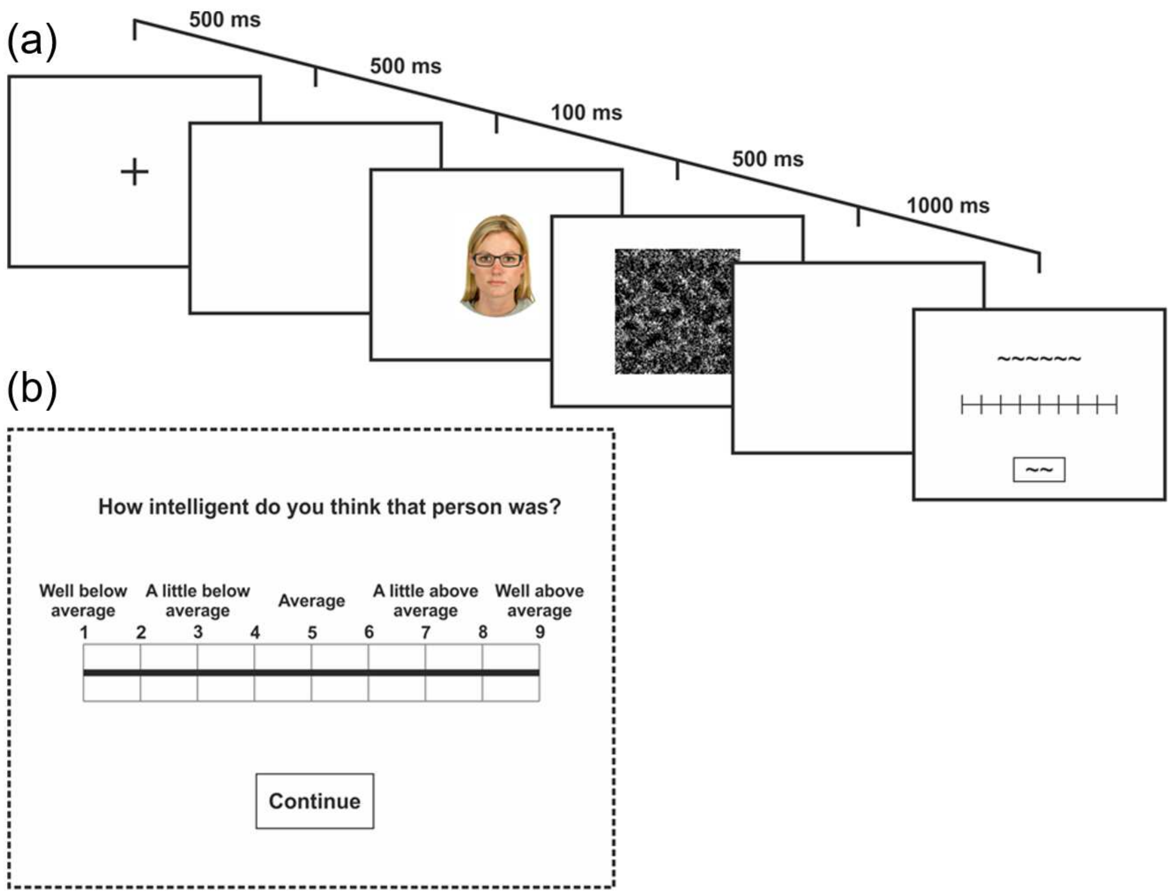

Figure 3. Trial structure in Study 3. (a) Schematic representation of a trial, (b) the rating screen.

Results

Following our pre-registered analysis plan (https://aspredicted.org/3ty5e.pdf), ratings of intelligence (Figure 2b) were analysed using ANOVA with Face Type (glass, no glasses) as a within-subjects factor, and Counterbalancing Condition (set A, set B) as a between-subjects factor. The analysis revealed a significant main effect of Face Type [$F(1,38) = 61.73$, $p < .001$, $\eta p^2 = .62$], whereby glasses wearers ($M = 5.91$, $SD = 0.57$) were rated as more intelligent than those without glasses ($M = 5.17$, $SD = 0.69$). There was no main effect of Counterbalancing Condition [$F(1,38) = .02$, $p = .892$, $\eta p^2 = < .001$], nor did we observe an interaction between Counterbalancing Conditions and Face Type [$F(1,38) = .95$, $p = .336$, $\eta p^2 = .02$].

Study 3

In our first two studies, we replicated the glasses effect (Study 1), and found that the effect is seen despite explicit instructions to ignore the glasses (Study 2). In both studies, the task completed by participants was self-paced; i.e., participants were free to inspect target faces for as long as they wished. In Study 3, we sought to determine whether the glasses effect would be seen when stimulus presentation was limited to 100ms. Whereas the first two studies were conducted online, Study 3 was conducted in the lab.

Methods

Participants

Forty participants were recruited from the University of York, Department of Psychology subject pool (M_{age} = 20.39, SD_{age} = 4.72; 34 female, 6 male). Sample size was decided in advance, based on the results of the first two studies. One participant declined to specify their age. Thirty-two participants identified as White, 2 as Multiracial, 1 as Indian, 4 as British (not otherwise specified) and 1 preferred not to say. Participants received course credit or a small honorarium for taking part.

Materials and procedure

At the start of each trial, a fixation cross appeared in the centre of the screen for 500 ms followed by 500 ms of blank screen. A target face then appeared for 100 ms before being masked for 500ms (Figure 3a). The rating screen appeared after 1000 ms of blank screen. Participants then rated the face for intelligence on a 9-point Likert scale (Figure 3b) using the mouse. The stimuli used in Study 3 were the same as those used in Studies 1 and 2. Faces were presented on a white background with 28mm distance between pupils. The square mask had sides of ~147mm.

Before completing the main experiment, participants first completed 4 practise trials. Participants then completed 24 experimental trials in a single block. Before the practice block participants were given on-screen instructions stating that they would see people presented for a very short period of time and that they would then rate how intelligent they thought the presented people were. Additionally, they were told that they should make their decisions as quickly as possible. At the end of the experiment participants completed a short questionnaire (age, gender, ethnicity, first language and glasses prescription).

The task was completed in a dimly-lit room on a Dell (Round Rock, USA) XPS PC (Intel Core 133 i5-4430, 3 GHz CPU, 12 GB RAM, 64 bit Windows 10 Enterprise), with a 23" LCD monitor (Iiyama (Tokyo, Japan) ProLite T2735MSC-B2, 1920×1080 pixels). Viewing distance was approximately 50 cm distance. Stimulus presentation (60Hz) and response recording were achieved using custom scripts and Psychtoolbox 3.0.11 (Brainard, 1997; Kleiner, Brainard, & Pelli, 2007; Pelli, 1997) operating within Matlab R2018a (The MathWorks Inc., Natick, USA).

Results

Following our pre-registered analysis plan (https://aspredicted.org/zg4wd.pdf), ratings of intelligence (Figure 2c) were analysed using ANOVA with Face Type (glass, no glasses) as a within-subjects factor, and Counterbalancing Condition (set A, set B) as a between-subjects factor. The analysis revealed a significant main effect of Face Type [$F(1,38) = 88.81$, $p < .001$, $\eta p^2 = .70$], whereby glasses wearers ($M = 6.30$, $SD = 0.64$) were rated as more intelligent than those without glasses ($M = 5.25$, $SD = 0.73$). There was no main effect of Counterbalancing Condition [$F(1,38) = .69$, $p = .412$, $\eta p^2 = .02$], nor did we observe an interaction between Counterbalancing Conditions and Face Type [$F(1,38) = .18$, $p = .670$, $\eta p^2 = .01$].

Study 4

Previous research has demonstrated adult-like levels of consensus in first impressions of trustworthiness (niceness), dominance (strength), and competence (intelligence) in Western children of ~5 years of age (Charlesworth et al., 2019; Cogsdill et al., 2014; Ewing et al., 2019) In Study 4, we sought to determine whether inferences of intelligence from glasses emerges at a similar point in development. We chose to test 4- and 6-year-olds because these age groups have been studied in previous research (Cogsdill et al., 2014) and research suggests that children's understanding of specific traits such as a person's intelligence or knowledge develops significantly across this age range (Brosseau-Liard & Birch, 2010; Lane, Wellman, & Gelman, 2013).

Method

Participants

Thirty-two 4-year-olds (16 boys, M_{age} = 53 months; age range = 48 to 59 months) and 32 6-year-olds (16 boys, M_{age}: 78 months; age range = 73 to 83 months) participated in this study. Sample size was decided in advance and is typical for research in this area (Caulfield, Ewing, Bank, & Rhodes, 2016; Ewing, Caulfield, Read, & Rhodes, 2015; Mondloch, Gerada, Proietti, & Nelson, 2019; Palmquist, Cheries, & DeAngelis, 2019). All 64 families who participated identified as White British in ethnicity. All children were recruited from a science museum in an urban centre and were tested on site the same day.

Materials and procedure

The stimuli in this study were again taken from the Chicago Face Database (Ma et al., 2015). Having selected 50 faces from the database (25 white female, 25 white male), we ran a pre-test in which we asked 20 undergraduate participants (from the Department of Psychology at the University of York) to rate the perceived intelligence of each. Ratings were taken on a scale that ranged between "0 (Not at all clever)" to "100 (Very clever)". Participants received course credit in return for their participation.

The pre-test ratings were used to create 24 pairs of faces. The ratings for each pair can be found at the OSF. Twelve pairs of faces (6 male pairs, 6 female pairs) were chosen because adults judged them be closely matched in terms of their perceived intelligence (Figure 4a). These pairs were used to assess whether children infer intelligence from glasses. Differences in adults' ratings of the perceived intelligence of the chosen face pairs without glasses ranged from .10 and 3.15 (M=1.55, SD = 1.01). Glasses were superimposed on the faces using Adobe

Photoshop. We counterbalanced which face was shown wearing glasses. The remaining 12 pairs (6 male pairs, 6 female pairs) were chosen because adults consistently judged one of them be more intelligence than the other (Figure 4b). These pairs were used to assess whether children infer intelligence from the physical cues present in faces alone. Difference in adults' ratings of intelligence between individuals within each pair of faces used on the physical trials ranged between 4.55 and 26.30 (M=13.67, SD = 5.60) . A book was created featuring the 24 to-be-judged pairs. The pairs were presented in a fixed order chosen at random before testing. High-intelligent and glasses wearing faces represented the target faces and were presented equally often on the left and right side.

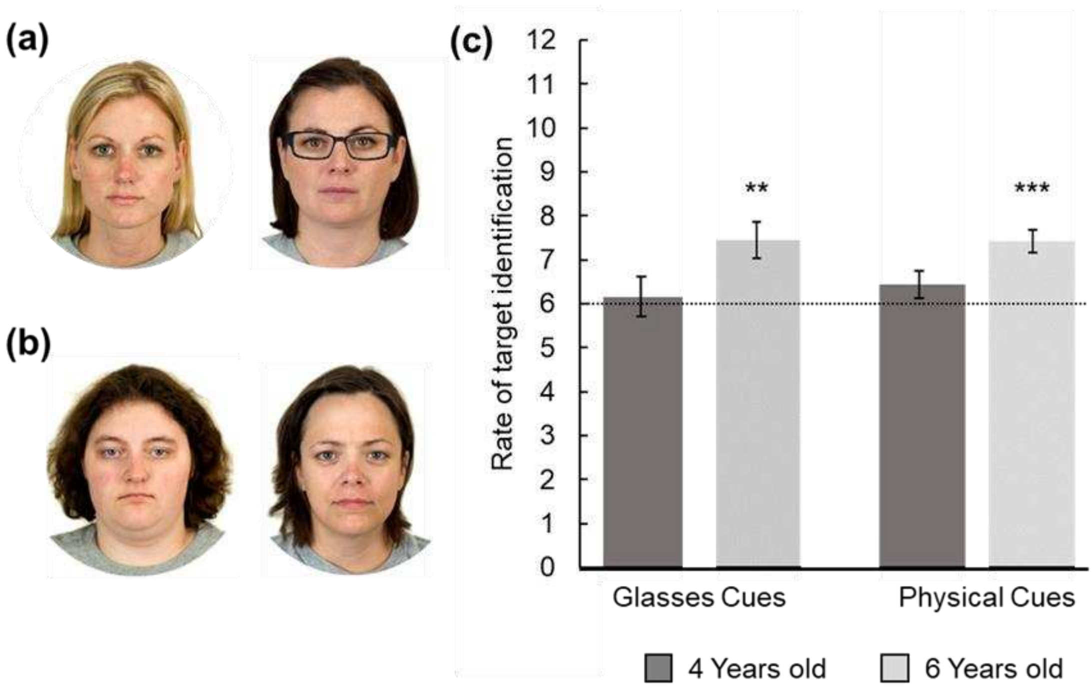

Figure 4. Stimuli and results from Study 4. (a) Example pair from the glasses task. (b) Example pair from the physical cues task. (c) Mean (±SEM) rate of correctly identifying the target face for the 4 and 6 year old children in the glasses and physical cues tasks. Dashed line indicates chance performance. Asterisks represent a result significantly different from chance. ** denotes $p < .01$; *** denotes $p < .001$.

Each participant was invited into the testing area and asked to sit at a small table. After a brief warm up, the experimenter tested the child's understanding of the term 'clever' by saying: "Now I am going to tell you about two different children and I would like you to tell me which child you think is the more clever, okay? This child got all their answers right on their homework and the teacher said it was really good work. This child got only a few answers right on their homework and the teacher said it wasn't good work at all. Who do you think is more clever, this child who did all their homework or this child who did half the homework?" All 64 children correctly identified the child who "got all their answers right on their homework" as the more clever. Children in both age groups therefore appear to understand the concept of relative intelligence as operationalized in the present task.

Children were then introduced to the first of the 24 face pairings by the experimenter as follows: "Now we are going to look at some pictures of different people. I would like you to tell me which person you think is more clever, okay? Take a look at these two people, which person do you think is more clever - this person or this person?" [Pointing to each picture in turn, left to right]. All remaining trials were identical except that the experimenter only pointed to the two faces in turn as a prompt if children showed hesitancy.

Coding

Children's responses were coded from the video. On the rare occasions when a child changed their response, their last response was coded. For each trial type (physical cues, glasses cues), participants were given a score out of 12 for the number of times they chose the individual in glasses or the individual previously rated by adults as more intelligent.

All videos were coded desperately by the experimenter and a rater naïve to the hypotheses of the study. There was perfect agreement between the two coder's judgements, $\kappa = 1$, $p < .001$.

Results

First, we sought to determine whether the children's identification of the target face exceeded chance levels when inferring intelligence from glasses and physical cues (Figure 4c). To this end, we conducted one-sample *t*-tests evaluating the number of times children correctly chose the target face, against a chance level of 50% (i.e., a score of 6 out of 12). In the glasses condition, the rate of target identification exhibited by the six-year-olds (M = 7.41, SD = 2.33) was significantly greater than chance [$t(31)$ = 3.42, p = .002, Cohen's d = .61]. However, the rate of target identification exhibited by the four-year-olds (M = 6.13, SD = 2.50) did not exceed chance [$t(31)$ = .283, p = .779, Cohen's d = .05]. A very similar pattern emerged with children's judgements of physical cues to intelligence. Once again, the rate of target identification exhibited by the six-year-olds (M = 7.38, SD = 1.48) exceeded chance [$t(31)$ = 5.27, p = <.001, Cohen's d = .93], whereas the rate of target of identification exhibited by the four-year-olds did not (M = 6.41, SD = 1.76) [$t(31)$ = 1.31, p = .201, Cohen's d = .23].

Next, we analysed the number of times the target faces were chosen using ANOVA with Cue Type (glasses cues, physical cues) as a within-subjects factor, and Age (4-year-olds, 6-year-olds) as a between-subjects factor. The analysis revealed a main effect of Age, with 6-year-olds choosing the target faces more often than did 4-year-olds [$F(1,62)$ = 8.73, p = .004, partial η^2 =.12]. However, there was no main effect of Cue Type [$F(1,62)$ = 0.13, p = .719, partial η^2 =.002] and no interaction between Age and Cue Type [$F(1,62)$ = 0.21, p = .653, partial η^2 =.003]. These results indicate that older children were more likely to identify the target faces than younger children, but that the developmental pattern was broadly similar for physical and cultural cues to intelligence.

The finding that four-year-olds do not show significant sensitivity to either cultural or physical cues to intelligence seems inconsistent with previous findings which report adult-like consistency in trait judgements of competence by this age (Charlesworth, Hudson, Cogsdill, Spelke, & Banaji, 2019; Cogsdill et al., 2014). This may be because previous developmental work has used computer generated stimuli whereas we used photographs of real people perhaps making the task more challenging.

General Discussion

We began our investigation by confirming that adults attribute intelligence to individuals who wear glasses (Study 1). We went on to extend the basic glasses effect by demonstrating that the inference of intelligence is seen despite explicit instructions to ignore the glasses cue, suggestive of automaticity (Study 2), and is evident following even very brief (100 ms) stimulus presentation (Study 3). Finally, we tested young children's propensity to infer intelligence from the presence of glasses and physical facial cues and found that, whereas six-year-olds use both glasses and physical cues, four-year-olds do not use either type of cue (Study 4).

Consistent impressions of trustworthiness and dominance appear to be automatic and rapid (Bar et al., 2006; Todorov et al., 2009; Willis & Todorov, 2006), and emerge early in development (Charlesworth, Tiarra, Hudson, & Banaji, 2019; Cogdill, 2014; Ewing, 2019). These findings have been cited as evidence that spontaneous trait inferences have an innate origin (Zebrowitz & Zhang, 2009). However, the present results demonstrate that the logic of this argument is flawed. Critically, the inference of intelligence from glasses – an effect that must emerge from learning – is automatic and rapid, and also emerges relatively early in development. Our results demonstrate that findings previously thought to support nativist accounts of the origins of first impressions are equally compatible with a learning-based account (Over & Cook, 2018).

The results described here accord with findings in other areas of cognition showing that learned skills, such as reading can become fast and automatic with sufficient experience (Heyes, 2018; Stroop, 1935). They are also compatible with research from developmental psychology demonstrating that learned preferences can appear early in development. For example, even infants prefer speakers of their native language to speakers of a foreign language (Kinzler et al., 2007).

What evidence remains for nativist accounts of first impressions? One possible source of evidence is data suggesting that even 6-to-8-month-old infants prefer to look at faces previously rated by adults as trustworthy (Jessen & Grossmann, 2016; Sakuta, Kanazawa, & Yamaguchi, 2018). Convincing evidence that infants under the age of one-year-old form spontaneous first impressions would support a poverty of the stimulus argument for at least first impressions of trustworthiness. However, these infant studies systematically confound the to-be-inferred trait with facial emotion; the faces described as "trustworthy" appear to be smiling whereas the faces deemed "untrustworthy" do not (Over & Cook, 2018). In the absence of evidence to the contrary, it is more likely that the orienting behaviours observed in infants in these studies are a response to the perceived emotional *states* of the actors shown, and have little to do with their perceived character *traits*.

Other evidence supports the claim that first impressions are culturally learned. For example, recent work has demonstrated the ability for individuals to update implicit and explicit judgements of trustworthiness by learning new behavioural information about a target (Shen, Mann, & Ferguson, 2020). Cross-cultural work has further supported a large role of learning, demonstrating that first impressions of trustworthiness, dominance, and other character traits are highly culturally variable (Over et al., 2020). Furthermore, there is considerable variation within cultures depending on individuals' learning experiences. For example, on encountering faces that vary in ethnicity, some individuals form strong first impressions of differing trustworthiness, while others do not (Devine, 1989). This extensive variability is difficult to reconcile with nativist accounts (Over et al., 2020).

Overall, findings that may initially appear to favour a nativist account of first impressions are, in reality, equally compatible with a learning account. On balance, we argue that the available evidence favours the view that first impressions from faces are acquired through experience. If correct, this conclusion has important applied implications. If first impressions are shaped by cultural learning, then changes to cultural products can alter the types of first impressions individuals form. In other words, it may be possible to mitigate widely held but deleterious societal beliefs through modifying the available cultural input.

References

Alguacil, S., Tudela, P., & Ruz, M. (2015). Ignoring facial emotion expressions does not eliminate their influence on cooperation decisions. *Psicologica*, *36*(2), 309–335.

Ballew, C. C., & Todorov, A. (2007). Predicting political elections from rapid and unreflective face judgments. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(46), 17948–17953. https://doi.org/10.1073/pnas.0705435104

Bar, M., Neta, M., & Linz, H. (2006). Very first impressions. *Emotion*, *6*(2), 269–278. https://doi.org/10.1037/1528-3542.6.2.269

Bonnefon, J.-F., Hopfensitz, A., & De Neys, W. (2017). Can We Detect Cooperators by Looking at Their Face? *Current Directions in Psychological Science*, *26*(3), 276–281. https://doi.org/10.1177/0963721417693352

Brainard, D. H. (1997). The Psychophysics Toolbox. *Spatial Vision*, *10*, 433–436.

Brosseau-Liard, P. E., & Birch, S. A. J. (2010). "I bet you know more and are nicer too!": What children infer from others' accuracy. *Developmental Science*. https://doi.org/10.1111/j.1467-7687.2009.00932.x

Caulfield, F., Ewing, L., Bank, S., & Rhodes, G. (2016). Judging trustworthiness from faces: Emotion cues modulate trustworthiness judgments in young children. *British Journal of Psychology*, *107*(3), 503–518. https://doi.org/10.1111/bjop.12156

Charlesworth, T., Tiarra, S.-K., Hudson, J., & Banaji, M. (2019). *Children Use Targets' Facial Appearance to Guide and Predict Social Behavior*. https://doi.org/10.1037/dev0000734

Cogsdill, E. J., Todorov, A. T., Spelke, E. S., & Banaji, M. R. (2014). Inferring Character From Faces: A Developmental Study. *Psychological Science*, *25*(5), 1132–1139. https://doi.org/10.1177/0956797614523297

De Gelder, B., & Vroomen, J. (2000). The perception of emotions by ear and by eye. *Cognition and Emotion*, *14*(3), 289–311. https://doi.org/10.1080/026999300378824

Devine, P. G. (1989). Stereotypes and prejudice: Their automatic and controlled components. *Journal of Personality and Social Psychology*, *56*(1), 5.

Ewing, L., Caulfield, F., Read, A., & Rhodes, G. (2015). Perceived trustworthiness of faces drives trust behaviour in children. *Developmental Science*, *18*(2), 327–334.

Ewing, L., Sutherland, C. A. M., & Willis, M. L. (2019). Children show adult-like facial appearance biases when trusting others. *Developmental Psychology*, *55*(8), 1694–1701. https://doi.org/10.1037/dev0000747

Fleischmann, A., Lammers, J., Stoker, J. I., & Garretsen, H. (2019). You Can Leave Your Glasses on: Glasses Can Increase Electoral Success. *Social Psychology*, *50*(1), 38–52. https://doi.org/10.1027/1864-9335/a000359

Hellström, Å., & Tekle, J. (1994). Person perception through facial photographs: Effects of glasses, hair, and beard on judgments of occupation and personal qualities. *European Journal of Social Psychology*, *24*(6), 693–705.

Heyes, C. (2018). Cognitive gadgets: The cultural evolution of thinking. In *Harvard University Press*. https://doi.org/10.4159/9780674985155

Ilardi, V. (2007). Renaissance Vision from Spectacles to Telescopes. *American Philosophical Society*, *259*.

Jessen, S., & Grossmann, T. (2016). Neural and Behavioral Evidence for Infants' Sensitivity to the Trustworthiness of Faces. *Journal of Cognitive Neuroscience*, *28*(11), 1728–1736. https://doi.org/10.1162/jocn_a_00999

Jessen, S., & Grossmann, T. (2017). Neural evidence for the subliminal processing of facial trustworthiness in infancy. *Neuropsychologia*, 1–8. https://doi.org/10.1016/j.neuropsychologia.2017.04.025

Kinzler, K. D., Dupoux, E., & Spelke, E. S. (2007). The native language of social cognition. *Proceedings of the National Academy of Sciences of the United States of America*, *104*(30), 12577–12580. https://doi.org/10.1073/pnas.0705345104

Kleiner, M., Brainard, D. H., & Pelli, D. (2007). What's new in Psychtoolbox-3? *Perception*, *36*(ECVP Abstract Supplement).

Lane, J. D., Wellman, H. M., & Gelman, S. A. (2013). Informants' traits weigh heavily in young children's trust in testimony and in their epistemic inferences. *Child Development*. https://doi.org/10.1111/cdev.12029

Ma, D. S., Correll, J., & Wittenbrink, B. (2015). The Chicago face database: A free stimulus set of faces and norming data. *Behavior Research Methods*, *47*(4), 1122–1135. https://doi.org/10.3758/s13428-014-0532-5

Mileva, M., Tompkinson, J., Watt, D., & Burton, A. M. (2017). Audiovisual Integration in Social Evaluation. *Journal of Experimental Psychology: Human Perception and Performance*. https://doi.org/10.1037/xhp0000439

Mondloch, C. J., Gerada, A., Proietti, V., & Nelson, N. L. (2019). The influence of subtle facial expressions on children's first impressions of trustworthiness and dominance is not adult-like. *Journal of Experimental Child Psychology*, *180*, 19–38. https://doi.org/10.1016/J.JECP.2018.12.002

Moon, C., Cooper, R. P., & Fifer, W. P. (1993). Two-day-olds prefer their native language. *Infant Behavior and Development*, *16*(4), 495–500. https://doi.org/10.1016/0163-6383(93)80007-U

Olivola, C. Y., Eubanks, D. L., & Lovelace, J. B. (2014). The many (distinctive) faces of leadership: Inferring leadership domain from facial appearance. *Leadership Quarterly*. https://doi.org/10.1016/j.leaqua.2014.06.002

Oosterhof, N. N., & Todorov, A. (2008). The functional basis of face evaluation. *Proceedings of the National Academy of Sciences*, *105*(32), 11087–11092.

Over, H., & Cook, R. (2018). Where do spontaneous first impressions of faces come from?

Cognition. https://doi.org/10.1016/j.cognition.2017.10.002

Over, H., Eggleston, A., & Cook, R. (2020). Ritual and the origins of first impressions. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *375*(1805), 20190435. https://doi.org/10.1098/rstb.2019.0435

Palmquist, C. M., Cheries, E. W., & DeAngelis, E. R. (2019). Looking smart: Preschoolers' judgements about knowledge based on facial appearance. *British Journal of Developmental Psychology*. https://doi.org/10.1111/bjdp.12303

Pelli, D. G. (1997). The VideoToolbox software for visual psychophysics: transforming numbers into movies. *Spatial Vision*, Vol. 10, pp. 437–442. https://doi.org/10.1163/156856897X00366

Rule, N. O., Krendl, A. C., Ivcevic, Z., & Ambady, N. (2013). Accuracy and consensus in judgments of trustworthiness from faces: Behavioral and neural correlates. *Journal of Personality and Social Psychology*, *104*(3), 409–426. https://doi.org/10.1037/a0031050

Sakuta, Y., Kanazawa, S., & Yamaguchi, M. K. (2018). Infants prefer a trustworthy person: An early sign of social cognition in infants. *PLOS ONE*, *13*(9), e0203541. https://doi.org/10.1371/journal.pone.0203541

Schaller, M. (2008). Evolutionary bases of first impressions. In *First Impressions* (pp. 15–34).

Shen, X., Mann, T. C., & Ferguson, M. J. (2020). Beware a dishonest face?: Updating face-based implicit impressions using diagnostic behavioral information. *Journal of Experimental Social Psychology*, *86*. https://doi.org/10.1016/j.jesp.2019.103888

Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, *18*(6), 643–662. https://doi.org/10.1037/h0054651

Sutherland, C. A. M., Liu, X., Zhang, L., Chu, Y., Oldmeadow, J. A., & Young, A. W. (2018). Facial First Impressions Across Culture: Data-Driven Modeling of Chinese and British Perceivers' Unconstrained Facial Impressions. *Personality and Social Psychology*

Bulletin, *44*(4), 521–537. https://doi.org/10.1177/0146167217744194

Sutherland, C. A. M., Oldmeadow, J. A., Santos, I. M., Towler, J., Michael Burton, D., & Young, A. W. (2013). Social inferences from faces: Ambient images generate a three-dimensional model. *Cognition*, *127*(1), 105–118. https://doi.org/10.1016/j.cognition.2012.12.001

Todorov, A., Olivola, C. Y., Dotsch, R., & Mende-Siedlecki, P. (2015). Social attributions from faces: Determinants, consequences, accuracy, and functional significance. *Annual Review of Psychology*, *66*.

Todorov, A., Pakrashi, M., & Oosterhof, N. N. (2009). Evaluating faces on trustworthiness after minimal time exposure. *Social Cognition*. https://doi.org/10.1521/soco.2009.27.6.813

Van Vugt, M., & Grabo, A. E. (2015). The Many Faces of Leadership: An Evolutionary-Psychology Approach. *Current Directions in Psychological Science*, *24*(6), 484–489. https://doi.org/10.1177/0963721415601971

Willis, J., & Todorov, A. (2006). First Impressions: Making Up Your Mind After a 100-Ms Exposure to a Face. *Psychological Science*, *17*(7), 592–598. https://doi.org/10.1111/j.1467-9280.2006.01750.x

Wilson, J. P., & Rule, N. O. (2015). Facial Trustworthiness Predicts Extreme Criminal-Sentencing Outcomes. *Psychological Science*, *26*(8), 1325–1331. https://doi.org/10.1177/0956797615590992

Zebrowitz, L. A., Wang, R., Bronstad, P. M., Eisenberg, D., Undurraga, E., Reyes-García, V., & Godoy, R. (2012). First impressions from faces among US and culturally isolated Tsimane'people in the Bolivian rainforest. *Journal of Cross-Cultural Psychology*, *43*(1), 119–134.

Zebrowitz, L. A., & Zhang, Y. (2009). The Origins of First Impressions in Animal and Infant

Face Perception. In *New York* (Vol. 389). https://doi.org/10.1093/oxfordhb/9780195342161.013.0029