Children show adult-like facial appearance biases when trusting others

Abstract

A large research literature details the powerful behavioral consequences that a trustworthy appearance can have on adult behavior. Surprisingly, few studies have investigated how these biases operate among children, despite the theoretical importance of understanding when these biases emerge in development. Here, we used an economic trust game to systematically investigate trust behavior in young children (5-8 years), older children (9-12 years) and adults. Participants played the game with child and adult 'partners' that varied in emotional expression (mild displays of happiness and anger, and a neutral baseline), which is known to modulate perceived trustworthiness. Strikingly, both groups of children showed adult-like facial appearance biases when trusting others, with no 'own-age bias'. There were no developmental differences in the magnitude of this effect, which supports adult-like overgeneralisation of these transient emotion cues into enduring trait impressions that guide interpersonal behavior from as early as 5 years of age. Irrespective of whether or not they were explicitly directed to do so, all participants modulated their behavior in line with the emotion cues: more generous/trusting with happy partners, followed by neutral and then angry. These findings speak to the impressive sophistication of children's early social cognition and provide key insights into the causal mechanisms driving trait impressions, suggesting they are not necessarily contingent upon protracted social experience.

Keywords: face perception, trust, emotional expression, development, children, adults

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Adults are known to form powerful impressions of other individuals' trustworthiness from a brief glance of their face (Willis & Todorov, 2006). These attributions are made with a remarkable degree of consensus (Engell, Haxby, & Todorov, 2007) and despite limited accuracy, they influence behavior across a range of contexts (for a review, see Todorov, Olivola, Dotsch, & Mende-Siedlecki, 2015). Developmental psychologists have recently become interested in how and when these trait impressions emerge, which would speak to the sophistication of early social cognition as well as give insight into potential causal mechanisms driving these judgments (e.g., whether these impressions appear to reflect/require protracted social learning).

A growing body of evidence supports an impressively early perceptual sensitivity to trustworthiness (including EEG studies with infants, Jessen & Grossmann, 2016; 2017 and behavioral studies with young children, Cogsdill, Todorov, Spelke & Banaji, 2014; Ma, Xu & Luo, 2016), which may be refined with age (see Caulfield, Ewing, Bank, & Rhodes, 2016). Little remains known, however, about how these early trait impressions influence trust *behavior* in children. Outside the context of first impressions from faces, research into the development of trait understanding indicates that children make attributions about internal and stable psychological characteristics from the early preschool years (see Heyman, 2009). They have been observed to appraise 'what people are generally like' from a range of information sources, including observations of past behavior (e.g., Boseovski, Chiu, & Marcovitch, 2013) and trait labels provided by others (e.g., Heyman & Gelman, 2003). By the age of five, they can also predict another's future behavior reliably based on these judgments: they have the capacity to functionally translate this knowledge into action (Vanderbilt, Liu & Heyman, 2011).

The question, then, of when do children "*choose* a book based on its cover?" is an important one. It is less elegantly expressed than the original adage, but the distinction between simply reading appearance-related trait information (perception) and responding to it (action) may be crucial. After all, much of our interest in how people 'read' faces to make trait inferences stems from their potentially serious consequences in the real world. In adults, face-based trait inferences have been shown to predict political (Todorov, Mandisodza, Goren, & Hall, 2005), professional (Rule & Ambady, 2008, 2011) and legal outcomes (Wilson & Rule, 2015). What about face-based trait inferences by children?

The first study to directly tackle children's impression-based behavior used an adapted trust game (Ewing, Caulfield, Read, & Rhodes, 2015b). Children aged 5 and 10 years, and adults were invited to make investments with a series of (bogus) partners that might or might not choose to repay them with large returns. When shown the faces of these partners during their 'Token Quest', all three age groups selectively placed their trust in those who looked trustworthy rather than untrustworthy. Interestingly this bias was only marginally significant for 5-year-old children and increased in magnitude with age, potentially suggestive of age-related differences in the translation of trait impressions into biased behavior.

Another study recently investigated the impact of emotional expressions on trait impressions and behavior in 4 to 5 year old children (Tang, Harris, Zou, & Xu, 2018). There is a strong association between perceived emotions and trustworthiness in judgments of both children and adults, such that happy expressions are associated with the appearance of trustworthiness and angry expressions with untrustworthiness (Caulfield et al., 2016; Oosterhof & Todorov, 2008; Willis, Palermo, & Burke, 2011). Tang and colleagues (2018) tested preferences to trust computer generated (CG) faces presented in pairs that dynamically expressed contrasting emotions: one happy versus neutral, one angry versus neutral. As

predicted, children consistently placed their trust in the face that was expressing the comparatively more positive emotion. Such associations between emotions and traits suggest that these transient facial cues are being interpreted as signals of enduring interpersonal attributions or intentions. This overgeneralization of social signals may have been evolutionarily adaptive, guiding important approach versus avoidance decisions about unfamiliar others (see Zebrowitz, 2017).

The two studies described above have provided important preliminary evidence that the appearance of facial trustworthiness *can* influence children's trust behavior. Still, the extent to which these response biases are as consequential as those of adults remains unclear because both studies only probed responses to extremely strong trait cues. The natural face images used by Ewing et al. (2015) were selected from the Internet and chosen by adults to represent extremely trustworthy and untrustworthy face identities. The CG faces used by Tang et al. (2018) expressed maximally intense emotions, to which the authors explicitly directed children's attention on each trial. Thus, it could be argued that participants were provided with the conditions most likely to elicit even very subtle behavioral biases present in these populations. Might there be a threshold below which children's (relatively immature) perceptions of trustworthiness fail to reliably modulate behavior?

There are critical theoretical reasons to predict developmental changes in appearance-related trust behavior with age. The influence of emotion-related cues, for example, seems likely to be amplified by age-related improvements in children's broader emotion recognition ability (Herba & Phillips, 2004; Rodger, Vizioli, Ouyang, & Caldara, 2015). Caulfield et al. (2016) observed that the modulatory power of emotion cues for trust *perception* increases across development. Developmental changes were observed in the influence of happy and angry cues on trustworthiness ratings in groups of children (5, 7 and 10 year-olds) and adults, along with age-related improvements in children's ability to recognize these expressions.

As well as being dependent on overgeneralization biases (Zebrowitz, 2017) trait-related biases are also contingent upon learning the associations between people's facial appearance and social actions (e.g., Hassin & Trope, 2000; Verosky & Todorov, 2013). Indeed, recent theory has suggested that this social learning is highly critical for impression formation, allowing only a limited role for innate mechanisms and natural selection (Over & Cook, 2018). Such face-trait links are likely to be strengthened with social experience. This increase in appearance biases may be most evident across the school-age years, when children's social world rapidly expands and they are called upon to evaluate the trustworthiness of unfamiliar others (Caulfield et al., 2016).

In summary, despite the theoretical importance of understanding the development of appearance-related biases, we still have only a limited understanding of how facial cues such as emotional expression come to exert their powerful influence on human social decisions. Here we provide a novel and systematic test of how these trust biases emerge and operate in school aged children.

Current study

We tested whether there are developmental changes in the influence of emotional cues on behavior during a trust game (Token Quest, Ewing, Caulfield, Read, & Rhodes, 2015a; Ewing et al., 2015b). To ensure that we presented participants with the full range of emotional cues available in daily life, we used natural faces rather than CG images. Different identities were morphed together with expression composites (happy, angry, neutral) to produce a stimulus set matched in emotion and intensity (always below the apex of extremity) for a nuanced test of how these cues influence trust behavior. To avoid potential demand characteristics associated with presenting participants with only obviously emotional and neutral faces, we included two different levels of emotional intensity: one subtle, and

another more extreme but still non-apex (see below for further details). Given that peer interactions account for a large portion of children's social life, it seemed appropriate to investigate trust behavior with both child and adult faces.

Trust biases are probed implicitly in the Token Quest paradigm, through a series of interpersonal interactions. Participants are not explicitly directed to consider partner trustworthiness and indeed the word trust is deliberately omitted from the task instructions. As a result there is no need to explicitly confirm a shared understanding of this construct, making the paradigm ideal for use with young children (Ewing et al., 2015b) and atypical developing populations (Ewing et al., 2015a). It remains an interesting open question, however, whether this measure captures the full potential impact of trait impressions upon child or indeed adult behavior. A secondary aim of the current study was to test whether participants' response profiles on this task differ when they are prompted to consider the appearance of this trait directly. We hypothesized that explicit prompting would boost behavioral biases in both children and adults, potentially reducing any developmental differences observed with the standard paradigm.

Methods

Participants

All participants provided verbal assent and written informed consent was provided by adult participants and parents/guardians in the case of children. The final sample comprised 48 younger children (5;1 to 8;11, M = 6;7, SD = 1;0; 25 males), 55 older children (9;1 to 12;9, M = 10;9, SD = 0;8; 28 males), and 40 adults (18 - 36 years, M = 22;2, SD = 3;0; 14 males). A Pearson's chi-square test confirmed there was no significant difference in the sex distribution across the three groups, χ^2 (2) = 3.15, p = .20. Adults were local community volunteers and undergraduate psychology students who participated for course credit.

Children were recruited from local schools and the community. All participants had normal or corrected-to-normal vision. The data of four additional participants (one younger child, two older children and one adult) were excluded after their responses were identified as outliers (± 3 standard deviations from their group mean). This study was approved by the School of Psychology Human Research Ethics Committees at the University of [*blinded*] ('Trust Perception and Behavior', 2017-0198-000738), and [*blinded*] University ('The Development of Facial Mimicry', 2014 301N).

Sample Size Justification

Two power analyses carried out using the pwr package in R version 3.5 (R Core Team, 2016). The first analysis was based on the results of Caufield et al (2015), who observed a difference of d = 0.74 between facial impressions in child and adult participants. We would achieve 80% power for a t-test for this effect size with a sample size of 30 in each group. The second was based on Ewing et al (2015b), who observed a difference of d = 0.80-2.06 between investments made to trustworthy vs untrustworthy partners in their trust game (child and adult participants). We would achieve 80% power for a t-test for this effect size with a sample size of 26 in each group. To be conservative, assuming the true effect size might be lower, we recruited 40-55 participants in each group, giving us 80% power to find an effect size of 0.63 or above.

Stimuli

Colour photographs of 24 identities (12 male) were morphed to create photo-realistic images displaying angry, neutral and happy expressions. Half of the identities were children, from the Child Affective Facial Expression (CAFE) set (LoBue & Thrasher, 2015) and the remainder were adults, from the University of Western Australia Facelab database (Rhodes,

Simmons, & Peters, 2005). Each face image presented during the study was blended with an age-appropriate, happy, angry, or neutral expression composite using PsychoMorph (Version 4: Tiddeman, Burt, & Perrett, 2001). The child composites were generated from five additional expressive faces from the CAFE set. The adult face composites were taken from Skinner and Benton (2010). Standard morphing procedures were employed to generate 20% (subtle expressions) and 70% (overt expressions) stimuli for each emotion (see Figure 1 for illustrative examples). Faces subtended a visual angle of 6.30° × 4.58° at a viewing distance of approximately 50 cm.

INSERT FIGURE ONE ABOUT HERE

Procedure

All participants completed the same Token Quest trust game (adapted from Ewing et al., 2014) which was programmed and presented using Psychopy (Peirce, 2007). This task provided a measure of each individual's willingness to trust a series of different (bogus) partners. Consistent with the original procedure, participants were informed that returns on investment might be large from some partners and small (or even zero!) from others. To avoid risking losses, participants could choose to give away few, or no tokens to their partners. We emphasized, however, that the goal of the game was to end up with as many tokens as possible.

After two practice rounds with cartoon partners (Daffy and Donald Duck: two familiar, non-human characters with no particular reputation for being trustworthy or untrustworthy), participants were guided one-on-one through five rounds of the game, each comprising six partners/turns. At the start of each round, the six partners were simultaneously shown on the screen and participants were given the opportunity to inspect them (self-paced) to confirm they would all be human faces of one age group (child or adult) and provide a sense of the facial cue variability within each block. Then, on each individual turn, the

partner's image appeared on the screen for four seconds, immediately followed by the text "How many tokens do you want to give your partner?" with the options of 0, 1, 2, 3, 4 tokens presented under the text. Responses were entered via keypress by the participant or experimenter (younger children responded verbally). At the end of each round, a feedback screen revealed how many tokens the participant had kept and/or won across the two trials (predetermined to always return participants twice as many tokens as they invested across the trials). By always delivering this feedback at the end of the rounds, it was not possible for participants to learn any associations between individual partners/faces and associated rewards.

In Round 1, partners were blank identities (see Figure 1). Investments on these trials (in the absence of specific cues) allowed us to establish baseline trust behavior in our three groups. Each of the remaining Rounds (2 – 5) comprised presentation of six faces (either child or adult) manipulated to show subtle (20% morph) and more overt (70% morph) emotional expressions: angry, happy and neutral. Each round included one example of each emotion x intensity combination, which were presented in a fixed, randomised order. The age of faces presented first during the task (e.g., child faces or adults) was counterbalanced between participants but face sex was held consistent across the whole task, i.e., each participant saw only male or female faces.

In Rounds 4 and 5 participants were explicitly cued to consider the appearance of partner trustworthiness when making their investments. To maximise their token returns, they were told to selectively give their tokens to the most trustworthy-looking partners. To confirm that even the youngest children understood what we meant by trustworthiness, we provided an extended description that focussed on three key components: honesty, reliability, and emotional trust (see Ewing et al., 2015b). The procedure and stimuli were otherwise identical to Rounds 2 and 3.

Results

Round 1 (Establishing baseline trust behavior)

It was important to check for any baseline group differences in trust behavior between the three participant age groups (i.e., test whether the children and adults might differ broadly in their willingness to invest vs risk tokens across trials). We performed a one-way between-subjects ANOVA to investigate whether participant age group had a significant effect on our index of trust behavior (mean number of tokens invested) on the 'blank identity' trials. This analysis revealed no differences in the total number of tokens invested between adults (M = 1.85, SE = 0.14), older children (M = 1.75, SE = 0.08), and younger children (M = 2.03, SE = 0.11), $F(2, 140) = 1.87$, $p = .158$, $\eta^2 = .03$. Overall, participants chose to invest approximately half their tokens on each trial (M = 1.87, SE = 0.06), suggesting that all three groups entered into the spirit of the game.

Rounds 2 - 5 (Face-related trust behavior)

For our main analysis, we ran a 4-way mixed model ANOVA on trust behavior with the between-subjects factor of participant age and repeated-measures factors of face age (child, adult), emotion (angry, neutral, happy) and trustworthiness cue (implicit, explicit). All significant effects and interactions were followed up with Bonferroni adjusted comparisons and where sphericity was violated, the Greenhouse-Geisser epsilon adjusted values are reported. Below we report the main effects and interactions that were relevant to our research questions, with inferential statistics for all main effects and interactions reported in Table 1.

Children show adult-like appearance biases. Critically, the pattern of investments was broadly similar in all three participant groups. The only difference observed was in overall investment: when the faces of their partners were available there was a main effect of

participant age (see Table 1). Older children ($M = 1.60$, $SE = 0.07$) invested significantly fewer tokens than younger children ($M = 1.99$, $SE = 0.08$), $p = .002$, $d = 0.70$. Adults' investments ($M = 1.76$, $SE = 0.09$) did not differ significantly from younger or older children, $ps \geq .174$, $ds \leq 0.38$. This dip in older children's trust behavior suggests a particular reluctance to trust identifiable but unknown others around age 10. Crucially, however, the effect of participant age on investment strategy was not moderated by emotion or trustworthiness cue, as all interactions with participant age were non-significant (Table 1). There was no evidence of a Face Age × Participant Age interaction, indicating that there were no own-age biases in child or adult investment strategies. There was also no main effect of face age (see Table 1) indicating that the number of tokens invested did not differ between child and adult faces. Overall, the children showed an investment profile that was highly similar to the adults.

INSERT TABLE ONE ABOUT HERE

Emotional expression guides trust behavior. Emotions displayed on partner faces had a significant main effect on participants' trust behavior (see Table 1). As anticipated, investments were greatest for happy faces ($M = 2.66$, $SE = .06$), compared to both neutral ($M = 1.79$, $SE = .06$) and angry faces ($M = 0.90$, $SE = .05$), $ps < .001$, $ds \geq 1.23$. Significantly fewer tokens were also invested in angry faces relative to neutral faces, $p < .001$, $d = 1.33$. A significant Face Age × Emotion interaction emerged (Table 1). Simple main effects analyses revealed that this interaction was driven by the investment of fewer tokens in angry child faces, compared to angry adult faces, $p < .001$, $d = 0.24$ (see Figure 2). In contrast, for happy faces, we observed greater investment in child faces than adult faces, $p = .006$, $d = 0.20$. There was no significant difference in investment in child and adult neutral faces, $p = .183$, $d = 0.12$.

INSERT FIGURE TWO ABOUT HERE

Explicit cuing consideration of partners' appearance of trustworthiness did not qualitatively change observed trust biases. A significant main effect of trustworthiness cue (explicit, implicit) reflected greater investment in the classic 'implicit' Token Quest investment condition ($M = 1.84$, $SE = 0.05$) compared to the explicit condition ($M = 1.73$, $SE = 0.05$). This main effect was moderated by a significant Trustworthiness Cue × Emotion interaction (see Table 1). Simple main effects analyses indicated that, for both the implicit and explicit conditions, investments were significantly greater for happy faces than neutral faces and then angry faces (all ps $< .001$, ds ≥ 0.84). Figure 3 confirms that the influence of emotion on investment strategy was similar in the implicit and explicit conditions. However, the trust bias was amplified in the explicit condition: children and adults made relatively more generous (with happy faces) and more risk-averse (with angry and neutral faces) investments, ps $\leq .012$, ds ≥ 0.20.

INSERT FIGURE THREE ABOUT HERE

Discussion

The current study set out to investigate the development of impression-based trust behavior, which is known to powerfully influence adult social interactions and outcomes across a range of domains (Todorov, Mende-Siedlecki, & Dotsch, 2013). We systematically probed behavioral biases while participants played a trust game, interacting with other children and adults displaying facial cues associated with trustworthiness (i.e., non-apex happy, angry, neutral expressions). Investments revealed that younger and older children discriminate between partners based on their appearance, even when emotion cues were only subtle and they were not explicitly prompted to do so. These early and spontaneous biases support impressively sophisticated social cognitive functioning in even our youngest participants.

Children's perceptual sensitivity to trustworthiness and cues associated with this trait (emotional expression) have previously been reported to improve with age (Caulfield et al., 2016). Thus, we anticipated that, relative to younger children, older children (and adults) might show a stronger bias to modulate their investments in line with the emotional expressions of their partners (more tokens for those who look happy, fewer for angry). Counter to prediction, however, this appearance-related bias was observed from the youngest ages tested and its magnitude did not increase with age. Older children invested significantly fewer tokens than the younger children overall, but, crucially, there was no difference in the extent to which their behavior was modulated in line with these powerful trust/emotion cues. It is interesting to consider whether group differences in the cognitive skills required for the perceptual tasks utilised in these previous studies (e.g., rating scales, see Chambers & Johnston, 2002) might have masked an early capacity in children, which is evident when probed with engaging child-friendly interactions.

Recently, Mondloch, Gerada, Proietti & Nelson (2019) used a different implicit measure of children's first impressions (a storybook paradigm) to obtain results contrasting with the current findings. They found that four to eleven year-old children failed to show expression-based modulation of preferences when choosing partners for scenarios/tasks requiring dominant versus trustworthy characters (e.g., 'would help fight dragons' vs 'would not steal your cape'). When presented with subtle emotional cues, children demonstrated a general preference for happy faces across scenarios; unlike adults they were not selectively more likely to choose an angry partner on dominance trials or a happy partner on trustworthiness trials. Even relatively strong emotional expressions did not lead to robust adultlike modulation of children's partner preferences (observed for angry faces only), despite confirmation that they conceptually understood the traits required for each different scenario.

The intriguing divergence between these and our own findings raises interesting questions about early appearance-related biases. Do children's first impressions depend on the context of the judgments? The scenarios presented to participants by Mondloch et al (2019) arguably required more complex social processing than in our task. Specifically, adultlike impressions in the storybook task required generalisation from transient emotion cues in order to make predictions about a diverse set of enduring trait-related behaviours. By contrast, the impressions in our trust game were linked to prediction of immediate behaviour in single, well-defined economic interaction. If such contextual features influenced the observed outcomes/judgments then it follows that in the age ranges tested, children's first impressions might be neither wholly immature or adultlike. They may function like those of adults in some situations and not others, depending on the alignment between task demands and each child's developmental stage (e.g., perhaps influenced by accumulated life experiences as well as emergent perceptual and cognitive abilities). Less theoretically interesting explanations of the contrasting result might also relate to methodological differences such as the age, gender and emotional intensities of stimuli presented across the two studies. Future research targeting these issues should prove extremely revealing regarding the typical development of this crucial aspect of social perception.

How sure can we be that the observed effects of expression in the current study were on participants' trust and not some other, perhaps more general (positive/negative) attribution of character or interpersonal preference? We utilised an experimental paradigm (trust game, Berg, Dickhaut & McCabe, 1995) that is widely used in both economic and psychological research to draw inferences about behavior in the context of interpersonal trust. Still, there are close associations between judgments of trustworthiness and other social characteristics like approachability (Sutherland et al., 2013). It is therefore theoretically possible that our participants' behavior was influenced by these other associations. Indeed, it will be an

interesting challenge for future studies to try to tease apart these possibilities, particularly when working with groups - such as young children – with linguistic and cognitive limitations that make it particularly difficult to confidently establish a shared operationalisation of 'trust' as a unique concept.

The presence of adult-like trait biases in children as young as five have a bearing on our theoretical understanding of where these first impressions come from. Particularly, our findings suggest that extended cultural learning of appearance-trait mappings (e.g., Over & Cook, 2018) is not necessary for adult-like appearance biases to emerge. Obviously, the early manifestation of these biases does not necessarily signal that these biases are innate. Moreover, there is evidence that social experience can shape impressions in adults (Verosky & Todorov, 2013). For example, in naturalistic images, glasses cue impressions of intelligence (Sutherland et al., 2013). Nevertheless, if face-trait associations were strongly or primarily driven by cultural learning, then we would expect to see clearer evidence of an increase in the strength of trait biases across the range of ages tested here. Instead, our findings are more consistent with evolutionary-based accounts of first impressions, wherein selection pressures to rapidly establish whether others appear likely to help or harm us may have shaped social biases that emerge relatively early in life (see Oosterhof & Todorov, 2008; Zebrowitz & Zhang, 2011).

Interestingly, there was no evidence of an own-age bias in trait-related behavior. That is, children were no more likely to invest in child partners than adult partners (and vice versa for adults). This result is perhaps not surprising given that own-age biases are more commonly observed for face identity recognition (e.g., Anastasi & Rhodes, 2005; Hills & Lewis, 2011) rather than emotion perception (Griffiths, Penton-Voak, Jarrold, & Munafò, 2015), the key manipulation here. Moreover, although social interactions with peers become increasingly important during the school years, adults are *always* powerful figures in

children's lives. Thus, trait impressions of mature faces are highly consequential for individuals of all ages. There was some indication that emotion cues displayed by child faces might prompt particularly extreme responses (i.e., relative to adults, child partners received fewer tokens when they were angry, and more tokens when they were happy) but future research should validate this result using a wider range of faces. Broadly speaking, the similarity of responses to emotion/trust cues present in child and adult faces observed in the current study supports generalizability of (present and past) research findings across face age.

We were interested to see whether directly cuing participants to explicitly consider each partner's appearance would change their response profiles. There was a possibility that the standard (implicit) rounds of Token Quest might not reflect trait biases observed when trustworthiness is more consciously evaluated. Importantly, however, results revealed that these biases did not qualitatively differ when participants were asked to particularly attend to the trustworthy versus untrustworthy appearance of their partners. Instead in both children and adults, biases towards and away from happy and angry faces respectively were amplified in the explicit (c.f., implicit) condition. This consistency supports our interpretation of investments during the implicit task as an index of the influence of facial trustworthiness. It is possible, of course, that first completing the implicit condition might have biased participant responses in the explicit condition. Future studies might consider trying to replicate the current 'explicit' condition results in a task without a preceding standard ('un-cued') round.

Future directions

Having established adult-like appearance-related biases in children as young as five, a crucial next step for future research is to test even younger children, to probe just how early these biases are observed. Reports of perceptual sensitivity to facial trustworthiness in infants as young as 7 months of age (Jessen & Grossmann, 2016, 2017), signal that it is possible that

the lower limit of these abilities may prove to be very young. Future research could also look developmentally at behavioral responses to facial cues that are more clearly culturally determined (e.g., glasses cuing intelligence or gender cuing dominance: Sutherland et al., 2013). It would also be interesting to track the development of meta-perception and/or confidence in appearance-based decision-making. The Token Quest paradigm could be adapted to ask the children directly about their responses during the trust game (e.g., why they selected the faces that they did) – to determine whether meta-perception comes online as early as do the behavioral biases. As the task is currently designed it is not clear whether the children were consciously aware of the differences in emotion within each set. These were never mentioned directly by the experimenter, though presenting the faces side-by-side at the start of each round may accentuated the differences between the different faces. Future studies may wish to investigate the impact of this subtle environmental cue on behavioral responses, e.g., whether appearance-related biases might be 'relativized' when considering individuals not just in isolation, but also as members of a group.

Conclusions

Children show adult-like facial appearance biases when trusting others. Whether or not they were explicitly directed to do so, younger and older children made adult-like trait attributions about others based on transient valence cues, and these attributions powerfully inform their subsequent interpersonal behavior. The lack of qualitative differences observed across development speaks to the impressive sophistication of children's early social cognitive capacity. These findings also suggest that the development of these influential appearance related biases are not necessarily contingent upon protracted experience, which may signal just how important these judgments are for successful social functioning.

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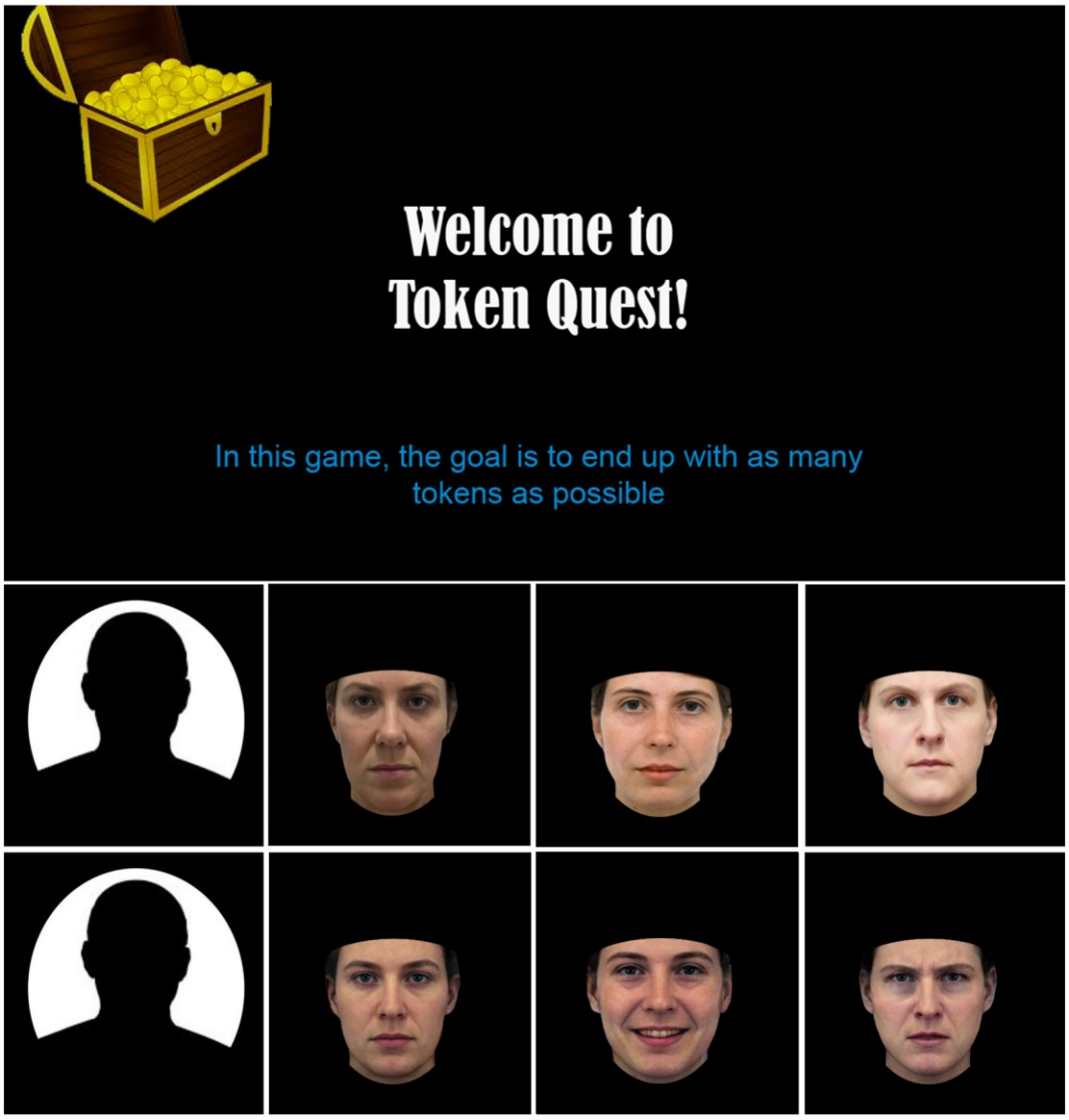

Figure 1. Illustrative examples (identities not shown during the task) of images representing partners during Token Quest. The columns from left to right show adult blank faces, neutral faces, happy faces and angry faces; the top row shows the subtle intensity (20% morphs) and the bottom row shows the more extreme intensity (70% morphs).

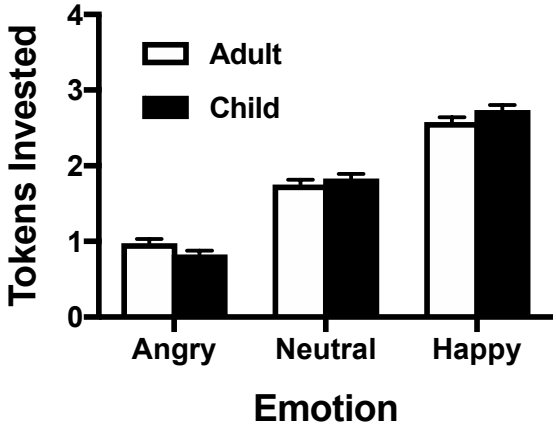

Figure 2. Mean tokens invested with child and adult partners displaying each of the three emotions, averaged across participant age.

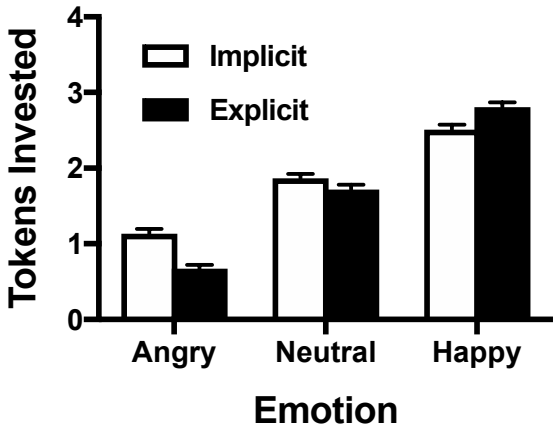

Figure 3. Mean tokens invested with angry, neutral and happy partners in the Implicit and Explicit conditions.

Table 1. Inferential statistics for all main effects and interactions.

	df	*F*	*p*	η_p^2
Participant Age	2, 140	6.13	.003	.08
Face Age	1, 140	1.41	.236	.01
Emotion	1.65, 231.6	557.62	<.001	.80
Trustworthiness Cue	1, 140	8.57	.004	.06
Participant Age x Face Age	2, 140	0.16	.856	.00
Participant Age x Emotion	3.31, 231.6	1.17	.323	.02
Participant Age x Trustworthiness Cue	2, 140	1.47	.235	.02
Face Age x Trustworthiness Cue	1, 140	0.81	.370	.01
Face Age x Emotion	2, 280	11.38	<.001	.08
Emotion x Trustworthiness Cue	1.81, 253.87	65.15	<.001	.32
Participant Age x Face Age x Emotion	4, 280	1.66	.159	.02
Participant Age x Face Age x Trustworthiness Cue	2, 140	0.28	.756	.00
Participant Age x Emotion x Trustworthiness Cue	3.63, 253.87	0.22	.916	.00
Face Age x Emotion x Trustworthiness Cue	2, 280	0.51	.599	.00
Participant Age x Face Age x Emotion x Trustworthiness Cue	4, 280	0.48	.749	.01