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Inferring Character From Faces: A Developmental Study

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Abstract

Human adults attribute traits to faces readily and with high consensus. In two experiments investigating the development of face-trait inference, adults and children ages 3–12 attributed *trustworthiness, dominance* and *competence* to pairs of faces. In Experiment 1, children as young as 3–4 years made face-trait attributions converging with those of adults and 5–6 year olds were at adult levels of consistency. In Experiment 2, children aged 3 and above consistently attributed the basic "mean/nice" evaluation to faces varying not only in trustworthiness but in dominance and competence. This research suggests that the predisposition to judge others using scant facial information that appears in adult-like forms early in childhood does not require prolonged social experience.

Keywords

Cognitive Development; Social Perception; Social Cognition; Physical Appearance

Faces command our attention and interest, and facial appearance has profound effects on social judgments (Todorov, Mende-Siedlecki, & Dotsch, 2013; Zebrowitz & Montepare, 2008). The speed and confidence with which we dispatch character assessments such as "trustworthy" or "competent" in response to a *face* is impressive. Face-to-trait inferences appear to be intuitive and automatic among human adults, and its development in early childhood is the focus here.

Prior research shows that face-trait inferences occur extremely rapidly, emerging within 50 milliseconds after exposure (Todorov, Pakrashi, & Oosterhof, 2009). Second, these character attributions show broad and cross-cultural consensus (Rule et al., 2010). Third, these judgments often result from overgeneralizing perceptions of facial configurations that signal ecologically valid information, such as emotional states (Said, Sebe & Todorov, 2009) and fitness (Zebrowitz & Rhodes, 2004). Finally, face-trait inferences occur even in consequential settings including criminal sentencing (Blair, Judd, & Chapleau, 2004),

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Authorship

E. Cogsdill and M. Banaji developed the study concept and design. Data collection was performed by E. Cogsdill. Data analysis and interpretation were performed by E. Cogsdill under advisement from all other authors. E. Cogsdill drafted the manuscript and all authors provided critical revisions and approved the final manuscript for submission.

financial success (Rule & Ambady, 2008), and election outcomes (Todorov, Mandisodza, Goren, & Hall, 2005).

The present studies begin an exploration testing whether young children infer character traits like trust, competence, and dominance simply by looking at 2-D static images of faces, and if so how early in development they do so in an adult-like manner[1]. If agreement in face-trait inferences emerges gradually across development, we might infer that they require prolonged social experience to manifest. If instead young children respond like adults, we would learn that face-to-trait character inferences are a fundamental social cognitive capacity that emerges early in life. Thus, our investigation is simply one of whether children and adults make similar trait inferences based on the same faces.

We know that infants prefer to look at faces over non-faces and form preferences based on attractiveness, gender, and race (Bar-Haim et al., 2006; Langlois, 2000; Quinn, Yahr, Kuhn, Slater, & Pascalis, 2002; Ramsey et al., 2004; Simion et al., 2001). However, little is known about how older children use faces to make inferences about others' character, and the existing research on this topic is mixed. Even though 3–4 year olds predict behavior from information about mental states (Wellman, Cross, & Watson, 2001), children under age seven usually fail simple behavior-to-behavior prediction tasks (Rholes & Ruble, 1984) and are less likely than older children to use trait words to describe people (Barenboim, 1981).

While some aspects of face-to-trait inference in children have been studied (see Antonakis & Dalgas, 2009; Clement et al., 2012; Keating & Bai, 1986; Montepare & Zebrowitz-McArthur, 1989) the present research explores the development of face-to-trait inferences within a wide age group and in a variety of domains. Importantly, our method enables us to test and compare responses between not only adults, but also 3–10 year old children. We explore face-based attributions of basic evaluations, like "nice/mean," as well as assessments of more specific traits, like "strong" and "smart."

General Method

Participants viewed computer-generated faces selected to be high or low on perceived *trustworthiness, dominance*, or *competence*. These extensively validated (Todorov et al., 2013) faces were created in FaceGen based on data-driven, computational models of the respective traits (Oosterhof & Todorov, 2008; Todorov & Oosterhof, 2011;) In both experiments, we used three sets of faces, each of which included six distinct face identities. The three sets each contained faces that appeared high or low on a single trait (±3 SD in trustworthiness, dominance, and competence; see Figure 1).

In each trial, participants viewed two faces side-by-side, one high and one low in a trait. Face pairs appeared in three blocks (order counterbalanced across participants), each containing 9 trials in which all face pairs (low vs. high on trait) varying in all three traits appeared in a random order.

[1]In this paper we do not address the veridicality of face-trait inference, as others have studied (e.g., Carré et al., 2009). Although this is an important topic, we focus centrally on the development of such inferences from the earliest ages that can be tested.

For each trial pair, participants identified the face that possessed a particular trait by answering short questions, e.g., "*Which of these people is very nice/strong/smart?*" Children answered by pointing to one of the faces on the screen, and adults responded online by selecting a face. Faces and prompts were randomized with the constraint that anticipated responses appeared on either side of the screen with approximately equal frequency.

Experiment 1

Method

141 children (*M*age = 6;5, range = 3;1–10;11, 68 females) participated at local museums and in the laboratory[2]; 99 adults (*M*age=30.23, range=18–67, 54 females, 1 unspecified) participated online through SocialSci[3]. Participants attributed *trustworthiness* ("mean/nice"), *dominance* ("strong/not strong"), and *competence* ("smart/not smart") to pairs of faces. Each pair contained faces from the same set (trustworthiness, dominance or competence), with one face appearing high and the other low in that trait.

Results

Figures 2–4 summarize results from all ages and traits, with greater proportions of expected responses – i.e., those predicted based on prior data collected with these faces (e.g., trustworthy faces = "nice" and untrustworthy faces = "mean") – indicating stronger consensus. All age groups showed significant consensus compared to chance (50%) when attributing "mean/nice" (93%; Fig. 2), "strong/not strong" (85%; Fig. 3), and "smart/not smart" (76%; Fig. 4).

Critically, all age groups made all three attributions with significant consensus, ps < .001, ds > 1.08. Although 3–4 year olds responded with robust and adult-like consensus (72% across all traits), they were less consistent than 5–6 year olds (81%), 7–10 year olds (88%), and adults (89%). These differences constituted a significant main effect of Age, $F(3,236) = 17.91$, $p < .001$. One-way ANOVAs followed by post-hoc tests using Sidak corrections for multiple comparisons were used to analyze age differences for each trait. This analysis revealed a pattern for both trustworthiness and dominance whereby 3–4 year olds were less consistent than all other age groups (all ps < .01, ds > .59), which were in turn equivalent to each other (all ps > .23, ds < .40).

Competence showed an altered developmental pattern whereby consensus primarily increased between the ages of 5–6 and 7–10. 3–4 year olds (68%) were identical to 5–6 year olds (66%; $p = 1.00$, $d = .07$) but less consistent than 7–10 year olds (84%, $p < .05$, $d = .64$) and marginally less consistent than adults (80%; $p = .08$, $d = .47$)[4]. In similar fashion, 5–6 year olds were less consistent than both 7–10 year olds ($p < .01$, $d = .67$) and adults ($p < .05$, $d = 51$). 7–10 year olds and adults attributed competence with similar consensus ($p = .91$, $d = .18$).

[2]Ages for groups of child participants are notated as "years;months."
[3]www.socialsci.com
[4]This result was statistically significant before correcting for multiple comparisons ($t(134) = 2.607$, $p = .01$).

Data were further analyzed using a 3 (trait: trustworthiness vs. dominance vs. competence) × 4 (age group: 3–4 year olds vs. 5–6 year olds vs. 7–10 year olds vs. adults) mixed model ANOVA with repeated measures on the first factor. This analysis revealed main effects of both Trait, $F(2.028^{5},472) = 42.66$, and Age Group, $F(3,236) = 18.09$, ps < .001. These main effects were qualified by a Trait*Age Group interaction, $F(6,472) = 4.031$, $p < .01$. Within-subjects contrasts revealed that response accuracy was highest for judgments of trustworthiness (91.6% accuracy). This overall accuracy was significantly higher than that of dominance (81.5%; $F(1,236) = 54.24$, $p < .001$), which was higher than competence (74.4%; $F(1,236) = 10.10$, $p < .01$).

Overall, the data suggest that children's face-trait inferences reach adult-like consensus at an impressively early age. For all three traits tested, children in the youngest age group responded with striking consistency greatly exceeding chance responding, although they were typically less consistent than older participants.

Although consensus was consistently high across all age groups and traits, the consensus that emerged in trustworthiness trials was significantly greater than that obtained in dominance and competence trials, suggesting that judgments of "mean" or "nice" might emerge uniquely early compared with other judgments. If true, such judgments might be fundamental to face-trait inference, and therefore broadly applied to faces varying in trait dimensions other than trustworthiness.

Experiment 2

Experiment 2 explored this possibility by testing whether "mean/nice" judgments emerge when viewing faces that vary in dominance and competence instead of trustworthiness. Given the primacy of valence evaluations in social judgments, children might robustly apply basic "nice/mean" judgments to faces varying in traits other than trustworthiness. If such evaluations rely on specific features varied in trustworthy/untrustworthy faces, however, consensus should not emerge when applying this global evaluation to other faces.

Method

A total of 203 children (*M*age = 5;11, range = 3;1 - 10;8, 110 female, 2 of unspecified gender) participated at museums and in the laboratory, and 301 adults (*M*age = 28.9, range = 18–72, 142 females, 6 unspecified) participated online through SocialSci and Qualtrics.

Participants viewed the same faces varying in perceived dominance and competence as in Experiment 1. Verbal prompts solely elicited "mean/nice" judgments (i.e., "*Which of these people is very [mean/nice]?*"). Unlike in Experiment 1, here Face Trait was a between-subjects variable. Sample sizes for all traits and age groups are displayed in Figures 5–7.

[5]Degrees of freedom were adjusted using a Greenhouse-Geisser correction after Trait failed a test of sphericity, Mauchly's $W = .726$, $p < .01$.

Results

As in Experiment 1, consensus of judgment was strikingly high, with consistency for all age groups and both traits vastly exceeding chance responding (50%), *p*s < .001, *d*s > 2.15. These results are summarized in Figures 5–6. Consensus of "mean/nice" judgments based on facial dominance (i.e., dominant = "*mean*") showed developmental invariance, ranging from 87% to 95% with no significant pairwise differences between any age groups, all *p*s > .06, *d*s < .50. Children of all ages also showed robust consensus when attributing "mean/nice" to faces varied on competence (82%–96%). Adults, however, showed markedly lower attributions of "nice/mean" to the competent/incompetent faces (76%) than did 5–6 year olds (94%) and 7–10 year olds (96%), *p*s < .01, *d*s > 1.03. Consensus increased with age among children, with 7–10 year olds responding significantly more consistently than 3–4 year olds (82%), $p < .05$, $d = 0.83$.

Data were further analyzed using a 2 (Face Trait: dominance vs. competence) × 4 (age group: 3–4 vs. 5–6 vs. 7–10 year olds vs. adults) between-subjects ANOVA. Main effects emerged for both Age Group ($F(3,506) = 10.804$, $p < .001$) and Face Trait ($F(1,506) = 3.721$, $p = .054$), with a significant Age*Face Trait interaction ($F(3,506) = 2.674$, $p < .05$). When collapsing data across Face Trait, an age-related increase was observed among children, with 7–10 year olds showing significantly greater consensus than 3–4 year olds (Sidak post-hoc $p < .05$). Adults showed the same consensus as 3–4 year olds ($p > .99$) but were less consistent than 5–6 or 7–10 year olds (*p*s < .01).

Further analyses explored the possibility that participants might be *more* consistent when attributing "mean/nice" than when attributing the more specific traits of "strong/not strong" and "smart/not smart." One-way ANOVAs using combined data from both studies compared consensus between "mean/nice" evaluations (Experiment 1) and specific trait judgments (Experiment 2) based on faces varying in dominance and competence. Overall, "nice/mean" judgments were significantly more consistent than judgments of "strong/not" and "smart/not" for faces varying in dominance ($F(1,629) = 5.332$, $p < .05$), and competence ($F(1,361) = 10.709$, $p < .01$), respectively. All groups of children were more significantly consistent when attributing "nice/mean" to faces as opposed to "strong/not strong" or "smart/not smart," *p*s < .05. However, adults were less consistent when attributing "mean/nice" rather than "strong/not very strong" to faces varied on dominance ($F(1,362) = 6.441$, $p < .05$), and equally consistent when attributing "smart/not" and "nice/mean" to faces varied on competence ($F(1,133) = .816$, *n.s.*).

General Discussion

Children in both experiments made reliable inferences about character that approached adult levels at the earliest ages tested, and matched adult levels by age 7. In particular, participants of all ages robustly applied basic "mean/nice" judgments in response to a variety of facial characteristics.

In both experiments, judgments based on facial competence appeared to develop differently than those of trustworthiness and dominance. The data also produced the seemingly anomalous result that adults were *less* consistent than 7–10 year olds when attributing "nice/

mean" to competence faces. It is possible that adult face-trait judgments might be more differentiated than those of children, who rely more on global valence. Heightened sensitivity with age to features other than those affecting global valence might also account for developmental increases in reliability when attributing strength and intelligence to faces (Experiment 1). The competence face model used here may also be less effective than those of trustworthiness and dominance.

The striking consensus in "mean/nice" attributions observed for all three trait dimensions suggests that such evaluations might underlie the consensus in face-trait inferences observed in Experiment 1. In fact, principal components analyses of trait judgments from faces show that trustworthiness judgments are strongly correlated with the first PC ($r > .90$), interpreted as valence (Oosterhof & Todorov, 2008), and the computational model of face trustworthiness closely resembles a valence model based on multiple social judgments (Said, Dotsch, & Todorov, 2010). Further research probing the relationship between "mean/nice" judgments and specific trait inferences will be necessary to evaluate this possibility.

These two experiments provide a clear demonstration that children as young as 3–4 years of age show an adult-like tendency to attribute both traits and "mean/nice" evaluations to faces based on their appearance. It is possible that attractiveness underlies character inferences, particularly for trustworthiness and competence faces. However, recent work has shown that the facial features manipulated in these models elicit divergent trait judgments irrespective of attractiveness (Todorov et al., 2013).

These data leave open the question of when face-trait inference *first* emerges. Animation-based stimuli may enable researchers to study even younger populations. If such inferences take root early in development, as the data suggest, even infants might associate faces with trait-consistent behaviors, such as those conveying prosociality (Hamlin et al., 2007) or dominance (Mascaro & Csibra, 2012).

The predisposition to make rapid and unreflective judgments based on scant facial information is a pervasive form of social judgment. Prior work suggests that such inferences have important real-world consequences. We demonstrate that face-to-trait judgments are robust by age three, and certain judgments reach fully adult-like levels at 5–6 years of age. By revealing the young age at which children make such judgments, these data challenge accounts of slow-learning mechanisms of social learning that develop through the gradual detection and internalization of environmental regularities (e.g., Fazio et al., 1986; Smith & DeCoster, 2000).

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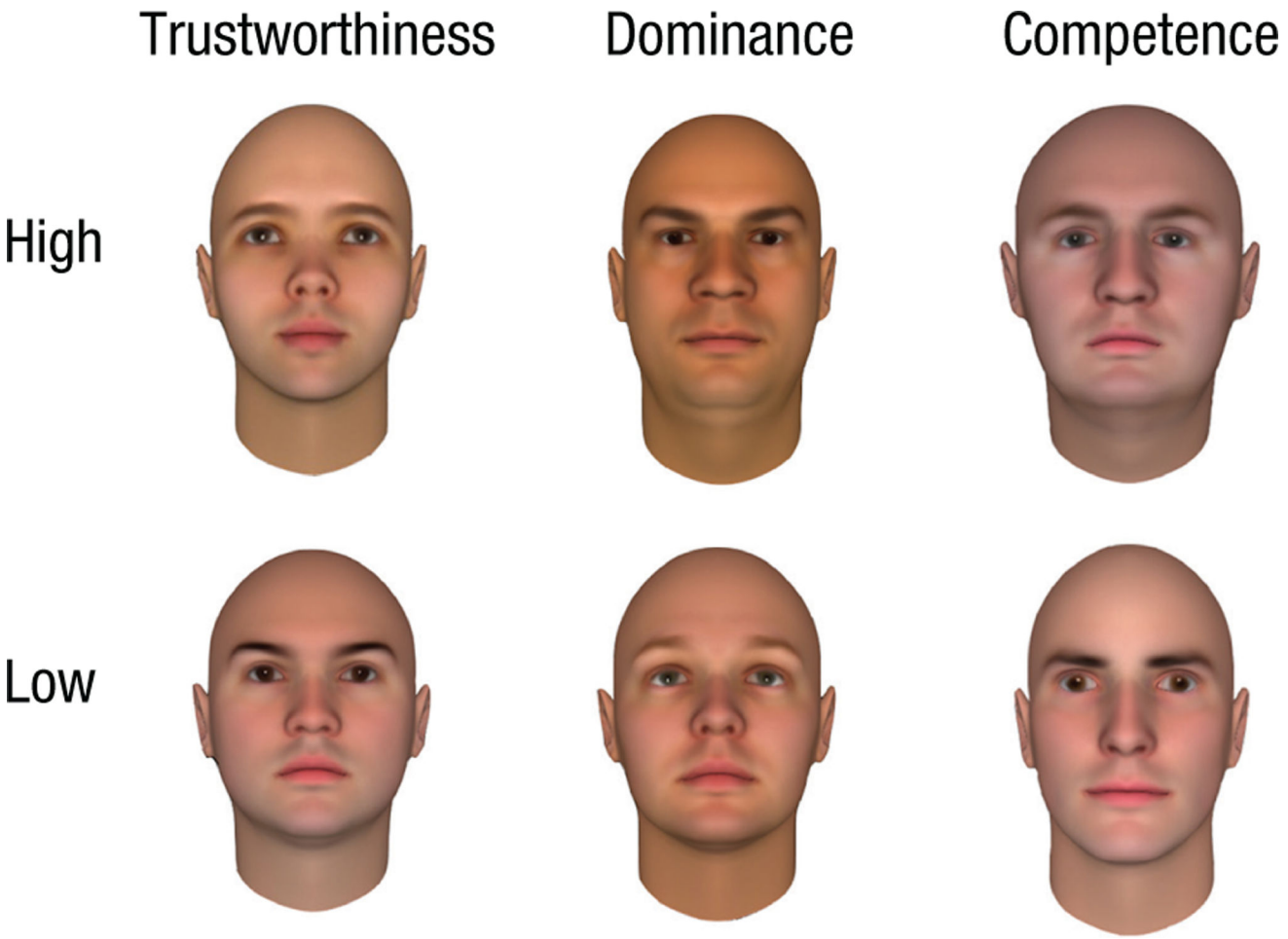

Figure 1.
Sample stimuli from Experiment 1.

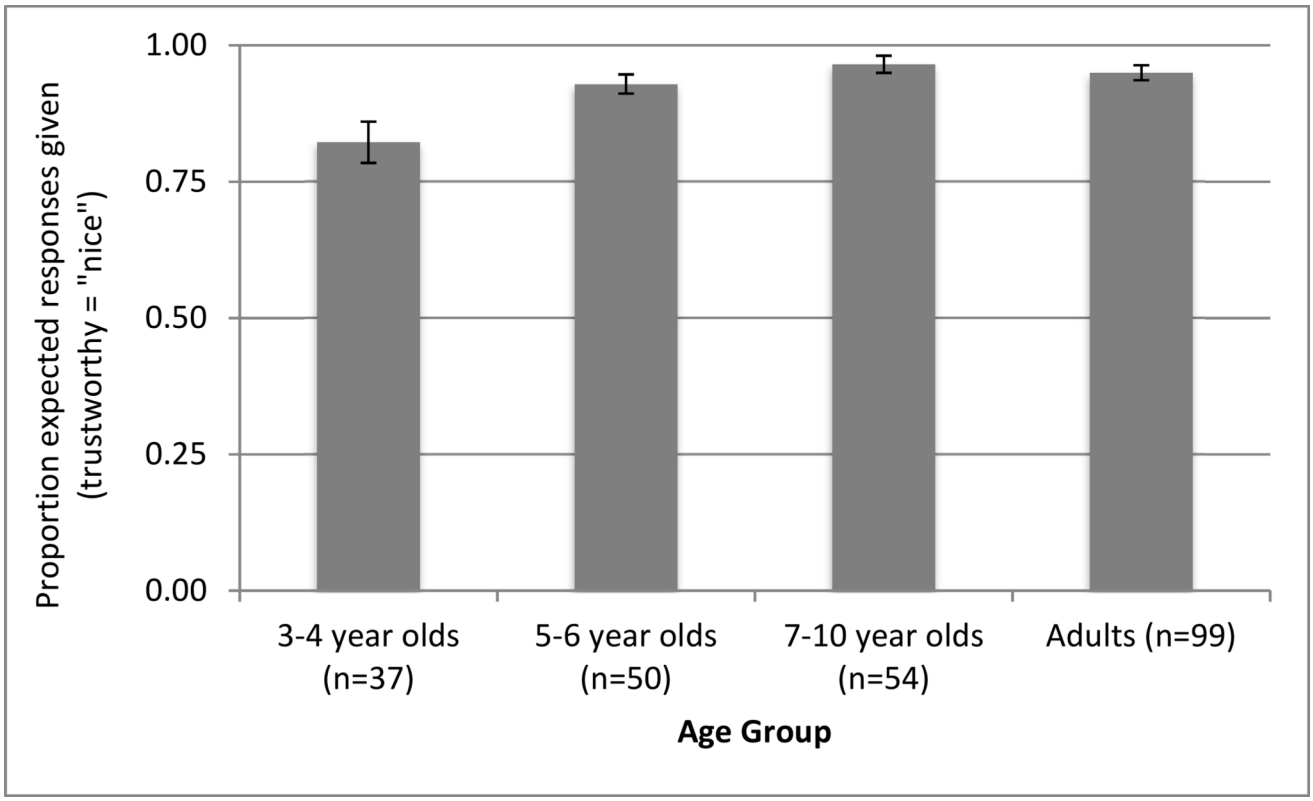

Figure 2.
Average rates of attributing “nice” to trustworthy and “mean” to untrustworthy faces. Error bars represent SEM.

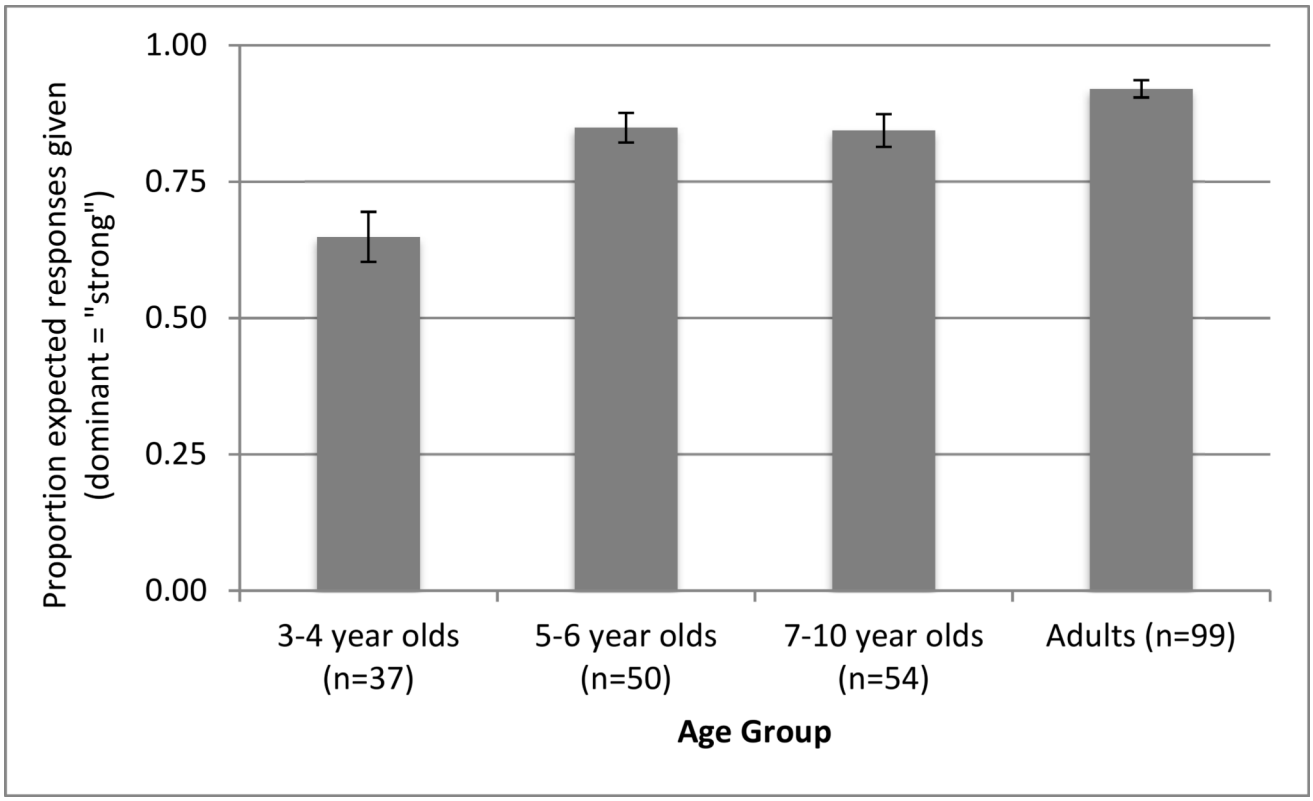

Figure 3.
Average rates of attributing “strong” to dominant and “not very strong” to submissive faces.

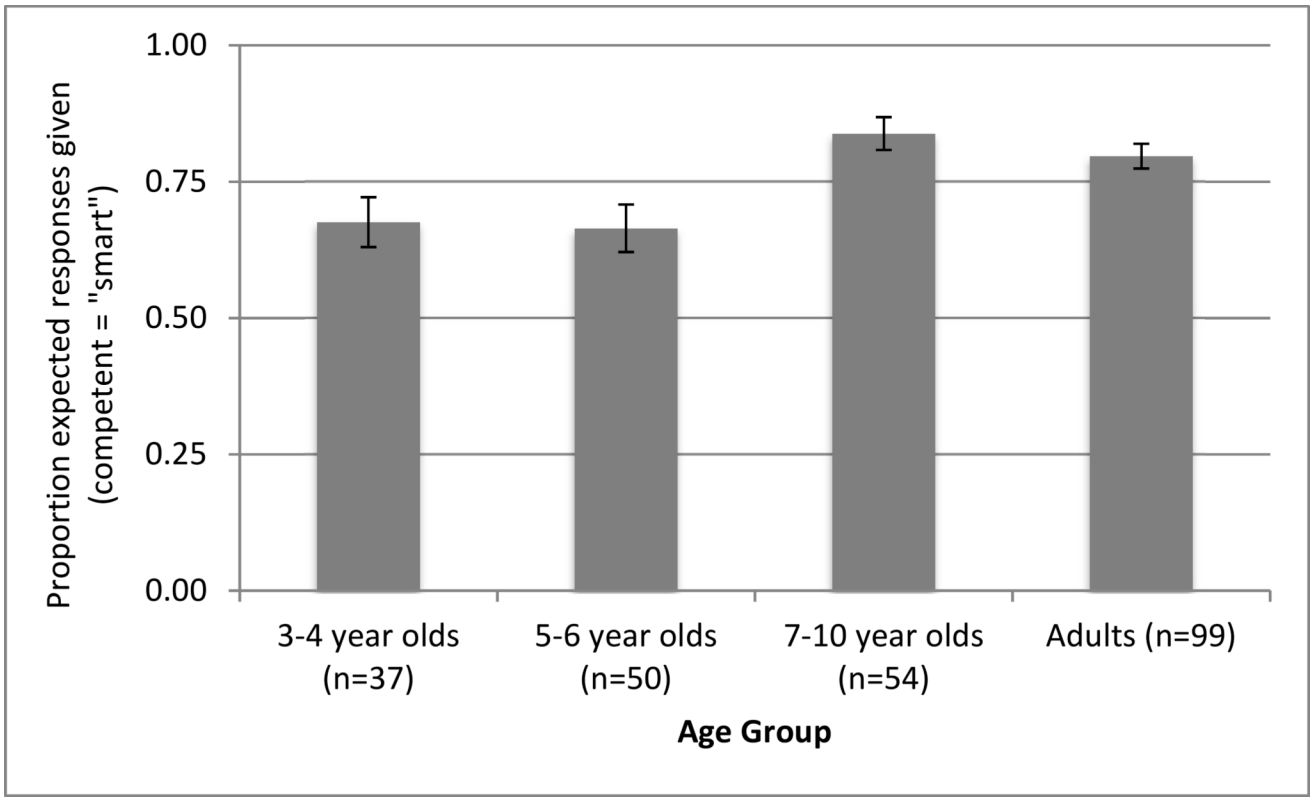

Figure 4.
Average rates of attributing “smart” to competent and “not very smart” to incompetent faces.

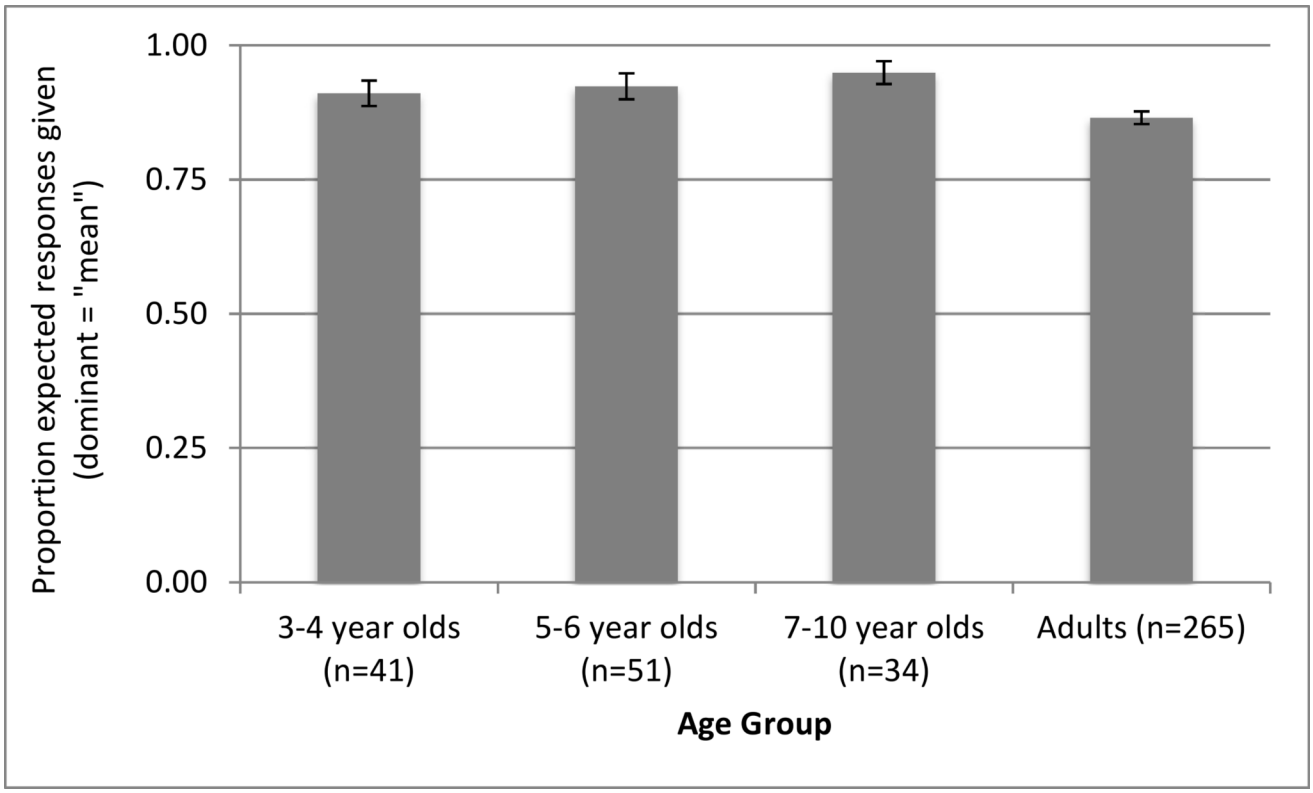

Figure 5.
Average rates of attributing “nice” to submissive and “mean” to dominant faces (Experiment 2).

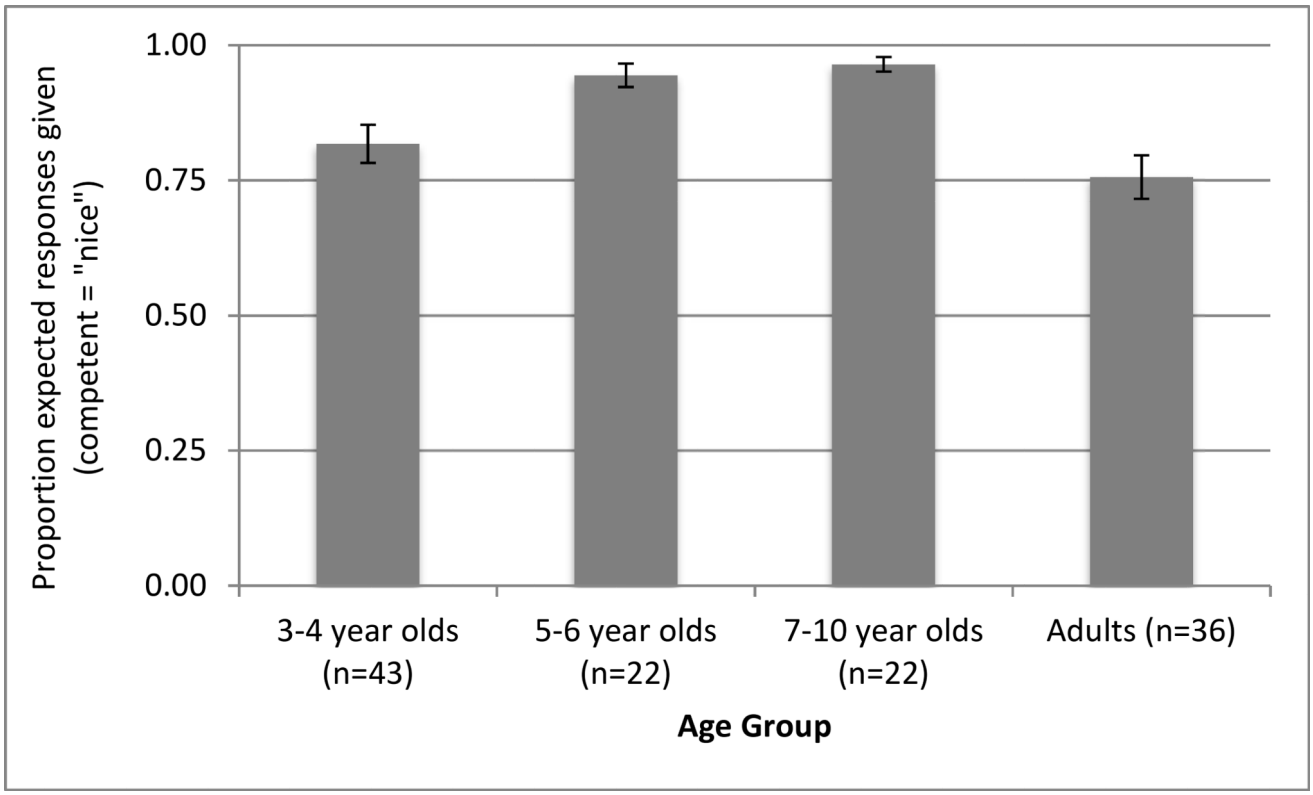

Figure 6.
Average rates of attributing “nice” to competent and “mean” to incompetent faces.