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Appearance-based trust behaviour is reduced in children with autism spectrum disorder

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Abstract:	Typical individuals make rapid and reliable evaluations of trustworthiness from facial appearances, which can powerfully influence behaviour. However, the same may not be true for children with autism spectrum disorder (ASD) Using an economic trust game, the current study revealed that like typical children, children with ASD rationally modulated their trust behaviour based on non-face cues to partner trustworthiness (e.g., reputation information) Critically however, they are no more likely to place their trust in partners with faces that look trustworthy to them, than those that look untrustworthy. These results cannot be accounted for by any group differences in children's conceptualization of trustworthiness, ability to read trustworthiness from faces, or understanding of the experimental paradigm. Instead, they seem to suggest that there may be a selective failure to spontaneously use facial cues to trustworthiness to guide behaviour in an ecologically valid context. Such a processing atypicality could have important implications for social processing in ASD.

Abstract

Typical individuals make rapid and reliable evaluations of trustworthiness from facial appearances, which can powerfully influence behaviour. However, the same may not be true for children with autism spectrum disorder (ASD). Using an economic trust game, the current study revealed that like typical children, children with ASD rationally modulate their trust behaviour based on non-face cues to partner trustworthiness (e.g., reputation information). Critically however, they are no more likely to place their trust in partners with faces that look trustworthy to them, than those that look untrustworthy. These results cannot be accounted for by any group differences in children's conceptualization of trustworthiness, ability to read trustworthiness from faces, or understanding of the experimental paradigm. Instead, they seem to suggest that there may be a selective failure to spontaneously use facial cues to trustworthiness to guide behaviour in an ecologically valid context. Such a processing atypicality could have important implications for social processing in ASD.

Though most would agree that one shouldn't judge a book by its cover, typical individuals are powerfully drawn to read trait information from faces (Hassin and Trope, 2000). For example, strong and reliable attributions of trustworthiness are made after very brief exposure to faces (Willis and Todorov, 2006) and these impressions influence behaviour. During economic interactions (e.g., trust games, Berg, Dickhaut and McCabe, 1995) participants trust their partners with significantly larger investments if they are perceived to have trustworthy-looking faces, rather than untrustworthy-looking faces (Chang, Doll, van't Wout, Frank and Sanfey, 2010; Rezlescu, Duchaine, Olivola and Chater, 2012; van't Wout and Sanfey, 2008).

There is a growing interest in social cognition and trait inferences in individuals with autism spectrum disorder (ASD), who often experience difficulties reading social information from faces (Webb, Faja and Dawson, 2011). Their perceptions of trustworthiness have received particular attention, because these judgments have been linked with the functioning of the amygdala (Adolphs, Sears and Piven, 2001; Winston, Strange, O'Doherty and Dolan, 2004), which may be atypical in ASD (Ashwin, Baron-Cohen, Wheelright, O'Riordan and Bullmore, 2007; Critchley et al., 2000; Kliemann, Dziobek, Hatri, Baudewig and Heekeren, 2012).

Perhaps surprisingly, studies have often failed to find evidence of atypical facial trustworthiness judgments in individuals (both children and adults) with ASD (Caulfield, Ewing, Avard and Rhodes, 2013; Mathersul, McDonald and Rushby, 2012; Pinkham, Hopfinger, Pelphrey, Piven and Penn, 2008; White, Hill, Winston and Frith, 2006). Despite the links to atypical amygdala fuctioning in ASD, only a few studies have reported selectively atypical (inflated) trust ratings of untrustworthy-looking faces (Adolphs et al., 2001; Couture et al., 2010; Losh et al., 2009). We note, however, that these explicitly prompted judgments of trustworthiness constitute a somewhat superficial measure of trust processing. Cued ratings could remain intact in the presence of profoundly atypical spontaneous responses to face stimuli, e.g., potentially reflecting differences in the emotional and motivational salience of faces for individuals with ASD (see Schultz, 2005). Indeed, there have been reports of atypical neural (Pinkham et al., 2008) and autonomic responses (Mathersul et al., 2012) in adults with ASD when viewing trustworthy and untrustworthy face stimuli.

A critical issue to resolve is whether impressions of trustworthiness modulate behaviour in ASD, as they do for typical individuals. Conveniently, researchers have developed economic trust games (Berg et al., 1995) as an elegant way to measure trust behaviour. In these games, Player A is given funds to invest with Player B, who receives triple whatever is given to her/him and then decides how much (if any) to return to Player A. Willingness to invest/reciprocate in each role signals participants' trust/trustworthiness, respectively. Several recent studies have demonstrated that trust behaviour in these games is powerfully influenced by facial appearances in typical adults (Chang et al., 2010; Rezlescu et al., 2012; van't Wout and Sanfey, 2008) and children (Ewing, Caulfield, Read and Rhodes, 2013). Here, we used an economic trust game to investigate the influence of facial appearances on trust behaviour in children with and without ASD.

In Token Quest, a developmentally appropriate trust game (see Ewing et al., 2013) participants took the role of Partner A in interactions across three experimental conditions: 1) when participants had no information about their partners, 2) when they had access to photographs of the faces of their partners, who appeared either very trustworthy or untrustworthy and 3) when they had access to reputation information about their partners indicating a history of past behaviour that sounded very trustworthy or untrustworthy.

We confirmed participants' perceptions of our face stimuli with an explicit trustworthiness-rating task and asked whether, like typical children, the children with ASD would selectively invest more tokens in those partners that looked trustworthy, than untrustworthy. We included the non-face (reputation) condition to determine whether any atypicalities in the use of trust information was specific to facial cues, or might reflect a broader trust processing atypicality. On special bonus trials, we also gave participants the opportunity to purchase access to these face and non-face cues (using their investment capital), reasoning that willingness to purchase might reveal whether they explicitly valued access to the faces and reputation information when making trust decisions, like typical children (Ewing et al., 2013) and adults (Eckel and Petrie, 2011). Together, these measures were intended to reveal how children with ASD read and use face and non-face cues to partner trustworthiness spontaneously and when explicitly prompted to do so.

Method

Participants

Nine cognitively-able boys with ASD aged 6 years 9 months to 11 years 10 months were recruited from the West Australian Register for Autism Spectrum Disorders, local schools and community groups (see Table 1) Each had received an independent diagnosis of an ASD by a multidisciplinary team following DSM-IV criteria (American Psychiatric Association, 2013) and were rated at or above the cut-off for clinically significant levels of symptomatology (score of 12, Corsello et al., 2007) by their parents on a retrospective measure of autism symptoms: the Social Communication Questionnaire (SCQ, Rutter, Bailey, Lord and Berument, 2003) All children were also scored above the autism spectrum cut-off (score of 7) on Module 3 of the Autism Diagnostic Observation Schedule-2 (ADOS-2; Lord et al., 2012), which is a measure of current ASD symptomatology.

In addition, 9 typically developing children (6 male) aged between 6 years 6 months and 9 years 11 months were recruited from local schools and community groups. These children were well matched to the ASD sample on non-verbal IQ and full-scale IQ and did not significantly differ in chronological age or verbal IQ (see Table 1). No typically developing participant displayed clinically significant levels of autistic symptomatology, as indexed by scores below the cut-off on the SCQ.

INSERT TABLE 1 ABOUT HERE

Procedure

All parents provided written consent prior to their children's participation in the project. All children also gave verbal and written assent before taking part. Token Quest was part of two or three extended testing sessions that were administered in the family home, at their school or at the University of Western Australia. During these sessions, children completed the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999), the ADOS-2 and five other experimental tasks unrelated to this study, programmed in Superlab 4 (Cedrus Corporation, 2008) and presented on a 15-inch MacBook Pro laptop computer.

Token Quest. This task measures willingness to trust others in an economic investment paradigm. Participants played 3 standard rounds (8 partners/trials) and 2 bonus rounds (2 partners/trials) of Token Quest (see Ewing et al., 2013 for more detailed description of the task and stimuli). In each round, participants were given the opportunity to invest 6 tokens, which looked like pieces of pirate treasure, with different (bogus) partners. These partners were described as staff and students from our University that had previously told us how they would play the game. On each trial, a representation of a partner appeared alongside the text "How many tokens would you like to give this partner?" (Figure 1), which remained on screen until the participant gave 0 - 6 tokens to the experimenter.

In each of the standard rounds, participants saw partners represented as either a blank identity (head silhouette) image (Round 1, Figure 1A), a photograph of a very trustworthy- or untrustworthy-looking face (as judged by adults) sourced from the Internet (Round 2, Figure 1B) or reputation information (presented as text and read aloud) about previous trustworthy or untrustworthy behaviour during the game (Round 3, Figure 1C). After each of Rounds 2 and 3, participants completed two bonus rounds. They were told that if they would like to see the faces of 2 additional partners (after Round 2) or access reputation information about their past behaviour (after Round 3), it would cost them 3 of their 6 tokens for that round (Figure 1D and E). If they elected not to purchase these cues, they viewed blank identities.

INSERT FIGURE 1 ABOUT HERE

Token Quest began with an extended explanation of the aims and rules of the game. Participants then completed two blank-identity practice trials. After each of these trials, a feedback screen revealed how many tokens the partner chose to return to them. This feedback was pre-determined to give participants one high token return experience (7 tokens) and one low token return experience (0 tokens). During the remainder of the game, feedback was provided at the end of each round to ensure that token returns were not associated with any specific partners. In all rounds, the number of tokens 'returned' to participants was contingent upon the number of tokens invested. All investments were rewarded, regardless of the identity of the 'trustee', such that participants that invested all or most of their tokens made better returns that those who invested fewer tokens. This feedback was presented on the computer screen and transferred to a personalized paper progress chart so that participants could keep track of the tokens in their treasure chest across rounds.

After completing Token Quest, participants were given a brief description of interpersonal trustworthiness that focused on three key elements: honesty, reliability and emotional trust (Rotenberg, 1994; Rotenberg et al., 2005). They then rated the trustworthiness of characters in six brief behavioural vignettes (3 trustworthy, 3 untrustworthy) to confirm that they understood the concept. They used a 7-point scale consisting of numbered cups (1 = not very trustworthy, 7 = very trustworthy) to make these ratings, via the keyboard (see Cooper, Geldart, Mondloch and Maurer, 2006). They then used the same scale to rate the trustworthiness of the 5 trustworthy and 5 untrustworthy stimuli presented during the game[1]. These faces appeared on screen individually (order

[1] Some participants might have only viewed 8 faces of the 10 faces during Token Quest, if they chose not to reveal the faces of the identities in the face identity bonus round.

randomized) until participants made their rating. Together, Token Quest and the rating task took approximately 20 minutes to complete.

Results

Understanding Trustworthiness

Children with ASD did not demonstrate any difficulties understanding the concept of trustworthiness. A 2 x 2 mixed ANOVA investigating the effects of group (ASD, typical) and stimulus trustworthiness (trustworthy, untrustworthy) on participants trust ratings of the characters in our behavioural vignettes revealed a significant main effect of trustworthiness, $F(1, 16) = 280.26$, $p <.001$, *partial* $\eta^2 = .94$, with no significant effect of participant group $F(1, 16) = .14$, $p = .70$, *partial* $\eta^2 = .01$ (see Table 2). Furthermore, despite a marginally significant interaction between group and trustworthiness, $F(1, 16) = 3.51$, $p = .07$, *partial* $\eta^2 = .18$, we confirmed that children with and without ASD significantly differentiated between the characters in the trustworthy and untrustworthy vignettes, *t*s > 8.4, *p*s < .001, *d*s > 2.83.

Trustworthiness Perception

There was also no evidence that children with ASD had any difficulties reading trustworthiness information from faces. Using the same ANOVA on children's explicit trust ratings of the faces used in Token Quest, we found that trustworthy faces were rated significantly more highly than the untrustworthy faces, $F(1, 16) = 23.45$, $p <.001$, *partial* $\eta^2 = .59$, with no effect of participant group $F(1, 16) = .26$, $p = .61$, *partial* $\eta^2 = .01$ or interaction involving group $F(1, 16) = 1.85$, $p = .19$, *partial* $\eta^2 = .10$ (Table 2).

INSERT TABLE 2 ABOUT HERE

Trust Behaviour

Most children with and without ASD entered into the spirit of Token Quest, investing all of their tokens in each of the three trust conditions: blank identity, Mdn = 6.0, SD = 0.4; faces, Mdn = 6.0, SD = 0.5; reputation, Mdn = 6.0, SD = 0.8). This ceiling effect indicates that participants were motivated to try to maximize their outcomes via token investments.

The influence of facial trustworthiness on behaviour. To assess how the appearance of trustworthiness influenced trust behaviour in children with and without ASD, we examined the number of tokens that each group invested in trustworthy-looking partners (ASD: M = 2.6, SD = 1.1, Typical: M = 4.2, SD = 1.0) and untrustworthy-looking partners (ASD: M = 3.2, SD = 1.2, Typical: M = 1.8, SD = 1.0). The difference between these values (i.e., tokens to trustworthy minus tokens to untrustworthy) served as our index of the influence of face cues on trust behaviour. There were no outliers, the data were normally distributed and the skew and kurtosis of the distributions for each group (z score < +/- 1.96) indicated that these data were appropriate for parametric analysis (Field, 2009).

A one-way ANOVA revealed that facial trustworthiness cues modulated trust behaviour in typical children significantly more than in children with ASD, $F(1, 17) = 9.92$, $p < .01$, *partial* $\eta^2 = .38$ (Figure 2). One-sample t-tests comparing means to zero revealed a significant influence of face cues on trust behaviour in the typical group, $t(8) = 3.77$, $p<.01$, d = 1.25, but not the children with ASD, $t(8) = 0.89$, $p = .29$. Thus unlike the typical children, children with ASD failed to selectively invest tokens with trustworthy-looking partners rather than untrustworthy-looking partners.

INSERT FIGURE 2 ABOUT HERE

During the face bonus round, fewer children with ASD (44%) than typical children (77%) chose to purchase access to face cues before making their investment decisions, although this difference was not statistically significant, $\chi^2(1) = 2.10$, $p < .14$.

The influence of non-face trustworthiness cues on behaviour. Inconsistent with any notions of broadly atypical trust processing in children with ASD, there was no evidence of atypicalities in the ASD group when participants had access to non-face cues to partner trustworthiness[2]. We calculated the mean difference between tokens invested with partners with trustworthy reputations (ASD: M = 4.9, SD = 1.4, Typical: M = 5.7, SD = 0.5) and untrustworthy reputations (ASD: M = 0.6, SD = 0.7, Typical: M = 0.2, SD = 0.4), to serve as our index of the influence of reputation cues on trust behaviour (see Table 2). Again there were no outliers and although the data were not all normally distributed, the low skew and kurtosis of the distributions for each group (z score < +/- 1.96) mean that parametric analyses were still acceptable (Field, 2009).

Trust behaviour in children with and without autism was powerfully influenced by the reputation cues. One-sample comparisons to zero indicated that both groups selectively invested tokens in partners with a trustworthy reputation rather than an untrustworthy reputation, both ts > 6.50, *ps* < .001, *ds* > 2.16. There was no significant group difference in this preference for trustworthy-sounding partners, $F(1, 17) = 2.32$, $p = .14$, *partial* $\eta^2 = .12$ (Figure 3). Nor was there any difference in willingness to purchase reputation cues

[2] Furthermore, an additional 2 x 2 mixed ANOVA also revealed an interaction between the effects of participant group (ASD, typical) and trustworthiness cue (faces, reputation) on trust behaviour, but unsurprisingly, given the small sample, this effect was only marginally significant, $F(1, 16) = 3.42$, $p = .08$, *partial* $\eta^2 = .17$.

during the reputation bonus round in the ASD group (44%) relative to the typical group (55%), χ^2 (1) = 0.22, p = 0.63.

INSERT FIGURE 3 ABOUT HERE

Discussion

These results reveal an intriguing profile of trust perception and behaviour based on facial appearances in children with ASD. Despite no deficits in understanding trustworthiness as a concept, or perceiving trustworthiness from faces (as in Caulfield et al., 2013; Mathersul et al., 2012; Pinkham et al., 2008; White et al., 2006) we observed a striking difference, relative to typical children, in the way that facial trustworthiness cues influenced behaviour. Specifically, during an economic trust game, children with ASD were no more likely to place their trust in partners that looked trustworthy than those that looked untrustworthy.

Results in the reputation condition signalled that this atypicality did not reflect group differences in how children understood the paradigm or engaged with the task. There, both groups selectively invested more tokens in partners with trustworthy than untrustworthy reputations. Therefore children with ASD had the capacity to invest their tokens rationally, i.e., in line with partner trustworthiness, when they chose to do so. These results validate our developmentally appropriate trust game and our interpretation of participants' investments as an index of perceived partner trustworthiness. They also speak against a broad trust processing atypicality in ASD.

What mechanisms/s might drive atypical trust behaviour based on face cues? One possibility is that children with ASD differ from typical children in the extent to which they *spontaneously* draw inferences about people from their facial appearances. In our study, children with ASD demonstrated intact perceptions of trustworthiness when they were explicitly prompted to rate faces for this characteristic, but they did not appear to draw upon this information during the trust game, when use of these cues was prompted more implicitly. Reduced social interest and atypical looking at faces is often reported in children with ASD (Dawson et al., 1998; Osterlng and Dawson, 1994; Palomo et al., 2006) and a limited 'default' level of scrutiny might limit spontaneous social inferences from faces. When explicitly prompted to make these judgments, however, they seemed to have the capacity to do so.

Another possibility is that they *do* spontaneously infer trustworthiness from faces, but fail to modulate behaviour in light of this information. This might occur for any number of reasons. For example, rational trust behaviour based on face cues might have required complex perspective taking, i.e., in order to anticipate whether each partner would be likely to repay their trust. If this were the case, then difficulties taking putting themselves in the pace of each partner (Baron-Cohen, Leslie and Frith, 1985; Baron-Cohen, Tager-Flusberg and Cohen, 2000; Leekam and Perner, 1991) might explain the relatively indiscriminate investments observed in children with ASD in the face condition, where this would have been more of an issue than in the reputation condition (with its more transparent trustworthiness cues). It also seems plausible that failure to use face cues could also reflect differences in the emotional and motivational salience of faces, associated with atypical amygdala functioning in ASD (see Schultz, 2005).

It seems pertinent to highlight here, that this processing atypicality need not constitute a processing weakness relative to typical children. If faces constitute honest signals of trustworthiness, as argued by some (Porter, England, Juodis, ten Brinke and Wilson, 2008; Stirrat and Perrett, 2010) then of course, a failure to use these cues might also make it harder for individuals with ASD to place their trust in those who most deserve it. Yet if faces are not honest signals of trustworthiness (see Rule et al., 2013) then a reduced influence of these impressions on trust behaviour would actually potentially constitute a social *strength* in this group. Irrespective of the accuracy of the inferences, however, any behavioural differences relative to typical children could introduce a degree of unpredictability into their interactions with others and contribute to social processing difficulties.

We also took an exploratory look at how children with ASD explicitly valued access to face stimuli when making investment decisions. When alerted to the idea that they could purchase access to these cues during the bonus round, more than half of the children with ASD chose to buy them and there was no significant group difference relative to typical children. These results are interesting, but must be interpreted cautiously given the limited data (it was a 'one-shot' measure) and the extent to which participants' intentions when purchasing were somewhat ambiguous. Nevertheless they suggest, again, that group differences in trust behaviour might be less evident participants were explicitly prompted to consider faces as cues to partner trustworthiness, than when these cues were to be considered more independently.

In summary, the current study revealed that when explicitly prompted, children with ASD demonstrated an intact understanding of trust and an intact ability to evaluate trustworthiness from faces. However, in an economic trust game paradigm, these same children failed to spontaneously use this information to guide their trust behaviour. Importantly, rational trust behaviour when provided with access to reputation cues ruled out a broad trust processing atypicality in ASD. This selective failure to modulate behaviour in light of facial trustworthiness cues may contribute to social processing difficulties, relative to typical children. Encouragingly, however, their intact capacity to make these inferences when explicitly prompted suggests that interventions targeting this 'default' difference in spontaneous trust behavior, could be effective.

References

Adolphs R, Sears L and Piven, J (2001) Abnormal processing of social information from faces in autism. *Journal of Cognitive Neuroscience, 13*(2): 232-240.

American Psychiatric Association (2013) *Diagnostic and statistical manual of mental disorders (5th ed.)* Arlington, VA: American Psychiatric Publishing.

Ashwin C, Baron-Cohen S, Wheelright S, O'Riordan M and Bullmore E (2007) Differential activation of the amygdala and the 'social brain' during fearful face-processing in Asperger Sydrome. *Neuropsychologia, 45*, 2 - 14.

Baron-Cohen S, Leslie A and Frith U (1985) Does the autistic child have a "Theory of Mind?". *Cognition, 21*, 37 - 46.

Baron-Cohen S, Tager-Flusberg H and Cohen D (2000) *Understanding other minds: Perspectives from Developmental Cognitive Neuroscience* (2nd ed.) Oxford: Oxford University Press.

Berg J, Dickhaut J and McCabe K (1995) Trust, reciprocity and social history. *Games and Economic Behavior, 10*, 122-142.

Caulfield F, Ewing L, Avard E and Rhodes G (2013) The influence of emotional expressions on trustworthiness judgments in children with Autism Spectrum Disorders. *in preparation*.

Chang L, Doll B, van't Wout M, Frank M and Sanfey A (2010) Seeing is believing: Trustworthiness as a dynamic belief. *Cognitive Psychology, 61*, 87 - 105.

Cooper PA, Geldart S, Mondloch CJ and Maurer D (2006) Developmental changes in perceptions of attractiveness: A role of experience? *Developmental Science, 9*(5): 530-543.

Corsello C, Hus V, Pickles A, Risi S, Cook EH, Leventhal BL and Lord C (2007) Between a ROC and a hard place: decision making and making decisions about using the SCQ. *Journal of Child Psychology and Psychiatry, 48*(9): 932-940.

Couture S, Penn D, Losh M, Adolphs R, Hurley R and Piven J (2010) Comparison of social cognitive functioning in schizophrenia and high functioning autism: more convergence than divergence. *Psychological medicine, 40*(4): 569-579.

Critchley H, Daly E, Bullmore E, Williams S, Van Amelsvoort T, Robertson D, Rowe A, Phillips M, McAlonan G., Howlin P and Murphy, G (2000) The functional neuroanatomy of social behaviour: Changes in cerebral blood flow when people with autistic disorder process facial expressions. *Brain, 123*, 2203 - 2212.

Eckel C and Petrie R (2011) Face value. *American Economic Review, 101*, 1497 - 1513.

Ewing L, Caulfield F, Read A and Rhodes G (2013) Trust behaviour is modulated by facial appearance from 5 years of age.

Field A. (2009) *Discovering Statistics Using SPSS*. London: Sage Publications.

Hassin R and Trope Y. (2000) Facing faces: Studies on the cognitive aspects of physiognomy. *Journal of Personality and Social Psychology, 78*(5): 837-852.

Kliemann D, Dziobek I, Hatri A, Baudewig J and Heekeren H (2012) The role of the amygdala in atypical gaze on emotional faces in autism spectrum disorders. *journal of Neurscience, 32*, 9469 - 9476.

Leekam S and Perner J (1991) Does the autistic child have a metarepresentational deficit? *Cognition, 40*, 203 - 218.
Lord C, Rutter M, DiLavore P, Risi S, Gotham K and Bishop D (2012) *Autism Diagnostic Observation Schedule, Second Edition (ADOS-2) Manual (Part I): Modules 1-4*. Torrance, CA: Western Psychological Services.
Losh M, Adolphs R, Poe M, Couture S, Penn D, Baranek G and Piven J (2009) The neuropsychological profile of autism and the briad autism phenotype. *Archives of General Psychiatry, 66*, 518 - 526.
Mathersul D, McDonald S and Rushby JA (2012) Psychophysiological correlates of social judgement in high-functioning adults with autism spectrum disorder. *International Journal of Psychophysiology*.
Pinkham AE, Hopfinger JB, Pelphrey KA, Piven J and Penn DL (2008) Neural bases for impaired social cognition in schizophrenia and autism spectrum disorders. *Schizophrenia research, 99*(1-3): 164-175.
Porter S, England L, Juodis M, ten Brinke L and Wilson K (2008) Is the face a window to the soul? Investigation of the accuracy of intuitive judgments of the trustworthiness of human faces. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement, 40*(3): 171-177.
Rezlescu C, Duchaine B, Olivola C and Chater N (2012) Unfakeable Facial Configurations Affect Strategic Choices in Trust Games with or without Information about Past Behavior. *PLOS ONE, 7*. doi: doi:10.1371/journal.pone.0034293
Rotenberg, KJ (1994) Loneliness and interpersonal trust. *Journal of Social and Clinical Psychology, 13*(2): 152-173.
Rotenberg KJ, Fox C, Green S, Ruderman L, Slater, K, Stevens K and Carlo G (2005) Construction and validation of a children's interpersonal trust belief scale. *British Journal of Developmental Psychology, 23*(2): 271-293.
Rutter M, Bailey A, Lord C and Berument S (2003) Social communication questionnaire. *Los Angeles, CA: Western Psychological Services*.
Stirrat M and Perrett D (2010) Valid facial cues to cooperation and trust: Male facial width and trustworthiness. *Psychological Science, 21*, 349-354.
van't Wout M and Sanfey A (2008) Friend or foe: The effect of implicit trustworthiness judgments in social decision-making. *Cognition, 108*, 796 - 803.
Webb SJ, Faja S and Dawson G (2011) Face processing in autism. In A. Calder, G. Rhodes, J. Haxby and M. Johnson (Eds.): *The Handbook of Face Perception* (pp. 839 - 856) Oxford: Oxford University Press.
Wechsler D (1999) *Wechsler abbreviated scale of intelligence*: Psychological Corporation.
White S, Hill E, Winston J and Frith U (2006) An islet of social ability in asperger syndrome: Judging social attributes from faces. *Brain and Cognition, 61*, 69 - 77.
Willis J and Todorov A (2006) First impressions: Making up your mind after 100 ms exposure to a face. *Psychological science, 17*, 592-598.
Winston J, Strange B, O'Doherty J and Dolan R (2004) Automatic and intentional brain responses during evaluation of trustworthiness of faces. *Social Neuroscience: Key Readings*, 277-283.

Table 1.

Descriptive statistics for age, cognitive ability and autism symptomatology measures.

Measure	Group				
	Children with ASD (n = 9)		Typical Children (n = 9)		
	M (SD)	Range	*M (SD)*	Range	
Age (mnths)	108.9 (21.8)	81 – 142	98.0 (14.8)	78 - 119	$t(16) = 1.24, p = .23$
Nonverbal IQ[a]	106.6 (16.1)	84 – 126	106.3 (16.1)	81 - 141	$t(16) = .03, p = .97$
Verbal IQ[a]	94.8 (9.1)	81 - 108	99.1 (6.9)	87 - 109	$t(16) = 1.14, p = .27$
Full Scale IQ[a]	99.9 (10.5)	87 - 116	102.7 (7.1)	88 - 112	$t(16) = .65, p = .52$
SCQ[b]	27.5 (7.4)	12 - 34	2.3 (3.2)	0 - 9	$t(16) = 9.3, p <.001$
ADOS-2[b]	10.9 (4.2)	8 - 21			

[a] Nonverbal and verbal IQ were measured with the WASI (Wechsler, 1999): Matrix Reasoning and Block Design (nonverbal IQ) and Similarities and Vocabulary (verbal IQ) Full-scale IQ (FSIQ) was derived by standardizing the sum of both verbal and performance ability scores against age-based norms. [b] Higher scores on both the SCQ (Rutter et al., 2003) and ADOS-2 (Lord et al., 2012) indicate a greater degree of autism symptomatology.

Table 2. *Trustworthiness ratings (1 = not very trustworthy, 7 = very trustworthy) assigned to trustworthy and untrustworthy stimuli by each group.*

	Trustworthy	Untrustworthy
Vignettes	M (SD)	M (SD)
Children with ASD	6.0 (1.1)	1.9 (1.0)
Typical Children	6.4 (0.6)	1.2 (0.4)
Faces		
Children with Autism	4.2 (1.4)	2.9 (0.8)
Typical Children	4.9 (0.8)	2.5 (1.3)

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Figure 1. Examples of stimuli presented during the different rounds of Token Quest: A) blank identity, B) face identity (note – this identity was not used in the task): C) reputation information. We also show the screens from the two bonus rounds that introduced participants to the notion of paying for access to D) faces and E) 'hints', i.e., reputation information.
147x88mm (72 x 72 DPI)

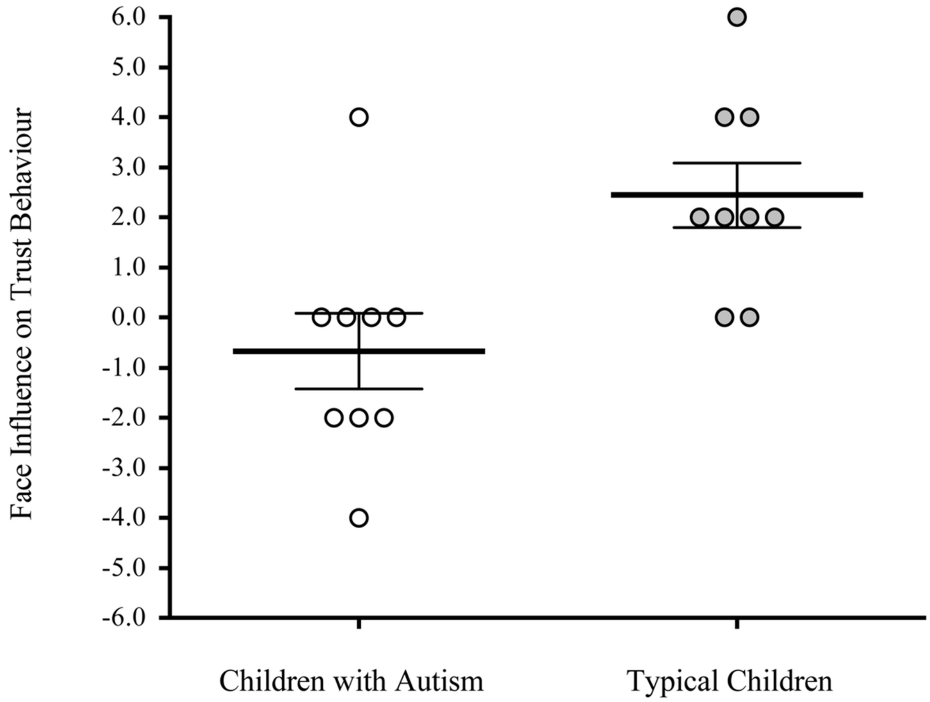

Figure 2. Mean (SEM) difference between token investments with partners with trustworthy faces and untrustworthy faces (i.e., investments to trustworthy minus untrustworthy faces) in children with ASD and typical children.
107x76mm (300 x 300 DPI)

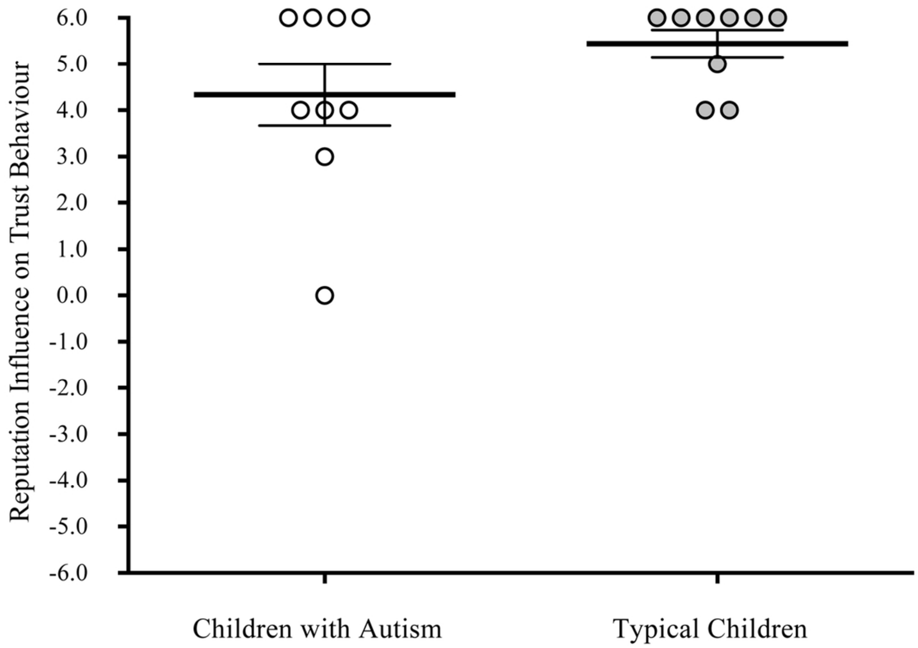

Figure 3. Mean (SEM) difference between token investments in partners with trustworthy reputations and untrustworthy reputations (i.e., investments to trustworthy- minus untrustworthy-sounding partners) in children with ASD and typical children.
110x81mm (300 x 300 DPI)