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ORIGINAL PAPER

Judgments of Nonverbal Behaviour by Children with High-Functioning Autism Spectrum Disorder: Can they Detect Signs of Winning and Losing from Brief Video Clips?

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Abstract Typically developing children are able to judge who is winning or losing from very short clips of video footage of behaviour between active match play across a number of sports. Inferences from "thin slices" (short video clips) allow participants to make complex judgments about the meaning of posture, gesture and body language. This study extends the use of the thin slice research paradigm to children with high-functioning autism spectrum disorder (ASD). We tested 38 children with ASD, in two age groups: 15 participants aged 5–8 years and 23 participants aged 9–13 years. We found that the children with ASD had a rate of accuracy similar to that of typically developing peers tested in a previous study.

Keywords Sport · Emotion expression · Nonverbal behavior · Thin slices · Autism · Social rank

Introduction

Autism spectrum disorder (ASD) is a developmental disability, which under the new DSM-5 criteria is described as having two key features; qualitative impairments in social interaction and communication , and restricted interests, repetitive behaviours and activities (American Psychiatric Association 2013; World Health Organization 1992; Young and Rodi 2014). Many studies have attempted to identify the underlying social skills difficulties experienced by children with ASD (DeRosier et al. 2011; Poljac et al. 2013) with a view to ameliorating these difficulties with training.

Emotion recognition is one of the most important skills in social interactions and in the development of empathy (Baron-Cohen 2002). Many studies have shown that children and adults with ASD are impaired in their ability to recognise emotions from facial expressions (Hobson 1986; Macdonald et al. 1989; Ozonoff et al. 1990) when using still photographs, but there have been a number of studies that have failed to replicate these findings. However, there are considerable methodological variations in the studies in this area with a wide variety of tasks being employed. Sometimes participants are given a list of emotion words and asked to say which one is the best match to the photograph of a facial expression (Ashwin et al. 2006) which primes the individual to look for emotional expressions and judge between a small range of choices. Alternatively, some studies have used a matching paradigm, in which the participant is asked to match pictures of facial expressions with target pictures (Castelli 2005, experiment 1; Celani et al. 1999) which might be achieved by pattern matching rather than emotion recognition. Still others required the participant to answer 'yes' or 'no' to the question of whether a photograph matched a target emotion for that block of the experiment (Tracy et al. 2011).

A recent meta-analysis by Uljarevic and Hamilton (2013) attempted to address these mixed results. The conclusion of their meta-analysis support the idea that recognition of emotions in ASD is a significant area of difficulty, with a mean effect size of Cohen's d = .80;

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albeit this reduces to an estimated effect size of .41 when a correction for publication bias is applied. This is close to the value of .5 that Cohen gave for a medium effect size (Cohen 1988). Though the meta-analysis supports the conclusion that emotion recognition is an area of difficulty for children and adults with ASD, it does not explain which methodological factors give rise to the variety of results.

The use of still images in assessing emotion recognition skills has been questioned by some researchers; for instance Back et al. (2009) point out that research on face recognition has found that participants perform better with dynamic stimuli than with static images and it may be that certain temporal cues are being relied upon that are not present in a still image. The importance of temporal cues was highlighted by Balas et al. (2012). In their study, children and adult participants watched short silent video clips in which a target child played with Lego (either in the off-screen presence of an adult or alone) and found they could detect the presence of an unseen social participant. Adults and older children benefitted from the videos being played in temporal sequence, rather than reversed, suggesting that adults (but not young children) are sensitive to natural movement in social interactions. This sensitivity to movement suggests that the use of video rather than photographic stimuli might be a better and more realistic test of in vivo emotion recognition skills in non ASD participants.

It might be the case that children and adults with ASD can perform at the same level as controls on "mindreading" and emotion recognition tasks when these tasks are organized in a way that facilitates visual processing. Roeyers et al. (2001) found that, while high-functioning adults with a pervasive developmental disorder (PDD) were as good as matched controls on static "mind-reading" tasks using photographs, the same participants showed significantly weaker performances than controls on tests involving inferences about unexpressed thoughts and feelings on a task using more naturalistic materials such as video recordings. Indeed, in many of the studies that did not find deficits in emotion recognition amongst individuals with ASD, the participants were given still photographs to judge (e.g. Tracy et al. 2011). It is also possible that the naming of emotions from photographs, as is often presented in the experimental context, is not lifelike enough to detect the kinds of difficulty people with ASD experience in everyday life. For the experimenter, asking someone to name the emotion provides an easy-to-test source of information. However, this is very dissimilar to the skill needed for everyday social interactions. Furthermore, many of the studies that did not detect problems in emotion recognition relied on the basic emotions (sadness, happiness, disgust, anger, fear and surprise) whereas studies involving complex emotion blends, like embarrassment and trustworthiness, have tended to record more significant difficulties for people with ASD (e.g. Harms et al. 2010).

Some studies have proposed that subtle or more difficult tasks are required to reveal the emotion reading problems that may be present in ASD (Clark et al. 2008; Humphreys et al. 2007; Law Smith et al. 2010). In the last 20 years there has been an increasing interest in the way in which people can "decode" the social world in a seemingly effortless manner from what are referred to as "thin slices" of behaviour. Ambady et al. (2000) have shown that people can be responsive to very subtle features of their social environment. Observers can make accurate judgements about other people based on very brief exposure to the person's behaviour (for instance video recordings of less than 5 min, but frequently as little as 5–10 s); these are referred to as "thin slices". The skills required appear to develop in childhood, and reach adult levels of performance by 9–10 years of age (Balas et al. 2012). A recent study by Furley and Schweizer (2014) showed that children were able to predict whether athletes were leading or trailing during sports matches based on nonverbal behaviour displayed during breaks in games. The mean duration of the video footage was 4 s. One significant benefit of using video clips drawn from real sports matches is that the "thin slices" have high external validity: the nonverbal behaviour happened naturally in real life settings (the stimuli used were not artificially created, but rather were recordings of real table tennis and basketball matches shown on television). Secondly, the actual scores at the time of each clip were known by the researchers, so the judgements of the research participants could be tested against an objective measure of whether or not the athletes were winning or losing. The high correspondence between the children's ratings and the actual score during the videos was attributed to our evolutionary inheritance and the importance of efficiently interpreting status related cues in group-living primates (Furley and Schweizer 2016).

In the present research, we examine whether children with high-functioning ASD can respond to the "thin slice" methodology as a tool for assessing judgements about nonverbal behaviour. Secondly, we compare the ability of children with ASD to recognize winning and losing behaviours with that of typically developing peers. We predict that children with ASD will be less accurate in their interpretations of the nonverbal behaviour in the video clips indicating whether the participants were winning or losing.

Method

Participants

Participants were recruited from a public health disability service. 38 children with a diagnosis of Childhood Autism (World Health Organization 1992) or Asperger Syndrome

(World Health Organization 1992) took part in the study. They had all received a diagnosis through a multidisciplinary assessment using both the ADOS-G (Lord et al. 2000) and either the Autism Diagnosis Interview-Revised (ADI-R) (Lord et al. 1994) or the Diagnostic Interview for Social and Communication Disorders schedule (DISCO-10) (Wing et al. 2002) direct observation of the child and information from other sources such as teachers and therapists.

The clinical group consisted of 15 participants aged 5–8, (12 male and 3 female; M = 7.54 years; SD = 1.24) and 23 participants aged 9–13 (19 male and 4 female; M = 11.08 years, SD = 1.26). Previously obtained Full Scale IQ ranged from Low Average to Superior measured principally using Wechsler Intelligence Scales. 10 children had a diagnosis of Asperger syndrome, while the remaining 28 had a diagnosis of childhood autism.

All of the children were in the so called "high-functioning" range—namely, they have IQs of 70 or more. Schwartz et al. (2010) suggest, given the lack of clear differences between children with high functioning autism and Asperger syndrome, that the groups can be combined for analysis. We pooled our results from these two diagnostic groups. Only individuals with a total IQ in the low average range or above were included to ensure that they were able to understand the test instructions, and that performance was specific to ASD rather than intellectual disability. All children had English as their first language. Ethical research committee approval was obtained and the young people and parents gave written, informed consent. All procedures performed were in accordance with the 1964 Helsinki declaration and its later amendments.

Materials

In order to make comparisons between the participants in the current study and the Furley and Schweizer (2014) study, we used exactly the same video footage, stimulus software presentation package and experimental design. As reported in Furley and Schweizer (2014), the video footage was collected from real televised sports games. This ensured that the videos contained genuine behaviours associated with winning and losing. The videos were taken during breaks in the game, at times when the players were not engaged in active play, to reduce the likelihood that they would contain any sport specific behaviours indicating the current score. Video clips containing obvious nonverbal signs of dominance or shame (e.g. raised fists or hiding the face behind hands) were excluded. The selected basketball videos had a mean duration of 3.9 s (*SD* = 2.8; *Mode* = 1) and selected table tennis videos had a mean duration of 3.5 s (*SD* = 3; *Mode* = 1). The videos are available for viewing on Youtube.[1]

Measure

Immediately after viewing each segment of video, participants rated the scene. Participants rated each scene, by moving a mouse cursor presented in the middle of the scale (representing a tied score/draw), toward either pole of the scale and logged their rating by clicking the left mouse button. The software converted the ratings into a value between .000 at the left pole of the scale with the label "far behind" and 1.000 at the right pole of the scale with the label "high lead." A further semantic anchor for "draw" appeared in the middle of the scale. The scale was further divided into an 11-point digital semantic differential scale to assist participants in providing a clear indication of their ratings.

Procedure

Participants were instructed to estimate who was winning or losing based on the video footage presented to them by moving the mouse cursor towards either the "high-lead" or "far behind" pole of the semantic differential scale. They were further instructed to answer as accurately as possible, while speed was not emphasized. Every participant was tested individually on a standard 17 inch notebook placed 60 cm away from the participants. E-Prime Professional 2.0 (Psychology Software Tools, Inc., Sharpsburg, PA) was used to present the stimuli and collect the judgments. All videos were presented silently to ensure that ratings were based on non-verbal behaviour and not, for example, crowd noise. For every participant the software randomly chose twelve videos from the categories far behind and high lead for both basketball and table tennis. For the other three categories close behind, draw, and close lead only four videos for each sport were randomly chosen so that twelve videos were also presented for the combined category "close score." Hence, every participant viewed 72 videos out of the 200 video clip battery in random order. In other words, different participants were randomly assigned to different sets of videos. This approach helps to ensure that results do not depend on specific combinations of stimuli. After every video clip participants had to give their rating by clicking the left mouse button on the score estimation

[1] In order to maximize transparency in the conducted research we provide hyperlinks to the stimulus material utilized in the studies. Note that the software randomly selected and displayed the stimulus material from the video stream according to the described procedure and not as shown in the video streams:

Basketball: (http://www.youtube.com/watch?v=WIZgJtiKh4w).

Table tennis: (http://www.youtube.com/watch?v=2Y3YeYqTnSY).

scale described above. Children were tested in a quiet room in their school, in the clinic or in a small number of cases at home.

Experimental Manipulation

The manipulation in the study involved the actual score of the game during the video. Following Furley and Schweizer (2014) we used the same five categories of scores: (1) far behind, displaying a team or player trailing substantially, (2) close behind, showing a team or player losing in a fairly close game situation, (3) a draw in which the score was equal; (4) close lead, showing a team or player leading in a fairly close game situation, (5) high lead, displaying a team or player leading substantially.

The data from Experiment 2 of Furley and Schweizer (2014) on typically developing, age-matched children were made available for this study. The original data set consisted of a 4 to 8-year-old group (11 male and 11 female; M = 6.7 years; SD = 1.4) and a 9 to 12-year-old group (12 male and 10 female; M = 11.1 years; SD = .8). Though the age ranges differed slightly between samples, there was no significant difference between the mean ages of the young and older children between the studies (see Table 1).

Results

The descriptive results are displayed in Fig. 1. A 2 (basketball vs. table tennis) × 5 (far behind, close behind, draw, close lead, and high lead) ANOVA revealed no significant main effect of sport on overall score estimates [$F(1, 37) = .375$, $p = .544$, $\eta_p^2 = .010$]. Most importantly, there was a significant main effect of actual score on the score estimates [$F(2.933, 108.515) = 3.420$, $p = .01$, $\eta_p^2 = .085$] indicating that participants with ASD were accurate at estimating whether both basketball and table tennis players were leading or trailing. In addition, there was a significant interaction between sport and actual score [$F(2.946, 109.017) = 5.830$, $p < .001$, $\eta_p^2 = .136$].

Follow-up polynomial linear contrasts across both sports revealed a linear relationship between the score estimates and the score categories [$F(1, 37) = 22.058$, $p < .001$, $\eta_p^2 = .373$] demonstrating that the score estimates corresponded in a linear manner with the scores during the game. The polynomial linear contrast analyses revealed significant linear relationships between the score estimates and the score categories for both the basketball stimuli [$F(1, 37) = 9.291$, $p < .01$, $\eta_p^2 = .201$] and the table tennis stimuli [$F(1, 37) = 12.780$, $p < .001$, $\eta_p^2 = .257$]. The significant interaction is due to the differences in the draw category across both sports, but can be ignored in the following analyses as participants showed similar linear trends in their score estimates across both sports. Therefore, for the comparison between age groups we collapsed the data from the basketball and table tennis stimuli.

Age-Group Comparison

The descriptive results of the comparison between age groups are displayed in Fig. 2. A 2 (younger vs. older) × 5 (far behind, close behind, draw, close lead, and high lead) ANOVA again revealed a significant main effect of actual score on the score estimates [$F(2.926, 105.353) = 3.275$, $p = .025$, $\eta_p^2 = .083$] indicating that, irrespective of the age group and stimulus material, the children with ASD were able to estimate who was leading or trailing based on nonverbal behaviour. The interaction between age group and actual score [$F(4, 144) = .588$, $p = .672$, $\eta_p^2 = .016$] was not significant; the older children did not demonstrate a greater ability to judge who was leading or trailing than the younger children (Fig. 2). However, there was a significant main effect for age group [$F(1, 36) = 6.327$, $p = .016$, $\eta_p^2 = .149$] amongst the children with ASD as the score ratings of the older participants were significantly lower across all score categories, but they were not more accurate across the score categories.

Comparison with Furley and Schweizer (2014)

When comparing the children with ASD to the typically developing children published in Furley and Schweizer (2014), a 2 (children with ASD vs. typically developing children) × 5 (far behind, close behind, draw, close lead, and high lead) mixed-design ANOVA only revealed a significant main effect of actual score on the score estimates (collapsed across both sports; $F(3.372, 269.746) = 3.420$, $p = .001$, $\eta_p^2 = .128$). There was no main effect for ASD group [$F(1, 80) = .190$, $p = .664$, $\eta_p^2 = .002$] and most strikingly no interaction between ASD group and actual score [$F(3.372, 269.746) = .636$,

Table 1 Mean ages by group

	ASD	TD[a]	Statistic	
Younger group—mean age (SD)	7.54 (1.24)	6.7 (1.4)	$t = .008$	n.s.
Older group—mean age (SD)	11.08 (1.26)	11.1 (.8)	$t = -1.79$	n.s.

[a] TD participants in Furley and Schweizer (2014)

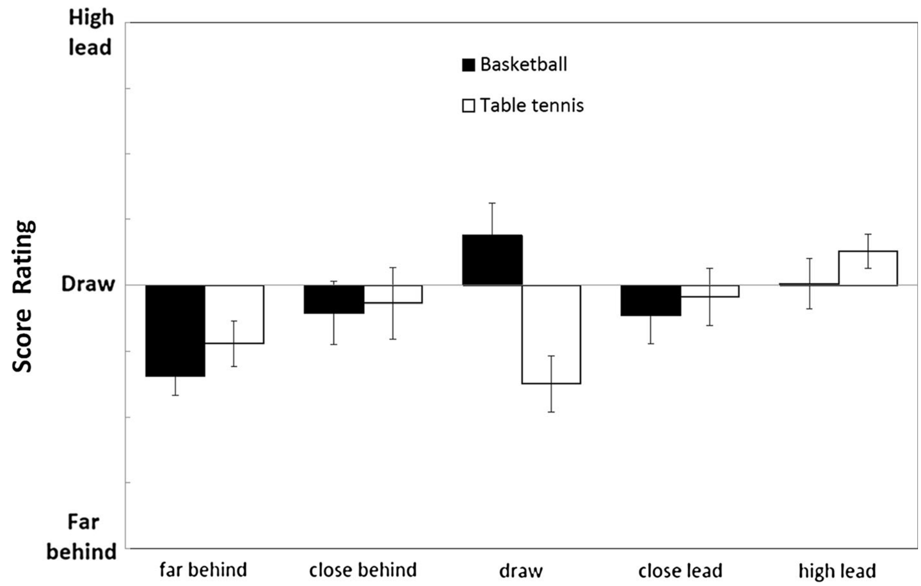

Fig. 1 Mean score (0 = far behind; 1 = high lead) estimates as a function of score category and sport. *Error bars* represent standard errors

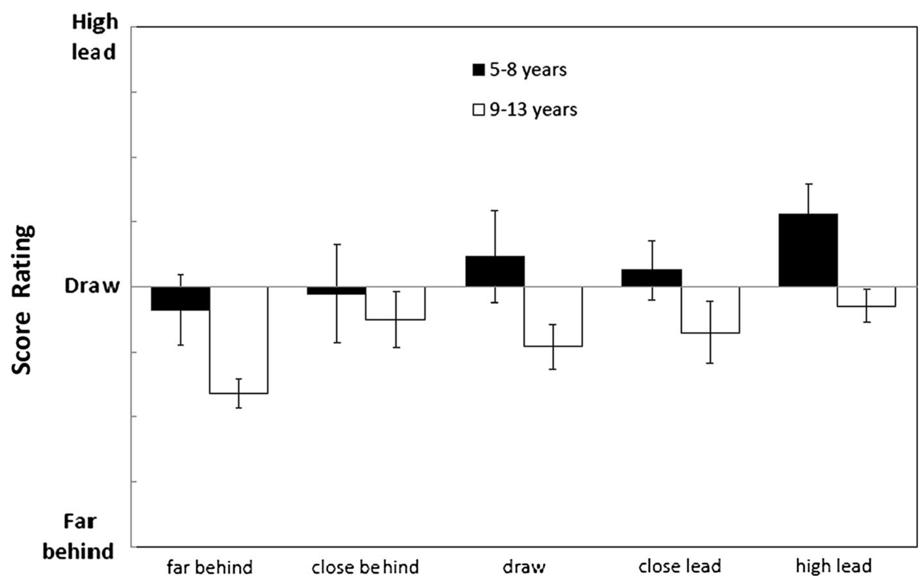

Fig. 2 Mean score (0 = far behind; 1 = high lead) estimates as a function of score category and child age group. *Error bars* represent standard errors

$p = .611$, $\eta_p^2 = .008$] demonstrating that the ratings of both groups corresponded in a similar manner with the score categories. When age-group is added as a factor (younger vs. older children) in a 2 (age-group) × 2 (ASD group) x 5 (score) mixed design ANOVA none of the between-subject variables interacted significantly with score category (all $p > .487$) indicating that all groups score ratings were similarly accurate.

Discussion

This study had two aims: firstly to examine whether children with ASD could understand and respond to an experimental paradigm that has been used with typically developing children and adults; secondly, to investigate whether the children with ASD would be able to judge who was leading or trailing based on thin slice video recordings of an athlete's nonverbal behaviour. The results indicated that 5–13 year old children with ASD were able to understand the video presentation of short clips of behaviours and gave responses using the mouse and laptop. When compared with previously published data on typically developing children (Furley and Schweizer 2014) the ratings made by the children with ASD (effect size $\eta_p^2 = .373$ of the polynomial linear contrast analysis) were similarly accurate as those made by typically developing children (effect size $\eta_p^2 = .582$ of the polynominal linear contrast analysis), albeit accuracy was slightly higher amongst typically developing children. The absence of a significant interaction between ASD group and score category challenges our hypothesis that children with ASD are less able to accurately interpret the nonverbal behaviour in the video clips that indicated whether the athletes were winning or losing. Instead, this suggests that, on average, children with ASD do not differ significantly from their age-peers in their ability to correctly decode nonverbal cues associated with winning or losing. Older children with ASD did not show more accurate performance than younger children, which one might have expected given that Balas et al. (2012) have highlighted that adult levels of performance are not usually achieved until 9–10 years of age. However, the older participants gave scores that were significantly lower across all score categories. There is evidence that depressive symptoms can increase through childhood (Boylan et al. 2011) and depression is associated with negative attributions (Lau et al. 2012). It could be the lower scores given by older participants are a result of more negative attributions. It would be useful, in any future research, to build in assessment of depressive thinking or negative attribution.

One possible explanation for the comparable levels of performance between children with ASD and typically developing peers, on this subtle test of non-verbal behaviour, is that the videos were presented without sound. This was done to ensure that all judgments were based on nonverbal behaviour rather than crowd noise. However, this may have enhanced the performance of participants with ASD, given the growing literature on the difficulties in multisensory integration in ASD (Brandwein et al. 2015; Donohue et al. 2012; Hillock et al. 2011).

It is important to note that in Furley and Schweitzer's (2014) research on which this study was based, video clips were avoided that showed behaviours linked to the final outcome of games (e.g. raised fists or covering one's face), and because the video clips all came during breaks in the game rather than during the actual winning or losing of points, they were less likely to feature explicit displays of emotion through facial expressions. However, it would seem likely that more subtle behavioural markers are present in the video clips and that it is these that are being used to correctly interpret the state of the score in the game. This study demonstrates the utility of using the "thin slices" research methodology with a group of children with ASD. The finding that children with ASD could detect nonverbal cues in these video clips was surprising and raises several interesting questions. For example, what signs, signals or cues are being used by participants, in their inferences about the thin slice videos? We do not know which behaviours exhibited by the athletes are indicative of winning, losing or drawing. How are children with ASD able to make accurate judgments about behaviours associated with winning and losing? Are they using the same behavioural markers as typically developing peers? Can those markers be taught to children with ASD who may perform poorly on the task to improve their ability to correctly interpret complex social information?

In this regard, one of the next steps in research will be to examine the behavioural markers present in the video clips that are associated with the score status. This can be done by coding the behaviours and examining the frequency of each within score categories. Previous research (Furley and Schweizer 2016) would lead us to speculate that behaviours indicative of social status, such as dominance displays, signs of submission, and indicators of pride and shame (Tracy and Matsumoto 2008; Martens et al. 2012) are likely to be relevant. A range of behaviours associated with dominance: erect and expansive posture, relaxed movement and direct gaze towards the opponent (Sloman et al. 2002) and the opposite behaviours: gaze avoidance, turning away one's head, dropping of the shoulders and shifting weight, are present in the video clips and probably form the basis of the correct score category inferences when they occur (see Footnote 1 for hyperlinks to the stimulus material used in this study). A further question will be whether both typically developing participants and those with ASD use the same information to derive their judgments of winning and losing, or whether the participants with ASD are using one or more compensatory strategies. There is a growing literature on such strategies in ASD (Rutherford and Troje 2012; Zalla et al. 2009; Teunisse and de Gelder 2001; Grossman and Klin 2000).

A 'think aloud' strategy could be employed to test what (conscious) cognitive processing the children are engaged in when they make their judgments about the video clips. Participants would be asked to 'think aloud', and verbalize everything that comes to mind, while they are working on the task (Ericsson and Simon 1993). However, due to the risk of verbal overshadowing (verbalizations interfering with performance) with this method, particularly where verbalizations require participants to explain their thoughts and ideas, this was not employed in this first study.

Limitations

There are a number of limitations to the present study. We only attempted to test the ability of children with high-functioning ASD. These results may not generalize to children with lower ability levels, though we do not know of any thin slice study that has tested the impact of cognitive ability. Many thin slice studies rely on trained observers to judge the video clips (Lambert et al. 2014) or untrained participants who are undergraduates (e.g. Oltmanns et al. 2004) so variations in cognitive ability and the impact it has on thin slice judgments have not been examined. Secondly, we did not collect data on any potential visual sensory sensitivity that the children with ASD may have had, nor did we control for visual acuity. Thirdly, gender differences on this task may exist (although these were not evident in Furley and Schweizer 2014, 2016).Women are reported to be more accurate judges of interpersonal behaviour than men (Carney et al. 2007) yet ASD disproportionally affects males. ASD in girls appears to be expressed differently (Carter et al. 2007) which could complicate the study of ASD and gender difference. Our study included too few girls to carry out any meaningful gender comparisons. Fourthly, our comparison to typically developing children relied on previously published data.

Despite these limitations, this is the first study to apply the thin slice paradigm to children with ASD. It raises a number of interesting questions for future research: there is growing evidence that we use dynamic social information in everyday life and in mediating relationships (Grossman 2015; Kendon 2004) and this probably draws on a range of implicit cognitive processes (Spezio et al. 2007, 2012). The thin slice paradigm has great potential in developing our understanding of the scope and limitations of these skills in children with ASD.

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Compliance with Ethical Standards

Conflict of interest All authors declares that they have no conflict of interest.

Ethical Approval All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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