cortex 173 (2024) 150–160

Available online at www.sciencedirect.com

ScienceDirect

Journal homepage: www.elsevier.com/locate/cortex

Special Issue "Neurodevelopmental Neurodiversity": Research Report

Can group membership modulate the social abilities of autistic people? An intergroup bias in smile perception

Ruihan Wu, Antonia F. de C. Hamilton and Sarah J. White *

Institute of Cognitive Neuroscience, University College London, London, UK

ARTICLE INFO

Article history:
Received 28 April 2023
Reviewed 15 June 2023
Revised 24 July 2023
Accepted 28 December 2023
Action editor Punit Shah
Published online 13 February 2024

Keywords:
Autism
Smiles judgements
Smiles discrimination
Intergroup bias
Minimal group

ABSTRACT

Autistic adults struggle to reliably differentiate genuine and posed smiles. Intergroup bias is a promising factor that may modulate smile discrimination performance, which has been shown in neurotypical adults, and which could highlight ways to make social interactions easier. However, it is not clear whether this bias also exists in autistic people. Thus, the current study aimed to investigate this in autism using a minimal group paradigm. Seventy-five autistic and sixty-one non-autistic adults viewed videos of people making genuine or posed smiles and were informed (falsely) that some of the actors were from an in-group and others were from an out-group. The ability to identify smile authenticity of in-group and out-group members and group identification were assessed. Our results revealed that both groups seemed equally susceptible to ingroup favouritism, rating ingroup members as more genuine, but autistic adults also generally rated smiles as less genuine and were less likely to identify with ingroup members. Autistic adults showed reduced sensitivity to the different smile types but the absence of an intergroup bias in smile discrimination in both groups seems to indicate that membership can only modulate social judgements but not social abilities. These findings suggest a reconsideration of past findings that might have misrepresented the social judgements of autistic people through introducing an outgroup disadvantage, but also a need for tailored support for autistic social differences that emphasizes similarity and inclusion between diverse people.

1. Introduction

Social communication differences are intrinsic to the definition of autism, both historically and currently, and difficulties recognising and responding to others' emotional states (ICD-11; World Health Organization, 2018) have long been suggested to be a central feature of autism (Hobson, 1986). However, a substantial body of behavioural research into facial emotion recognition in autism has produced mixed findings, with some studies showing difficulties (e.g., Uljarevic & Hamilton, 2013) but others showing seemingly typical responses (e.g., Cook et al., 2013; Ketelaars et al., 2016). Moreover, autistic people are more accurate than those with ADHD

* *Corresponding author.*
E-mail addresses: r.wu.16@ucl.ac.uk (R. Wu), a.hamilton@ucl.ac.uk (A.F.C. Hamilton), s.white@ucl.ac.uk (S.J. White).
https://doi.org/10.1016/j.cortex.2023.12.018

in recognizing basic emotions, such as happiness, sadness, anger, fear and disgust (Downs & Smith, 2004; Sinzig et al., 2008). One suggested explanation of these observations is that autistic adults are able to recognize basic facial emotions (Castelli, 2005), but struggle to identify more complex and subtle facial emotions (for reviews, see Harms et al., 2010; Liu & Humpolíček, 2013), such as differentiating genuine from posed smiles (Boraston et al., 2008). More detailed study of the perception of these subtly different expressions is therefore important for understanding autistic social communication. However, it remains unclear whether such difficulties are characteristic of autism per se or are, for example, related to alexithymia, a commonly co-occurring condition affecting emotion recognition (Cook et al., 2013; Dyck et al., 2001; Hill et al., 2004; Salminen et al., 1999; Shah et al., 2016).

Smiles are important social cues but are not always a reliable indicator of affective states (e.g., Ekman, 2003; Lazarus, 1991). Genuine smiles are considered to be associated with positive emotions, while posed smiles are not necessarily related to positivity and can be a potential signal that the real emotional state is obscured (Ekman, 2003; Krumhuber et al., 2007), such as when hiding deception (Biland et al., 2008). Consistently, smilers expressing genuine smiles are perceived as more cooperative, likeable and trustworthy, as well as less disingenuous and misleading than those displaying posed smiles (e.g., Biland et al., 2008; Ekman, 2003; Frank & Ekman, 1993; Johnston et al., 2010; Krumhuber et al., 2007; Mehu et al., 2007; Schug et al., 2010). Similarly, genuine smiles are intrinsically more rewarding than posed smiles. People prefer the former over the latter and are willing to offer a higher monetary value to receive genuine than posed smiles (Shore & Heerey, 2011).

There is a physical reality to the differences between the two types of smiles. One of the most robust yet subtle features that differentiates genuine from posed smiles is muscle activation. During genuine smiles, both the zygomatic major (i.e., AU12; in the cheek) and the orbicularis oculi (i.e., AU6; around the eyes) muscles are involuntarily activated, while posed smiles only involve the voluntary activation of the AU12 (Duchenne & de Boulogne, 1990; Ekman et al., 1990; Ekman & Friesen, 1982). Therefore, accurate differentiation between, and response to, them is challenging but also an essential ability to effectively cope with the complexity of social interactions.

Boraston et al. (2008) compared the ability of autistic and non-autistic adults to distinguish between genuine and posed smiles from static images. They found autistic adults were less accurate in discriminating the two smile types than non-autistic adults, but they were just as good at discriminating between neutral and smiling faces. Additionally, in the autism group, the ability to differentiate the two types of smile was negatively associated with the degree of social communication difficulties: the more severe the social difficulties, the more affected the smile discrimination ability. Boraston et al. (2008) suggested that failure to decode these subtle social cues is likely to be associated with reasoning about another's mental state and could contribute to social difficulties in autism.

Blampied et al. (2010) observed similar differences between autistic and non-autistic children using face images displaying a neutral expression, genuine and posed smiles. However, social communication ability was not related to the sensitivity to make subtle distinctions between the two smile types. Similarly, both Heerey (2014) and Manera et al. (2011) did not observe any relationship between individual differences in recognizing smile authenticity and autistic traits, although these studies involved only non-autistic adults. It remains unclear therefore whether this ability contributes to the social communication difficulties in autism.

Given the importance of detecting these subtle facial emotional expressions in everyday life, exploring factors that may modulate emotion identification might not only help explain the difficulties autistic people experience but also highlight possible ways to make social interactions easier to navigate. One potential factor is intergroup bias which refers to the systematic finding that people tend to favour those who are more similar to themselves (i.e., ingroup members) over those who are less similar to themselves (i.e., outgroup members). Ingroup favouritism can regulate how people act towards each other, for example, people tend to cooperate and share resources more with ingroup members but punish outgroup members more harshly (e.g., Balliet et al., 2014; Jordan et al., 2014). These effects are stronger when in-group identity is stronger (Doosje et al., 1995; Ellemers et al., 2002). Intergroup bias can be generated not only when the group boundary is definite in the real world, such as gender and race (e.g., Montagu, 1997; Rudman & Goodwin, 2004), but also when it is completely arbitrary and people are randomly assigned to one of two mutually exclusive groups (i.e., minimal group; e.g., Allen & Wilder, 1975; Doosje et al., 1995; Howard & Rothbart, 1980; Tajfel, 1970).

Intergroup biases have been shown to affect emotion recognition. People tend to be more accurate in decoding basic facial emotions displayed by ingroup members than by outgroup members under definite group boundaries (e.g., Elfenbein & Ambady, 2002) as well as minimal group settings (e.g., Bernstein et al., 2007; Young & Hugenberg, 2010). Indeed, an intergroup bias has been detected in identifying genuine from posed smiles within a minimal group setting (Young, 2017). Surprisingly, an outgroup advantage was observed: people were not only more accurate but also faster in differentiating genuine from posed smiles for outgroup than ingroup smilers. Specifically, people were more likely to mistake posed smiles for genuine from ingroup members. Young (2017) suggested that ingroup favouritism may explain this effect; more positive feelings towards ingroup members may have biased people to interpret ingroup posed smiles as more genuine, whilst wariness of outgroup members may have led to a more vigilant approach.

While no study has assessed an intergroup bias in smile authenticity judgements in autism, a few recent studies have suggested that intergroup bias is attenuated and even absent in autistic people in studies using definite intergroup boundaries (e.g., nationality) and in non-autistic adults with high autistic traits in studies using minimal group settings. Qian et al. (2022) investigated intergroup bias in "third-party punishment" behaviours in autistic adults and found that non-autistic adults penalised outgroup members more harshly than ingroup members by removing money, but this ingroup favouritism was attenuated in autistic adults. With a similar paradigm, Vaucheret Paz et al. (2020) found the effect of intergroup bias was completely absent in autistic children compared with three other neurodivergent groups: children with ADHD, learning disabilities and intellectual disability. With a different paradigm, Uono et al. (2021) observed an attenuated racial intergroup bias in perceiving self-directed gazes (i.e., gazes that look at self) in autistic compared to non-autistic adults, even though both groups did equally well in distinguishing self-directed gaze from averted gaze. Likewise, with non-autistic adults, Bertschy et al. (2020) reported that higher autistic traits were associated with less ingroup favouritism in a minimal group paradigm.

On the other hand, the cross-race effect, the tendency to recognize own racial (i.e., ingroup) faces more easily than other racial faces, appears to be typical in autistic adults and children in studies, at least in those studies where the facial gaze patterns of both groups were comparable (Hadad et al., 2019; Kang et al., 2020; Wilson et al., 2011; Yi et al., 2015, 2016), indicating that it is possible to detect intergroup bias in autism under the right condition. Importantly, none of the aforementioned studies measured group identification, so the potential effect of the subjective attitude of autistic people towards their group membership is not clear; if they did not feel so closely affiliated with ingroup members, it might not be surprising that an intergroup bias was reduced or absent. Consequently, group membership seems to be a compelling factor that may potentially modulate the accuracy of autistic people when decoding subtle facial expressions, such as smile authenticity.

Another factor that may modulate emotion recognition and also relate to intergroup bias is empathy. Empathy enables people to understand and share another's emotions and feelings (De Vignemont & Singer, 2006; Singer et al., 2004) and plays a crucial role in emotion recognition (Dyck et al., 2001) and intergroup relations (Dovidio et al., 2010; Vanman, 2016). Although it is hotly debated, autistic people have been widely reported to show empathic difficulties (Baron-Cohen & Wheelwright, 2004; Bird & Viding, 2014; Smith, 2009). This is related not only to their difficulties in identifying emotional expressions (Dyck et al., 2001; Sucksmith et al., 2013) but also to their attenuated favouritism towards ingroup members (Qian et al., 2022; Vaucheret Paz et al., 2020). However, it should not be overlooked that the prevalence of alexithymia, referring to difficulties in identifying and describing one's own emotions, is significantly higher in autism than in the general population (Hill et al., 2004; Salminen et al., 1999; Shah et al., 2016). Although characterised as involving difficulties identifying one's own emotions, Bird et al. (2010) found that alexithymia, but not autism, can predict empathic brain responses in the left anterior insula, linking alexithymia rather than autism to difficulties representing other's emotions. Indeed, co-occurring alexithymia in autism may be directly responsible for emotion recognition difficulties (Cook et al., 2013) and attenuated intergroup bias (Komeda et al., 2019) instead of autism per se.

We predicted that.

1. autistic adults would show an intergroup bias on smile authenticity judgements, rating ingroup smiles as more genuine than outgroup smiles
2. this intergroup bias would be attenuated in autistic adults compared to non-autistic adults
3. autistic adults would show less sensitivity to smile types, rating genuine smiles and posed smiles as more similar compared to their non-autistic counterparts
4. both autistic and non-autistic adults would show greater discrimination between genuine and posed smiles for outgroup than ingroup smiles
5. both non-autistic and autistic adults would be more likely to identify with ingroup than outgroup members, but autistic adults would possess an attenuated intergroup identification compared to non-autistic adults
6. higher degrees of empathy would be associated with higher ingroup identification and more genuine ingroup smile ratings.

2. Method

We report how we determined our sample size, all data exclusions, all inclusion/exclusion criteria, whether inclusion/exclusion criteria were established prior to data analysis, all manipulations, and all measures in the study. No part of the study procedure/analyses was pre-registered prior to the research being conducted.

2.1. Participants

Across the two diagnostic groups, 151 adults (85 females, 66 males) were recruited. The sample size was calculated to be 41 per group, assuming a medium effect size ($f = .25$), by referring to Young (2017)'s and Boraston et al. (2008)'s studies, and a power of .80. However, given the current study was conducted online, we decided to increase the sample size by a further 50% in each group, to mitigate the noise that may be introduced by the lack of control over participants' hardware, software and environment (Rodd, 2023). Prolific (www.prolific.co) was used for recruitment and Gorilla (www.gorilla.sc) for creating and delivering the experiment. Participants were required to be fluent in English and have normal or corrected-to-normal vision. The autism criterion in Prolific in addition to a questionnaire, including autism diagnosis, age of diagnosis, and family history, was used to identify autistic and non-autistic participants. Participants were over recruited to allow for participants who might need to be excluded and so that we might ensure a close match for age and non-verbal reasoning between the groups.

Fifteen participants from the entire sample were excluded prior to data analysis, who were inconsistent in reporting their diagnosis, or who self-identified as autistic without a diagnosis. The resulting two groups (75 autistic and 61 non-autistic) were comparable for age, sex, educational level and non-verbal reasoning as measured by the Matrix Reasoning Item Bank (MaRs-IB; Chierchia et al., 2019), but, as expected, were significantly different in autistic traits, alexithymia, and empathic concern (see Table 1). Additionally, although both groups were predominantly white, the proportion in the autism group was significantly higher than in the non-autism group. Given that emotion recognition sensitivity is independent of verbal ability

Table 1 – Autistic and non-autistic participants' characteristics; Mean (Standard Deviation).

	Autism ($n = 75$)	Non-autism ($n = 61$)	Inferential statistic
Sex (M:F)	35:41	28:33	$\chi^2(1) = .14$, $p = .706$, odds ratio = .88
Age	28.27 (9.15)	29.05 (8.45)	$t(134) = -.51$, $p = .610$, $d = -.09$
Ethnicity	Asian (1.3%) Black (6.7%) White (82.7%) Mixed (9.3%)	Asian (4.9%) Black (24.6%) White (62.3%) Mixed (8.2%)	$\chi^2(3) = 10.77$, $p = .013$
Education	High school (52%) UG[e] (33.3%) PG[f] (13.3%) Missing (1.3%)	High school (42.6%) UG[e] (37.7%) PG[f] (19.7%)	χ2(2) = 1.63, $p = .443$
Non-verbal reasoning (MaRs-IB[a])	.58 (.19)	.58 (.17)	$t(134) = .45$, $p = .964$, $d = .008$
Autistic traits (AQ-10[b])	6.71 (2.40)	3.36 (1.82)	$t(133.38) = 9.25$, $p < .001$, $d = 1.55$
Alexithymia (TAS-20[c])	60.12 (10.96)	48.62 (12.68)	$t(119.33) = 5.59$, $p < .001$, $d = .98$
Empathic concern (IRI-EC[d])	18.25 (6.29)	20.67 (4.71)	$t(133.14) = -2.56$, $p = .011$, $d = -.43$

Note. [a]MaRs-IB = Matrix Reasoning Item Bank; [b]AQ-10 = 10 item Autism-Spectrum Quotient; [c]TAS-20 = Toronto Alexithymia Scale; [d]IRI-EC = Interpersonal Reactivity Index (empathic concern subscale); [e]UG = undergraduate; [f]PG = postgraduate.

(Blampied et al., 2010; Hobson, 1986) and the minimal group induction and the smile discrimination task involved relatively simple questions that did not require participants to give a verbal response, only non-verbal reasoning was measured and matched between groups. None of the non-autistic participants reported a diagnosis of psychiatric or neurodevelopmental conditions. All participants in the autism group stated that they had a diagnosis from a qualified clinician with an average diagnostic age of 18.16 years ($SD = 11.10$), ranging from 3 to 49 years. This study was approved by the local Research Ethics Committee. All participants gave informed consent and were reimbursed for their time and effort.

2.2. *Procedure*

The procedure was finalized after consultation with autistic community members. Participants started the session by completing a dot-estimation task as an induction for setting minimal groups, then a smile discrimination task. This was followed by the MaRs-IB and finished with a series of questionnaires measuring: ingroup and outgroup identification; individual differences in autistic traits, alexithymia and empathic concern; and demographic information. Participants were then fully debriefed. The overall duration of the experiment was one hour.

The Gorilla version of the minimal group induction, smile discrimination task (BBC stimuli only) and group identification questionnaire can be accessed here: https://app.gorilla.sc/openmaterials/746364. We do not have permission to share the stimuli from Farmer et al. (2021). The other measures that we used were not adapted in any way from the original publications and are already freely available.

2.3. *Minimal group induction*

A dot-estimation task adapted from Howard and Rothbart (1980) was used, which served as a minimal group induction to randomly categorize participants into two groups: overestimators and underestimators. Participants were instructed that, according to previous studies, people tend to consistently overestimate or underestimate the number of objects they have seen, which also relates to their personality. They were also told they would later watch some videos of overestimators and underestimators, so it was important to remember their group.

Ten pictures each containing 50–250 dots were presented, each for 2000 msec (see Fig. 1 for an illustration). Participants were asked to estimate the number of dots after each picture on a slider bar. After the ten trials, participants were told their scores were being calculated, and after a 2000 msec delay they were informed that they were either an overestimator or an underestimator. To encourage participants to believe they were similar to their in-group members, they were told this was based on their estimation of the dots; however, the group allocation was fully randomized. Participants were given either yellow or green as an indicator of their group membership, which was reinforced by some positive personality traits of their ingroup members. The same colour badge would appear in each video later in the smile discrimination task, indicating the group membership of the smiler. For counterbalance, approximately half of the autistic and non-autistic participants were assigned to each minimal group and therefore to each colour.

2.4. *Smile discrimination task*

Stimuli. The 20 colour videos used in Young (2017) were adopted, which have been validated to detect intergroup differences in smile discrimination (retrieved from https://www.bbc.co.uk/science/humanbody/mind/surveys/smiles/). Each smiler only presented one of two smile types (i.e., genuine or posed), 13 were males and 7 females, with a range of races (e.g., White, Black, Asian) and ages, and presumed to be non-autistic. To improve task reliability and sensitivity, the present study set out to increase the number of trials by employing a second set of 64 colour videos taken from Farmer et al. (2021). We intended to improve the signal-to-noise ratio and increase power, allowing for a better estimation of individual performance. This set of stimuli contained eight actors, half male and half female, all White young adults, and presumed to be non-autistic. Each smiler provided four genuine and four posed smiles. Therefore, the total number of videos was 84, half genuine and half posed. These videos were determined to be valid emotional expressions through previous studies (e.g., Young et al., 2015) and independent ratings (Farmer et al., 2021).

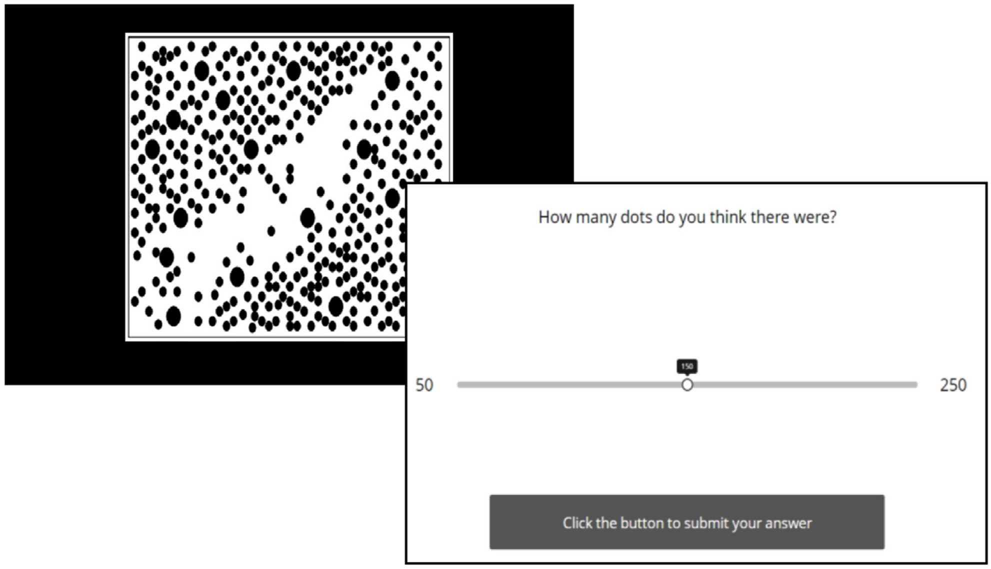

Fig. 1 – Illustration of the dot-estimation task.

To match the two sets of stimuli, each clip was edited to the same size (i.e., 354px*360px) and length (i.e., 2000 msec), to begin with a neutral facial expression and end with a fully expressed smile, using Adobe Premier Pro 2020. Each smiler was given either a yellow or green badge to indicate their group membership (overestimator or underestimator) as well as a name (e.g., Joshua), and both were placed along the bottom of each clip (see Fig. 2). Half of the clips were randomly preselected to always be labelled as overestimators and the other half as underestimators. Colour (i.e., green versus yellow) and minimal group type (i.e., overestimator versus underestimator) were counterbalanced in both participants and smilers.

Setup. Participants were told they would watch a series of videos of underestimators' and overestimators' emotional facial expressions made in response to some funny things and would be required to make judgements of authenticity, contagion, valence and intensity after each recording. Only the authenticity ratings are analysed here but contagion, valence and intensity ratings were included to discourage participants from overthinking. Participants responded on a 7-point Likert scale, with 1 = not genuine (i.e., not spontaneous, feels controlled) and 7 = extremely genuine (i.e., spontaneous, feels uncontrolled). Each trial began with a 500 msec central fixation cross, with a 100 msec blank screen before and after this. The video clip then played automatically only once, followed immediately by the authenticity question (see Fig. 2). There was unlimited time for participants to make their judgements.

The two sets of videos were presented separately, split into two blocks. The first block contained two sub-blocks (10 trials

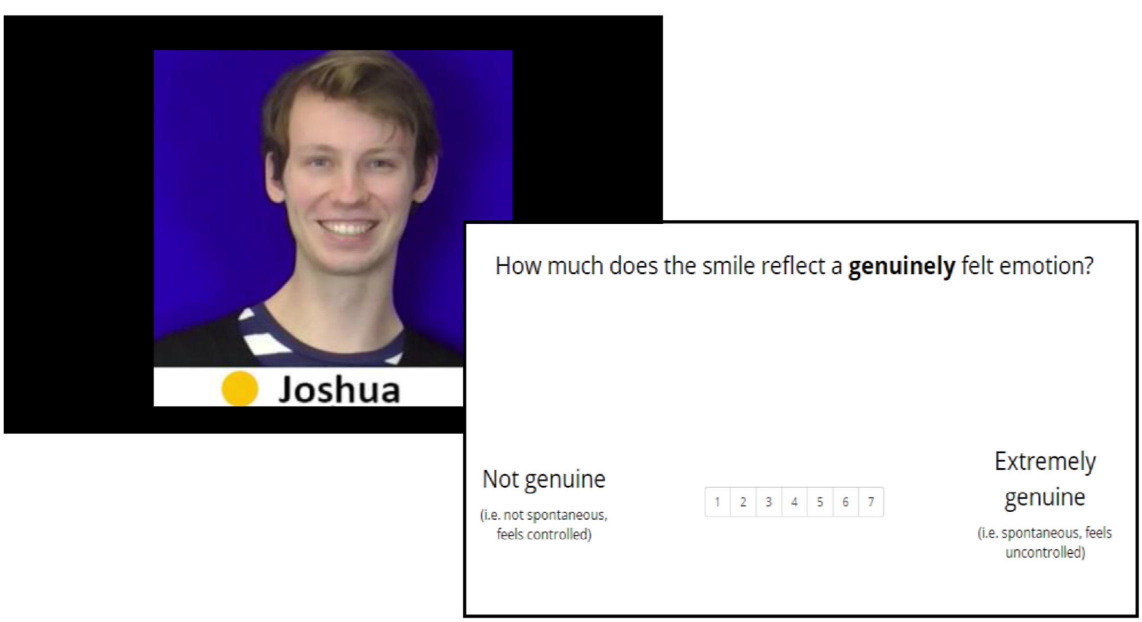

Fig. 2 – Illustration of the smile discrimination task and an authenticity judgement.

each), and the second block contained four sub-blocks (16 trials each). Each sub-block only presented faces from one minimal group (half genuine half posed), and the group type was presented to participants at the beginning of the sub-block. Sub-blocks within each block and trials within each sub-block were randomly presented. Four 15,000 msec countdown breaks were included before the second block and between its sub-blocks to prevent fatigue. Participants were asked about the group membership of the smiler after the first and second trials of each sub-block to check and help maintain their attention. They were also asked about their own group membership at the end of the entire task to verify whether they had correctly remembered their minimal group affiliation.

Analysis. Item-wise analysis was applied to analyse the main effects and interactions of autism diagnosis, group membership and smile type on the authenticity rating in the smile discrimination task in two mixed ANOVAs. In the current study, it was assumed that the variance between different smilers was greater than the variance between different judges, so we took the average rating per video within autistic and non-autistic participants and for ingroup and outgroup smiles. Accordingly, we treated each video as an independent item, even though some smilers provided multiple videos. Diagnosis (autism versus non-autism) and Group (ingroup versus outgroup) were therefore treated as within-subject variables, while Smile type (genuine versus posed) was a between-subjects variable.

2.5. *Self-reported measures*

Following the smile discrimination task, group identification (GI) was measured by rating the applicability of eight statements (i.e., four ingroup and four outgroup) covering three areas (i.e., cognition, evaluation and affection) adapted from Doosje et al. (1995): (1) “I feel strong ties to overestimators [underestimators]”, (2) “I see myself as a member of the overestimator [underestimator] group”, (3) “I identify with the members of the overestimator [underestimator] group”, (4) “I am glad to be a member of the overestimator [underestimator] group”. The group type was highlighted with the corresponding colour. Each statement was rated on a 7-point Likert scale (1 = not at all, 7 = very true). The average GI score for ingroup and outgroup for each participant was calculated across the four questions.

Autistic traits were measured by the ten-item Autism-Spectrum Quotient (AQ-10; Allison et al., 2012), with higher scores indicating more autistic traits, ranging between 0 and 10. Empathic concern was measured by the empathic concern scale of the Interpersonal Reactivity Index (IRI-EC; Davis, 1980), with higher scores indicating a greater tendency to experience feelings of concern, compassion and warmth for others, ranging between 0 and 28; it should be noted that this measure does not directly assess the tendency to experience the feelings of others. Alexithymia was measured by the twenty-item Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994), with higher scores indicating more difficulties identifying one's own emotions, ranging between 20 and 100; this was included in order to control for alexithymia, to test whether this condition could explain any group differences. Demographic information was collected at the end of the experiment, including age, sex, education, ethnicity, autism diagnosis and age at diagnosis (if applicable).

3. Results

All the data were analysed using IBM SPSS Statistics (Version 29). No analysis code was used.

3.1. *Smile discrimination*

Authenticity ratings. A 2 × 2 × 2 mixed-design ANOVA was conducted using the authenticity rating as the outcome variable, with Diagnosis (autism versus non-autism) and Group (ingroup versus outgroup) as within-subjects variables, and Smile type (genuine versus posed) as a between-subjects factor. The results indicated main effects of Diagnosis, $F(1, 82) = 194.14$, $p < .001$, partial $\eta^2 = .703$, Group, $F(1, 82) = 26.11$, $p < .001$, partial $\eta^2 = .242$, and Smile type, $F(1, 82) = 124.82$, $p < .001$, partial $\eta^2 = .604$, and an interaction between Diagnosis and Smile type, $F(1, 82) = 36.75$, $p < .001$, partial $\eta^2 = .309$. Importantly, there was no interaction between Diagnosis and Group predicted by our second hypothesis, $F(1, 82) = .21$, $p = .646$, partial $\eta^2 = .003$, nor between Group and Smile Type predicted by our fourth hypothesis, $F(1, 82) = .07$, $p = .792$, partial $\eta^2 = .001$, nor 3 way interaction.

Specifically, non-autistic adults considered smiles overall as more genuine than autistic adults; smiles from ingroup members were rated as more genuine than those from outgroup members; and genuine smiles were rated as more genuine than posed smiles (see Fig. 3). To further investigate the interaction between Diagnosis and Smile type, ingroup and outgroup were collapsed, and then the rating difference

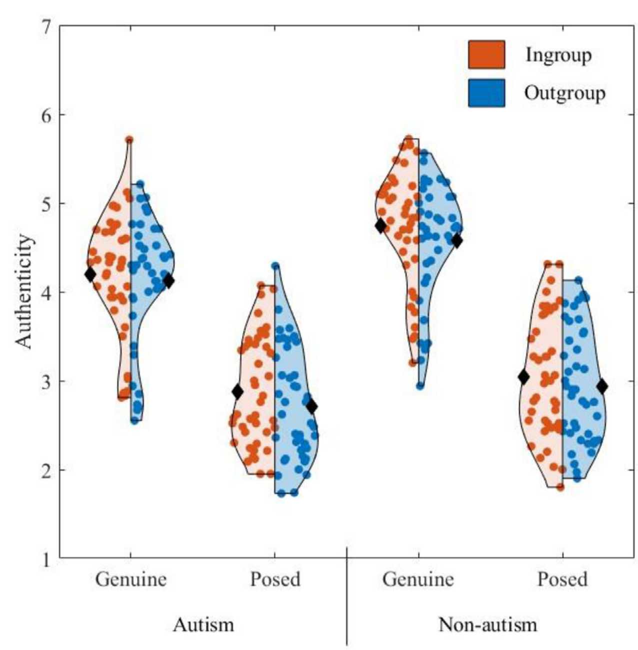

Fig. 3 – The smile authenticity ratings by Diagnosis, Group and Smile type (each dot represents the mean rating of each smile); black diamonds represent the mean of each condition.

between the non-autistic and autistic adults was calculated for each smile item. Post-hoc tests revealed that the rating difference between non-autistic and autistic participants for genuine smiles ($M = .49$, $SD = .25$) was significantly greater than that for posed smiles ($M = .19$, $SD = .21$), $t(82) = 6.06$, $p < .001$, $d = 1.32$.

Adjusted authenticity ratings. Given the greater prevalence of alexithymia in autism and the group difference on the TAS-20 in the current sample (see section 2.1), it is possible that the observed effect of diagnosis, to some extent, is driven by alexithymia rather than autism (see Introduction). To control for alexithymic characteristics, a simple linear regression model was used to predict the authenticity ratings of each smile item across all participants based on the TAS-20 scores, then we calculated the difference between the observed value of the authenticity rating and the value of the rating predicted from the regression line (i.e., the standardized residual). The residual, or the adjusted authenticity rating, was entered in the same analysis as the unadjusted rating, a 2 × 2 × 2 mixed-design ANOVA. There were main effects of Diagnosis, $F(1, 82) = 155.64$, $p < .001$, partial $\eta^2 = .655$, Group, $F(1, 82) = 25.53$, $p < .001$, partial $\eta^2 = .237$, and Smile type, $F(1, 82) = 10.96$, $p = .001$, partial $\eta^2 = .118$, and an interaction between Diagnosis and Smile type, $F(1, 82) = 36.07$, $p < .001$, partial $\eta^2 = .306$, but no other significant interactions (see Table 2 for descriptive statistics). The results therefore remain the same after controlling for alexithymia, which indicates that alexithymia cannot explain the main variance observed in the smile discrimination task.

3.2. Group identification

Group identification scores were analysed using a 2 × 2 mixed-design analysis of variance (ANOVA), with Group (ingroup versus outgroup) as a within-subjects variable, and Diagnosis (autism versus non-autism) as a between-subjects factor. There were significant main effects of Diagnosis, $F(1, 134) = 16.45$, $p < .001$, partial $\eta^2 = .109$, and Group, $F(1, 134) = 162.66$, $p < .001$, partial $\eta^2 = .548$, and an interaction between Diagnosis and Group, $F(1, 134) = 5.12$, $p = .025$, partial $\eta^2 = .037$. Specifically, non-autistic participants were more likely to identify with others than autistic participants; and participants identified more strongly with ingroup members than outgroup members. Post-hoc tests (with Bonferroni correction for multiple comparisons, α-level adjusted to $p = .025$) indicated that non-autistic adults reported greater group identification with their ingroup members than autistic adults, $t(134) = -4.07$, $p < .001$, $d = -.70$, but no group difference was observed in outgroup identification, $t(134) = -1.66$, $p = .099$, $d = -.29$ (see Fig. 4).

Table 2 – Standardised residuals of smile authenticity rating after controlling for alexithymia, Mean (Standard Deviation).

		Ingroup	Outgroup
Autism	Genuine	−.114 (.15)	−.161 (.10)
	Posed	−.014 (.13)	−.116 (.10)
Non-autism	Genuine	.190 (.11)	.086 (.13)
	Posed	.065 (.14)	−.003 (.09)

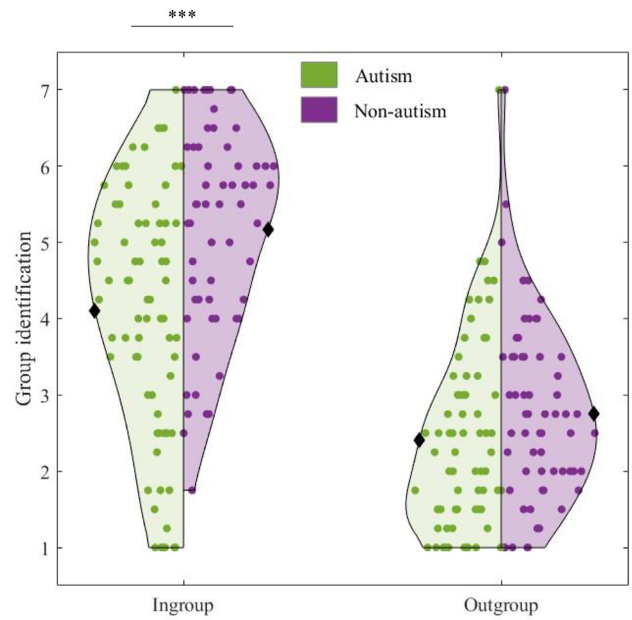

Fig. 4 – Diagnosis × Group interaction on group identification scores (each dot represents the score of each participant); black diamonds represent the mean of each condition.

3.3. Correlations

In both autistic and non-autistic adults, correlations were conducted to determine whether empathic concern was associated with intergroup identification and intergroup bias in smile discrimination, and whether smile discrimination ability contributes to social communication difficulties. As this was exploring individual differences, we recalculated the smile judgement ratings by taking the average rating per participant for ingroup and outgroup smiles. In autistic adults, empathic concern was positively correlated with authenticity ratings of ingroup smiles, $r = .28$, $p = .015$, and outgroup smiles, $r = .27$, $p = .017$, but not with the group identification scores, ingroup $r = .05$, $p = .670$, outgroup, $r = .05$, $p = .677$; and autistic traits were negatively correlated with authenticity ratings of posed smiles, $r = -.27$, $p = .018$, but not genuine smiles, $r = -.14$, $p = .238$. In contrast, in non-autistic adults, empathic concern was correlated with the ingroup identification, $r = .44$, $p < .001$, but not with the outgroup identification, $r = -.152$, $p = .243$, nor with ingroup smiles $r = .13$, $p = .322$, nor outgroup smiles, $r = .13$, $p = .338$; and autistic traits were not correlated with authenticity ratings of genuine, $r = -.10$, $p = .468$, nor posed smiles, $r = .18$, $p = .177$. Additionally, the difference between ingroup and outgroup identification was not associated with the difference between ingroup and outgroup smile judgements in either autistic, $r = .14$, $p = .223$, or non-autistic people, $r = -.21$, $p = .111$.

4. Discussion

To the best of our knowledge, this is the first study to investigate whether an intergroup bias can modulate the perception of genuine and posed smile authenticity among autistic adults. We found that group membership did affect authenticity judgements similarly in autistic and non-autistic adults, but did not modulate the ability to differentiate genuine from posed smiles in either diagnostic group.

As expected, ingroup favouritism on smile authenticity identification was found not only in non-autistic adults, replicating Young (2017)'s findings, but also in autistic adults; specifically, ingroup smiles were rated as more genuine than outgroup smiles in our minimal group setting. This indicates that intergroup bias can indeed influence how autistic people perceive smile authenticity. Furthermore, autistic people seemed to be as susceptible as non-autistic people to this intergroup bias, because no interaction was observed between Diagnosis and Group; accordingly, autistic adults' sensitivity to intergroup bias on smile judgements seems not to be attenuated. Considering results in the recent autism literature, this is consistent with some studies on the cross-race effect (Wilson et al., 2011; Yi et al., 2015, 2016), although differs from a number of other studies (Hadad et al., 2019; Kang et al., 2020). It is possible that these latter studies involved tasks that autistic people struggled more with, such as judging social norms (Qian et al., 2022) and direct gaze aversion (Uono et al., 2021), making intergroup modulation harder to detect, whilst we were using a task that autistic were capable of, albeit to a lesser extent than non-autistic people (see below). Regardless, the current results indicate that ingroup members might be perceived as more authentic and therefore interaction with them might be more rewarding (Shore & Heerey, 2011) and enjoyable (Krumhuber et al., 2007) for both autistic and non-autistic people.

We also observed that autistic adults generally rated smiles as less authentic than non-autistic adults. It is possible that autistic adults are generally less trusting of unfamiliar people, given their increased likelihood to have experienced victimisation (Sterzing et al., 2012), and therefore judge all smiles to be less genuine. Relatedly, we found that those autistic adults who gave lower ratings of smile authenticity also reported lower empathic concern, but it is not possible from our data to know whether or how this might relate to reduced trust. Alternatively, given the autistic adults were susceptible to a minimal group manipulation, they could presumably also be influenced by pre-existing social groups, such as autism versus non-autism groupings. If the diagnostic-group identification also caused intergroup effects, and if our autistic adults assumed in the absence of evidence to the contrary that all the videos contained people from the non-autistic majority, this could account for the generally lower ratings made by the autism group. Indeed, the idea of diagnostic-ingroup favouritism has been supported by Sasson et al. (2017) and Alkhaldi et al. (2019), who both reported that non-autistic people rated autistic people less favourably than other non-autistic people. If a diagnostic intergroup bias does account for the generally lower ratings given by our autistic participants, we might have failed to fairly measure how autistic adults judge smile authenticity. This could also be said for the many studies in the literature assessing social judgements in autism, which presumably used non-autistic protagonists (Gernsbacher et al., 2017). This might suggest a need to re-evaluate past findings of social perception in autism and consider whether any of those studies might have misrepresented the social judgements of autistic people through introducing an outgroup disadvantage. Future studies could test this possibility directly by including autistic as well as non-autistic protagonists.

Certainly, when we asked participants how closely they identified with each minimal group at the end of the experiment, although both diagnostic groups reported higher identification towards their ingroup than outgroup, autistic adults reported identifying less with the actors than non-autistic adults, and this was especially the case for ingroup members. Whatever the cause, this reduction in identification is likely to have been related to the lower authenticity ratings given by autistic adults.

Consistent with Boraston et al. (2008) and Blampied et al. (2010)'s findings but here using dynamic stimuli, the interaction between Smile type and Diagnosis indicates that, while autistic people are capable of discriminating genuine from posed smiles, this is to a lesser extent than non-autistic adults. Importantly, the results remained the same after controlling for alexithymia, so smile authenticity judgements must rely on autism-specific cognitive processes. Autistic adults may be less sure of the authenticity of others, perhaps due to differences in reasoning about mental states (Boraston et al., 2008), which could subsequently affect their social communication. Interestingly, the interaction was driven by genuine smiles, as there was a greater difference between autistic and non-autistic adults in identifying genuine than posed smiles. As posed smiles are thought to represent concealment of the true emotional state (Ekman, 2003; Krumhuber et al., 2007), these are considered more complex social signals that involve mentalizing and hence might give rise to higher authenticity ratings and reduced smile discrimination if taken at face value. Indeed, the degree of self-reported autistic traits was correlated to posed but not genuine smile ratings. The greater difference between autistic and non-autistic adults on genuine than posed smiles may therefore have resulted due to the generally lower ratings given by autistic adults, as already discussed, so it seems it is the reduction in discrimination that is most important here.

As well as differing in reliance on mentalizing, genuine and posed smile judgements rely on attention to different parts of the face. Only genuine smiles involve muscle contraction around the eyes, especially the AU6 (Duchenne & de Boulogne, 1990; Ekman et al., 1990; Ekman & Friesen, 1982), so a lack of attention to the eye region during smile judgements could explain the reduction in smile discrimination in autism (Boraston et al., 2008). Future studies using eye-tracking technology could reveal the fixation pattern and attention distribution of autistic people when judging smiles, to explore the information they tend to use from smiling faces; it would also be of interest to understand the use of these muscles in autistic smile production. This might give a deeper insight into the mechanisms underlying subtle facial expression recognition differences in autism.

An alternative interpretation of this reduction in smile discrimination in autistic adults comes from a neurodiversity perspective. Following from the ‘double empathy problem’ (Milton, 2012) which hypothesises that autistic social interaction and communication difficulties are bidirectional, it has been suggested that autistic people can more easily decode social cues and reason about the mental states of other autistic people than about non-autistic people, and the opposite would be true for non-autistic people (e.g., Fletcher-Watson & Happé, 2019; Komeda et al., 2019). It is possible therefore that the reduced smile discrimination in the autism group is due to the actors in the videos being assumed to be non-autistic and therefore diagnostic outgroup members. However, Young (2017)'s study of smile discrimination would indicate that we should expect increased smile discrimination for outgroup members. Having said this, Young (2017) failed to replicate this increased outgroup smile discrimination effect in his second experiment, as did we in ours – there was no interaction between smile type and intergroup membership, nor a 3-way interaction with diagnostic group, indicating that an intergroup bias did not modulate smile discrimination ability. It therefore seems unlikely that a diagnostic intergroup bias could explain the diagnostic group difference in smile discrimination ability.

More generally, our use of a minimal group paradigm to generate intergroup bias meant we were able to minimize the potential effects of other forms of intergroup bias and elucidate that even arbitrary labels can induce ingroup favouritism in both autistic and non-autistic people, quite apart from groupings that are associated with social stigmatism (Milton, 2012). Further, conducting of the study online was advantageous during the COVID-19 pandemic and for the inclusion of autistic people who might not be have able to participate in laboratory experiments, and our findings hold promise that it is feasible and valid to assess smile perception and more generally implement minimal group paradigms online. In fact, it is possible that minimal group paradigms might have stronger effects in online than in lab-based studies, as there is little other contextual information to guide them online and hence the assigned membership would be more prominent than in lab-based environments.

However, we are also aware that an online approach also has limitations – less control over the environment, the monitor and the integrity of participants during testing (Tsantani et al., 2022). Similarly, because of ethics and feasibility, we could not verify participants' diagnoses, although our autistic adults showed significantly higher autistic traits than the non-autism group, so we believe that our findings are still a valuable addition to current autism research. Additionally, all of our autistic adults possessed average-to-high non-verbal reasoning ability – future studies should confirm these results in a laboratory setting and recruit autistic people with diverse cognitive abilities.

Of course there are large individual differences in genuine and posed smile expressions, which are usually interpreted in more ambiguous and varied social interaction contexts (Heerey, 2014). Thus, our findings may require evaluation under more naturalistic settings. However, given the videos of genuine and posed smiles produced by actors were differentiable even in a remote online situation, their fundamental differences could be more salient and therefore more likely to be identified in face-to-face interaction. Thus, we believe that our findings are useful for understanding subtle expression discrimination under intergroup settings in autism.

In conclusion, the current study contributes to a better understanding of autism through demonstrating autistic sensitivity to social group categories despite a tendency to judge all smiles as less genuine and difficulties in differentiating a subtle facial emotion expression under minimal group settings. We propose that this might be due to reduced identification with, empathy for or trust in unfamiliar or diagnostic outgroup members, in combination with mentalizing or social attention differences. As autistic people perceive ingroup members to be more authentic, this is likely to give rise to more rewarding and more comfortable interactions. This has implications for designing tailored support and policies that emphasize similarities and inclusion between autistic and non-autistic people to avoid intergroup conflicts (Mitchell et al., 2021), rather than focussing on how they might be different (Baron-Cohen, 2017). This might facilitate autistic people in navigating the social world more effectively and make society more inclusive.

Funding

SJW was supported by the Royal Society [Dorothy Hodgkin Fellowship DH150167 and Research Fellows Enhancement Award RGF\EA\201059]. RW was supported by a UCL Graduate Research Scholarship and a CSC PhD scholarship during the period of this work.

Open practices

The dataset supporting the conclusions of this article is available in the Open Science Framework repository, at https://osf.io/2fnr8/.

CRediT authorship contribution statement

Ruihan Wu: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Visualization, Writing – original draft, Writing – review & editing. **Antonia F. de C. Hamilton:** Conceptualization, Data curation, Investigation, Methodology, Supervision, Visualization, Writing – review & editing. **Sarah J. White:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Supervision, Visualization, Writing – review & editing.

Declaration of competing interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

Alkhaldi, R. S., Sheppard, E., & Mitchell, P. (2019). Is there a link between autistic people being perceived unfavorably and having a mind that is difficult to read? *Journal of Autism and Developmental Disorders, 49*(10), 3973–3982.

Allen, V. L., & Wilder, D. A. (1975). Categorization, belief similarity, and intergroup discrimination. *Journal of Personality and Social Psychology, 32*(6), 971.

Allison, C., Auyeung, B., & Baron-Cohen, S. (2012). Toward brief "red flags" for autism screening: The short autism spectrum quotient and the short quantitative checklist in 1,000 cases and 3,000 controls. *Journal of the American Academy of Child and Adolescent Psychiatry, 51*(2), 202–212. e207.

Bagby, R. M., Parker, J. D., & Taylor, G. J. (1994). The twenty-item Toronto Alexithymia Scale—I. Item selection and cross-validation of the factor structure. *Journal of Psychosomatic Research, 38*(1), 23–32.

Balliet, D., Wu, J., & De Dreu, C. K. (2014). Ingroup favoritism in cooperation: A meta-analysis. *Psychological Bulletin, 140*(6), 1556.

Baron-Cohen, S. (2017). In *Editorial Perspective: Neurodiversity–a revolutionary concept for autism and psychiatry* (Vol. 58, pp. 744–747). Wiley Online Library.

Baron-Cohen, S., & Wheelwright, S. (2004). The empathy quotient: An investigation of adults with Asperger syndrome or high functioning autism, and normal sex differences. *Journal of Autism and Developmental Disorders, 34*(2), 163–175.

Bernstein, M. J., Young, S. G., & Hugenberg, K. (2007). The cross-category effect: Mere social categorization is sufficient to elicit an own-group bias in face recognition. *Psychological Science, 18*(8), 706–712.

Bertschy, K., Skorich, D. P., & Haslam, S. A. (2020). Self-categorization and Autism: Exploring the relationship between autistic traits and ingroup favouritism in the minimal group paradigm. *Journal of Autism and Developmental Disorders, 50*(9), 3296–3311.

Biland, C., Py, J., Allione, J., Demarchi, S., & Abric, J.-C. (2008). The effect of lying on intentional versus unintentional facial expressions. *European Review of Applied Psychology, 58*(2), 65–73.

Bird, G., Silani, G., Brindley, R., White, S., Frith, U., & Singer, T. (2010). Empathic brain responses in insula are modulated by levels of alexithymia but not autism. *Brain: a Journal of Neurology, 133*(5), 1515–1525.

Bird, G., & Viding, E. (2014). The self to other model of empathy: Providing a new framework for understanding empathy impairments in psychopathy, autism, and alexithymia. *Neuroscience and Biobehavioral Reviews, 47*, 520–532.

Blampied, M., Johnston, L., Miles, L., & Liberty, K. (2010). Sensitivity to differences between enjoyment and non-enjoyment smiles in children with autism spectrum disorder. *British Journal of Developmental Psychology, 28*(2), 483–489.

Boraston, Z. L., Corden, B., Miles, L. K., Skuse, D. H., & Blakemore, S.-J. (2008). Brief report: Perception of genuine and posed smiles by individuals with autism. *Journal of Autism and Developmental Disorders, 38*(3), 574–580.

Castelli, F. (2005). Understanding emotions from standardized facial expressions in autism and normal development. *Autism: the International Journal of Research and Practice, 9*(4), 428–449.

Chierchia, G., Fuhrmann, D., Knoll, L. J., Pi-Sunyer, B. P., Sakhardande, A. L., & Blakemore, S.-J. (2019). The matrix reasoning item bank (MaRs-IB): Novel, open-access abstract reasoning items for adolescents and adults. *Royal Society Open Science, 6*(10), Article 190232.

Cook, R., Brewer, R., Shah, P., & Bird, G. (2013). Alexithymia, not autism, predicts poor recognition of emotional facial expressions. *Psychological Science, 24*(5), 723–732.

Davis, M. H. (1980). A multidimensional approach to individual differences in empathy. *JSAS Catalog of Selected Documents in Psychology, 10*, 85.

De Vignemont, F., & Singer, T. (2006). The empathic brain: How, when and why? *Trends in Cognitive Sciences, 10*(10), 435–441.

Doosje, B., Ellemers, N., & Spears, R. (1995). Perceived intragroup variability as a function of group status and identification. *Journal of Experimental Social Psychology, 31*(5), 410–436.

Dovidio, J. F., Johnson, J. D., Gaertner, S. L., Pearson, A. R., Saguy, T., & Ashburn-Nardo, L. (2010). *Empathy and intergroup relations*.

Downs, A., & Smith, T. (2004). Emotional understanding, cooperation, and social behavior in high-functioning children with autism. *Journal of Autism and Developmental Disorders, 34*(6), 625–635.

Duchenne, G.-B., & de Boulogne, G.-B. D. (1990). *The mechanism of human facial expression*. Cambridge University Press.

Dyck, M. J., Ferguson, K., & Shochet, I. M. (2001). Do autism spectrum disorders differ from each other and from non-spectrum disorders on emotion recognition tests? *European Child & Adolescent Psychiatry, 10*(2), 105–116.

Ekman, P. (2003). Darwin, deception, and facial expression. *Annals of the New York Academy of Sciences, 1000*(1), 205–221.

Ekman, P., Davidson, R. J., & Friesen, W. V. (1990). The Duchenne smile: Emotional expression and brain physiology: II. *Journal of Personality and Social Psychology, 58*(2), 342.

Ekman, P., & Friesen, W. V. (1982). Felt, false, and miserable smiles. *Journal of Nonverbal Behavior, 6*(4), 238–252.

Elfenbein, H. A., & Ambady, N. (2002). On the universality and cultural specificity of emotion recognition: A meta-analysis. *Psychological Bulletin, 128*(2), 203.

Ellemers, N., Spears, R., & Doosje, B. (2002). Self and social identity. *Annual Review of Psychology, 53*(1), 161–186.

Farmer, H., Mahmood, R., Gregory, S. E., Tishina, P., & Hamilton, A. F.d. C. (2021). Dynamic emotional expressions do not modulate responses to gestures. *Acta Psychologica, 212*, Article 103226.

Fletcher-Watson, S., & Happé, F. (2019). *Autism: A new introduction to psychological theory and current debate*. Routledge.

Frank, M. G., & Ekman, P. (1993). Not all smiles are created equal: The differences between enjoyment and nonenjoyment smiles. *International Journal of Humor Research, 6*(1), 9–26. https://doi.org/10.1515/humr.1993.6.1.9

Gernsbacher, M. A., Stevenson, J. L., & Dern, S. (2017). Specificity, contexts, and reference groups matter when assessing autistic traits. *PLoS One, 12*(2), Article e0171931.

Hadad, B.-S., Schwartz, S., & Binur, N. (2019). Reduced perceptual specialization in autism: Evidence from the other-race face effect. *Journal of Experimental Psychology: General, 148*(3), 588.

Harms, M. B., Martin, A., & Wallace, G. L. (2010). Facial emotion recognition in autism spectrum disorders: A review of behavioral and neuroimaging studies. *Neuropsychology Review, 20*(3), 290–322.

Heerey, E. A. (2014). Learning from social rewards predicts individual differences in self-reported social ability. *Journal of Experimental Psychology: General, 143*(1), 332.

Hill, E., Berthoz, S., & Frith, U. (2004). Brief report: Cognitive processing of own emotions in individuals with autistic spectrum disorder and in their relatives. *Journal of Autism and Developmental Disorders, 34*(2), 229–235.

Hobson, R. P. (1986). The autistic child's appraisal of expressions of emotion. *Journal of Child Psychology and Psychiatry, 27*(3), 321–342.

Howard, J. W., & Rothbart, M. (1980). Social categorization and memory for in-group and out-group behavior. *Journal of Personality and Social Psychology, 38*(2), 301.

Johnston, L., Miles, L., & Macrae, C. N. (2010). Why are you smiling at me? Social functions of enjoyment and non-enjoyment smiles. *British Journal of Social Psychology, 49*(1), 107–127.

Jordan, J. J., McAuliffe, K., & Warneken, F. (2014). Development of in-group favoritism in children's third-party punishment of selfishness. *Proceedings of the National Academy of Sciences, 111*(35), 12710–12715.

Kang, J., Han, X., Hu, J.-F., Feng, H., & Li, X. (2020). The study of the differences between low-functioning autistic children and typically developing children in the processing of the own-

race and other-race faces by the machine learning approach. *Journal of Clinical Neuroscience, 81*, 54–60.
Ketelaars, M. P., Mol, A., Swaab, H., & van Rijn, S. (2016). Emotion recognition and alexithymia in high functioning females with autism spectrum disorder. *Research in Autism Spectrum Disorders, 21*, 51–60.
Komeda, H., Kosaka, H., Fujioka, T., Jung, M., & Okazawa, H. (2019). Do individuals with autism spectrum disorders help other people with autism spectrum disorders? An investigation of empathy and helping motivation in adults with autism spectrum disorder. *Frontiers in Psychiatry, 10*, 376.
Krumhuber, E., Manstead, A. S., Cosker, D., Marshall, D., Rosin, P. L., & Kappas, A. (2007). Facial dynamics as indicators of trustworthiness and cooperative behavior. *Emotion, 7*(4), 730.
Lazarus, R. S. (1991). *Emotion and adaptation*. Oxford University Press.
Liu, L., & Humpolíček, P. (2013). The comparative study of facial emotion recognition ability in ADHD individuals and individuals with high functioning autism/Asperger syndrome. *Klinická psychologie a osobnost, 2*(1), 15–25.
Manera, V., Del Giudice, M., Grandi, E., & Colle, L. (2011). Individual differences in the recognition of enjoyment smiles: No role for perceptual–attentional factors and autistic-like traits. *Frontiers in Psychology, 2*, 143.
Mehu, M., Grammer, K., & Dunbar, R. I. (2007). Smiles when sharing. *Evolution and Human Behavior, 28*(6), 415–422.
Milton, D. E. (2012). On the ontological status of autism: The 'double empathy problem'. *Disability & Society, 27*(6), 883–887.
Mitchell, P., Sheppard, E., & Cassidy, S. (2021). Autism and the double empathy problem: Implications for development and mental health. *British Journal of Developmental Psychology, 39*(1), 1–18.
Montagu, A. (1997). *Man's most dangerous myth: The fallacy of race*. Rowman & Littlefield.
Qian, C., Tei, S., Itahashi, T., Aoki, Y. Y., Ohta, H., Hashimoto, R.-i., Nakamura, M., Takahashi, H., Kato, N., & Fujino, J. (2022). Intergroup bias in punishing behaviors of adults with autism spectrum disorder. *Frontiers in Psychiatry, 13*, 884529–884529.
Rodd, J. M. (2023). *Moving experimental psychology online: How to maintain data quality when we can't see our participants*.
Rudman, L. A., & Goodwin, S. A. (2004). Gender differences in automatic in-group bias: Why do women like women more than men like men? *Journal of Personality and Social psychology, 87*(4), 494.
Salminen, J. K., Saarijärvi, S., Äärelä, E., Toikka, T., & Kauhanen, J. (1999). Prevalence of alexithymia and its association with sociodemographic variables in the general population of Finland. *Journal of Psychosomatic Research, 46*(1), 75–82.
Sasson, N. J., Faso, D. J., Nugent, J., Lovell, S., Kennedy, D. P., & Grossman, R. B. (2017). Neurotypical peers are less willing to interact with those with autism based on thin slice judgments. *Scientific Reports, 7*(1), 1–10.
Schug, J., Matsumoto, D., Horita, Y., Yamagishi, T., & Bonnet, K. (2010). Emotional expressivity as a signal of cooperation. *Evolution and Human Behavior, 31*(2), 87–94.
Shah, P., Hall, R., Catmur, C., & Bird, G. (2016). Alexithymia, not autism, is associated with impaired interoception. *Cortex; a Journal Devoted to the Study of the Nervous System and Behavior, 81*, 215–220.
Shore, D. M., & Heerey, E. A. (2011). The value of genuine and polite smiles. *Emotion, 11*(1), 169.
Singer, T., Seymour, B., O'doherty, J., Kaube, H., Dolan, R. J., & Frith, C. D. (2004). Empathy for pain involves the affective but not sensory components of pain. *Science, 303*(5661), 1157–1162.
Sinzig, J., Morsch, D., & Lehmkuhl, G. (2008). Do hyperactivity, impulsivity and inattention have an impact on the ability of facial affect recognition in children with autism and ADHD? *European Child & Adolescent Psychiatry, 17*(2), 63–72.
Smith, A. (2009). The empathy imbalance hypothesis of autism: A theoretical approach to cognitive and emotional empathy in autistic development. *The Psychological Record, 59*(3), 489–510.
Sterzing, P. R., Shattuck, P. T., Narendorf, S. C., Wagner, M., & Cooper, B. P. (2012). Bullying involvement and autism spectrum disorders: Prevalence and correlates of bullying involvement among adolescents with an autism spectrum disorder. *Archives of Pediatrics & Adolescent Medicine, 166*(11), 1058–1064.
Sucksmith, E., Allison, C., Baron-Cohen, S., Chakrabarti, B., & Hoekstra, R. A. (2013). Empathy and emotion recognition in people with autism, first-degree relatives, and controls. *Neuropsychologia, 51*(1), 98–105.
Tajfel, H. (1970). Experiments in intergroup discrimination. *Scientific American, 223*(5), 96–103.
Tsantani, M., Gray, K. L., & Cook, R. (2022). New evidence of impaired expression recognition in developmental prosopagnosia. *Cortex, 154*, 15–26.
Uljarevic, M., & Hamilton, A. (2013). Recognition of emotions in autism: A formal meta-analysis. *Journal of Autism and Developmental Disorders, 43*(7), 1517–1526.
Uono, S., Yoshimura, S., & Toichi, M. (2021). Eye contact perception in high-functioning adults with autism spectrum disorder. *Autism: the International Journal of Research and Practice, 25*(1), 137–147.
Vanman, E. J. (2016). The role of empathy in intergroup relations. *Current Opinion in Psychology, 11*, 59–63.
Vaucheret Paz, E., Martino, M., Hyland, M., Corletto, M., Puga, C., Peralta, M., Deltetto, N., Kuhlmann, T., Cavalié, D., & Leist, M. (2020). Sentiment analysis in children with neurodevelopmental disorders in an ingroup/outgroup setting. *Journal of Autism and Developmental Disorders, 50*(1), 162–170.
Wilson, C. E., Palermo, R., Burton, A. M., & Brock, J. (2011). Recognition of own-and other-race faces in autism spectrum disorders. *The Quarterly Journal of Experimental Psychology, 64*(10), 1939–1954.
World Health Organization. (2018). *International classification of diseases for mortality and morbidity statistics (11th Revision)*. https://icd.who.int/.
Yi, L., Quinn, P. C., Fan, Y., Huang, D., Feng, C., Joseph, L., Li, J., & Lee, K. (2016). Children with Autism Spectrum Disorder scan own-race faces differently from other-race faces. *Journal of Experimental Child Psychology, 141*, 177–186.
Yi, L., Quinn, P. C., Feng, C., Li, J., Ding, H., & Lee, K. (2015). Do individuals with autism spectrum disorder process own-and other-race faces differently? *Vision Research, 107*, 124–132.
Young, S. G. (2017). An outgroup advantage in discriminating between genuine and posed smiles. *Self and Identity, 16*(3), 298–312.
Young, S. G., & Hugenberg, K. (2010). Mere social categorization modulates identification of facial expressions of emotion. *Journal of Personality and Social Psychology, 99*(6), 964.
Young, S. G., Slepian, M. L., & Sacco, D. F. (2015). Sensitivity to perceived facial trustworthiness is increased by activating self-protection motives. *Social Psychological and Personality Science, 6*(6), 607–613.