Judging intentionality in the context of ambiguous actions among autistic adults

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Abstract

Background: Discerning intentional from unintentional actions is a key aspect of social cognition. Mental state attribution tasks show that autistic people are less accurate than neurotypicals in attributing an agent's intention when there is clearly a right answer. Little is known about how autistic people judge the intentionality of ambiguous actions (i.e., actions that are neither clearly intentional nor clearly unintentional).

Aims: This study sought to find out whether autistic individuals differ in their interpretation of ambiguous action compared to neurotypical controls.

Methods and Procedures: 20 autistic and 20 neurotypical adults completed an ambiguous action and theory of mind task. Autistic traits, verbal reasoning and non-verbal perceptual reasoning ability were measured.

Outcomes and Results: Results show that intentionality endorsement scores for ambiguous but prototypically accidental actions were higher in autistic participants than controls. Theory of Mind (ToM) scores did not correlate with intentionality endorsement scores in either group therefore group differences could not be explained by ToM ability.

Conclusion and Implications: Autistic participants had a tendency to over-attribute intention compared to neurotypicals, which could not be explained by ToM ability. Studying ambiguous action is important with respect to ecological validity, given that we often face ambiguous actions during social encounters.

Key words: Social cognition; theory of mind; intention attribution; intentionality bias

What this paper adds?

Previous research has conceptualised intention attribution among autistic people in terms of accuracy when faced with clear action-intention vignettes. However, little is known about how autistic people judge the intentionality of ambiguous actions (i.e., actions that are neither clearly intentional nor clearly unintentional, such as blinking or breaking an object). Studying ambiguous action is important with respect to ecological validity, given that we often face ambiguous behaviours during social encounters. Reconceptualising accuracy of intention attribution with attribution bias may be a useful focus for future research in autism and understanding intentional versus accidental action.

1. Introduction

Distinguishing intentional from unintentional behaviour is a key aspect of social interaction. It helps us to decide on the right course of action in response to other people's actions and enables successful collaboration. As "social experts" most of our intentionality judgements seem to happen effortlessly. However, on those occasions when we misjudge the intentionality of others' actions, this can have negative consequences for social interaction. This is because the moral judgement of an agent rests largely on an appraisal of the intentionality of their actions (Leslie, Knobe & Cohen, 2006). For example, we are more likely to reciprocate helping behaviour or react more aggressively toward harmful behaviour we think was done on purpose (e.g., Cushman, 2008; Gray & Wegner, 2008; Gilbert, Lieberman, Morewedge, & Wilson, 2004; Taylor et al., 1979 ; Swap, 1991).

1.1 Intentionality Judgements in ASC

A vast body of the literature on social cognition in autism spectrum conditions (ASC) addresses the question of how and when people with a diagnosis *accurately* attribute intentions to actions. Performance on mental state attribution tasks, in which there is clearly a right or wrong answer, consistently shows difficulties in intention attribution accuracy in those with ASC (Castelli, Frith, Happé & Frith, 2002; Kana, Libero, Hu, Deshpande & Colburn, 2014). Even for autistic individuals who pass standard theory of Mind (ToM) tasks, long developmental delays in the development of mentalising skills have been observed. Furthermore, autistic people are prone to errors on more advanced tests (e.g., Roeyers, Buysse, Ponnet, & Pichal, 2001; Baron-Cohen et al., 2001; Klin, 2000; Happé, 1994). Hence, there is strong evidence to suggest that autistic individuals tend to be less accurate in their intentionality judgements for actions that have a clear goal or intention (e.g. comic strip paradigm, see Baron-Cohen, Leslie, & Frith, 1986; animated shape task, see Castelli, Frith, Happé & Frith, 2002; valley task, see Castelli, 2006). However, we know relatively little about how autistic individuals judge ambiguous action (i.e., action where intentionality is not clearly evident). Examples of ambiguous actions are breaking an object, stepping on somebody's toe, or leaving the window open, which - depending on the agent's mental state - can all be done intentionally or unintentionally. In contrast, unambiguous actions are actions with strong cues implying intentionality (e.g., punching somebody in the face, cleaning an object) or indeed unintentionality (e.g., forgetting, having a seizure). This study focuses on the interpretation of such actions. This has great ecological validity, as many behaviours we view during social interaction are ambiguous and require some interpretation on the part of the viewer.

Some evidence suggests that typically developing individuals have an automatic tendency to judge ambiguous behaviour to be intentional, especially when under conditions of cognitive load (e.g., Moore & Pope, 2014; Rosset, 2008). This biased processing style has been shown to be augmented under alcohol intoxication (Begue, Bushman, Giancola, Subra, & Rosset, 2010). It is also associated with schizophrenia (Peyroux, Strickland, Tapiero, & Franck, 2014) and Tourette's syndrome (Eddy, Mitchell, Beck, Cavanna, & Rickards, 2010), both of which are associated with social dysfunction.

One framework suggests that perceiving action to be *accidental* requires higher cognitive demand and reflects greater maturation of intentional reasoning than simply understanding intentionality (Rosset & Rottman, 2014). The framework is based on a dual-process model of intention attribution (Rosset, 2008), which suggests an automatic tendency to judge all behaviour to be intentional which can only be overridden by a more controlled cognitive pathway when enough cognitive capacity is available. Rosset and Rottman (2014) argued that it is the more controlled pathway, i.e., the one that requires more mature cognitive processing skills and inhibitory control that develops with age rather than the ability to understand intention. This is in line with previous discussions by Buon, Seara-Cardoso & Viding (2016) as well as Margoni and Surian (2016) on generating moral judgements following accidental harm (i.e., unintentional harmful action). Specifically, understanding that mental states such as intentions are not necessarily in line with action outcomes, likely involves higher cognitive processing skills such as ToM to understand the dissonance between mental state and outcome, in addition to executive functioning capabilities to inhibit the negative appraisal that tends to occur in response to being victim to a harmful act. Supporting evidence for link between a bias towards outcome-based moral judgements and immature higher cognitive processing skills, comes from recent studies by Margoni and Surian (2020) as well as Margoni, Guglielmetti and Surian (2019), which suggest that when processing demand is reduced, neurotypical as well as autistic children are indeed able to form intent-based judgements when evaluating accidental harm.

In the case of adults, prior studies report over-attribution of intent in Asperger Syndrome (AS) for faux-pas tasks. Individuals were less likely to think that the person who committed a faux-pas did so out of a false belief but rather out of an intention to do so (Zalla, Sav, Stopin, Ahade, & Leboyer, 2009). Similarly, it was found that individuals on the autism spectrum were more likely than neurotypical controls to judge a clearly accidental action to be intentional (Buon et al., 2013). Results of a recently published study also suggest that autistic traits in a neurotypical sample predict intentionality endorsement of accidental harmful behaviour, in that higher autistic traits were associated with high intentionality endorsement scores (Zucchelli, Nori, Gambetti, & Giusberti, 2018).

These findings suggest it is not primarily the understanding of intentionality that individuals on the autism spectrum or with high autistic traits struggle with (i.e., they are not “blind” to intentions), but rather that their intention attributions may be biased and therefore their style of processing differs to that of neurotypicals. As discerning intentional from unintentional behaviour is a key aspect of social cognition and individuals with ASC often exhibit difficulties in social interaction, it is important to understand the patterns of intentional reasoning in autistic individuals, any potential differences with neurotypicals and the mechanisms that underlie any differences.

1.2 Theory of Mind and Judging Intentionality

Results from Zucchelli et al.'s (2018) study suggest that the relation between autistic traits and attribution of intentionality is partially mediated by a theory of mind (ToM) ability, which is understood as the ability to attribute mental states to oneself and to others (Premack & Woodruff, 1978). More specifically, decreased ToM abilities mediated the positive relation between autistic traits and intentionality endorsement. One interpretation of their results is that ToM is required to understand that overt behaviour does *not* necessarily correspond to an agent's mental state, i.e., that an action can be done accidentally and can lead to an unintended outcome.

There is broad consensus in the literature that autism is associated with ToM difficulties (for review see Baron-Cohen, 2000). However, autistic adults often pass commonly used ToM tasks, as lab-based experimental measures sometimes cannot pick up more subtle difficulties. Hence, in this study, we use the Strange Stories Film Task (SSFt), which was designed to test ToM abilities using naturalistic video scenarios (Murray et al., 2017). The SSFt is based on the Strange Stories Task (Happé, 1994), but conversely requires individuals to process social information at a pace corresponding to that of naturalistic social interactions rather than reading the scenarios at one's own pace (see Methods section for more detail).

1.3 Present Study

This study will investigate differences between an ASC group and a neurotypical control group in the perceived intentionality of ambiguous actions. Considering the evidence discussed above, it was predicted that:

1) Individuals on the autism spectrum will tend towards appraising ambiguous actions to be intentional.

2) There will be a difference in intentionality endorsement scores between individuals on the autism spectrum and neurotypical controls.

3) If we accept the first two hypotheses, we predict that ToM capabilities will in part explain this difference.

2. Methods

2.1 Participants

This study was approved by Goldsmiths University, Psychology Department Ethics Committee. Individuals with an ASC diagnosis (*n*=20; 7 female) and neurotypical controls (*n*=20; 11 female) took part in the study. They were recruited via the National Autism Society UK, social media platforms and community platforms, as well as through London-based community organisations. All of the participants in the ASC group had been previously diagnosed by a clinician. One statistical outlier was identified in the ASC group, based on their performance in the Ambiguous Sentences Paradigm (see below for details of the paradigm). More specifically, they had an intentionality endorsement score of 77.27 for the Prototypically Accidental test sentences. This individual was removed prior to the analysis.

The ASC and control group differed significantly in terms of autism traits measured by the Autism Spectrum Quotient (Table 1). Significant differences were also observed on all three sub-measures of the ToM task (SSFt), with the ASC group scoring lower on all three sub-measures (ToM accuracy: *p*=.01, ToM interaction: *p*=.01; ToM mental state: *p*=.02; Table 1). There were no significant group differences for the control items (Control accuracy: *p*=.4; Control mental state: *p*=.2; Control interaction: *p*=.16). Therefore, it was concluded that the two groups differed in our variables of interest; autism traits and ToM ability. There were no significant group differences in verbal reasoning abilities (VCI) between the ASC group and controls (*p*=.35; Table 1). Nor were there group difference in perceptual reasoning abilities (PRI; *p*=.87; Table 1).

Table 1. Means and Standard Deviations for Age, AQ scores, verbal reasoning ability (VCI), perceptual reasoning ability (PRI) and performance on SSFt sub-measures (accuracy, interaction and mental state words)

	ASC *N*=19		Control *N*=20				
	M	*SD*	*M*	*SD*	*t*	*d*	*p*
Age (months)	40.89	16.2	30.00	10.32			
AQ (max 50)	36.26	6.47	14.25	7.60	**9.76**	3.12	**<.001**
VCI	109.72	15.82	114.15	16.40	-0.96	0.28	.35
PRI	110.16	15.40	109.35	15.30	0.16	0.05	.87
ToM-accuracy	15.42	4.80	19.05	3.30	**-2.76**	0.88	**.01**
ToM-interaction	11.95	4.40	16.50	4.70	**-3.12**	0.99	**.01**
ToM-mental state	9.11	3.21	11.20	1.96	**-2.44**	0.79	**.02**

2.2 Measures and Procedure

All participants gave informed written consent and completed the following measures:

2.2.1 Wechsler Abbreviated Scale of Intelligence II.

The WASI-II (Wechsler, 2011) was used to assess verbal reasoning ability and non-verbal perceptual reasoning ability. Each participant received a verbal reasoning ability score (VCI) and a perceptual reasoning score (PRI) score, which reflect performance taking into account age. Excellent test-retest stability has been reported in an adult sample (r=.90- .96.; Wechsler, 2011). Regarding internal consistency, average reliability coefficient for VCI and PRI have been reported to be excellent at .95 and .94 (Wechsler, 2011).

2.2.2 Ambiguous Sentence Paradigm.

A modified version of Rosset's (2008) Ambiguous Sentence Paradigm was used, in which participants were presented with 34 test sentences describing ambiguous actions that could either be intentional or unintentional. There are two types of ambiguous sentences: 22 ambiguous but prototypically accidental sentences (e.g., He broke the window) and 12 ambiguous but prototypically intentional sentences (e.g., She cut him off driving). Participants were presented with 10 control sentences that were unambiguously unintentional (e.g., The girl had a seizure.) and 10 control sentences that were unambiguously intentional (e.g., He listened attentively). Sentences were presented one at a time in a set-randomised order on a computer screen. Participants were asked to indicate whether they thought the action described in each sentence was done on purpose or by accident by clicking on the corresponding answer. An intentionality endorsement score was computed for every sentence category, comprising the percentage of items for which actions were judged to be intentional. The modified version involved reducing number of control sentences from 20 to 10 to reduce participant fatigue. The purpose of the control sentences is to check that participants understood the task instructions, and this could be confirmed after 10 control sentences.

2.2.3 The Autism Spectrum Quotient.

The AQ (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) is a self-report questionnaire used to measure autistic traits in both the general and clinical population, made up of ten items measuring five relevant aspects of autistic traits (social skills, attention switching, attention to detail, communication, and imagination). Good test-retest reliability (r=.7) and moderate internal consistency for each of the five domains (Cronbach's alphas:

social skill α=0.77, attention switching α=0.67, attention to detail α=0.63, communication α=0.65, imagination α=0.65) has been reported (Baron-Cohen et al., 2001).

2.2.4 Strange Stories Film Task.

The SSFt (Murray et al., 2014) measured ToM abilities using 12 videos depicting acted social interactions. After each clip participants are asked three questions to evaluate their social understanding, namely, what the actors' intention was (*accuracy*), how they would react to what had been said (*interaction*) and a memory question (*memory;* control question). Responses to the intention question were also scored for the use of mental state language (*mental state language*). Adequate internal consistency for experimental clips has been reported (Cronbach's α ranging from α=.454 to α=.745; Murray et al., 2014) has been reported. (Interrater reliability was calculated with two coders, using two-way random model intraclass correlations (absolute agreement). All scores showed good or excellent agreement (ToM accuracy: r=.93; ToM interaction: r= .77; mental state language: r=.95; memory: r=.91; control accuracy: r=.89, control interaction: r=.91, control mental state language: r=.84, control memory: r=.93).

3. Results

3.1 Unambiguous Control Sentences

All participants in the control group responded correctly to the unambiguous control items indicating that they were able to follow the task instructions. Participants in the ASC group on average responded correctly to 94.7% of the Accidental control items and 97.4% of the Intentional control items. Mann Whitney-U tests revealed no significant difference between the ASC and the control group for either category of unambiguous control sentences (Accidental: U=150, p=.27; Intentional: U=170, p=.59; Table 2).

Table 2. Means and standard deviations for intentionality endorsement scores for Prototypically Accidental test sentences (PA), Prototypically Intentional test sentences (PI), Accidental Control sentences (UA) and Intentional control sentences (UI)

	ASC *N*=19		Control *N*=20	
	M	*SD*	*M*	*SD*
PA	18.42	7.34	13.18	8.59
PI	65.35	13.96	60.83	19.70
UA	5.27	11.72	0	0
UI	97.37	9.33	100	0

3.2 Main Analysis: Ambiguous Test Sentences

The two categories of ambiguous test sentences (prototypically intentional actions versus prototypically accidental actions) were analysed separately as they measure qualitatively different types of ambiguous actions. As can be seen in Figure 1, the ASC group showed a higher intentionality endorsement score than controls for both types of sentences. An independent sample t-test revealed a significant difference in intentionality endorsement scores for Prototypically Accidental test sentences between the two groups ($t(37)=2.04$, $p=.048$, $d=0.66$). This effect is marginally significant and should be treated with caution. There was no significant group difference in intentionality endorsement scores for Prototypically Intentional test sentences ($t(37)=.82$, $p=.42$, $d=0.26$; Figure 2).

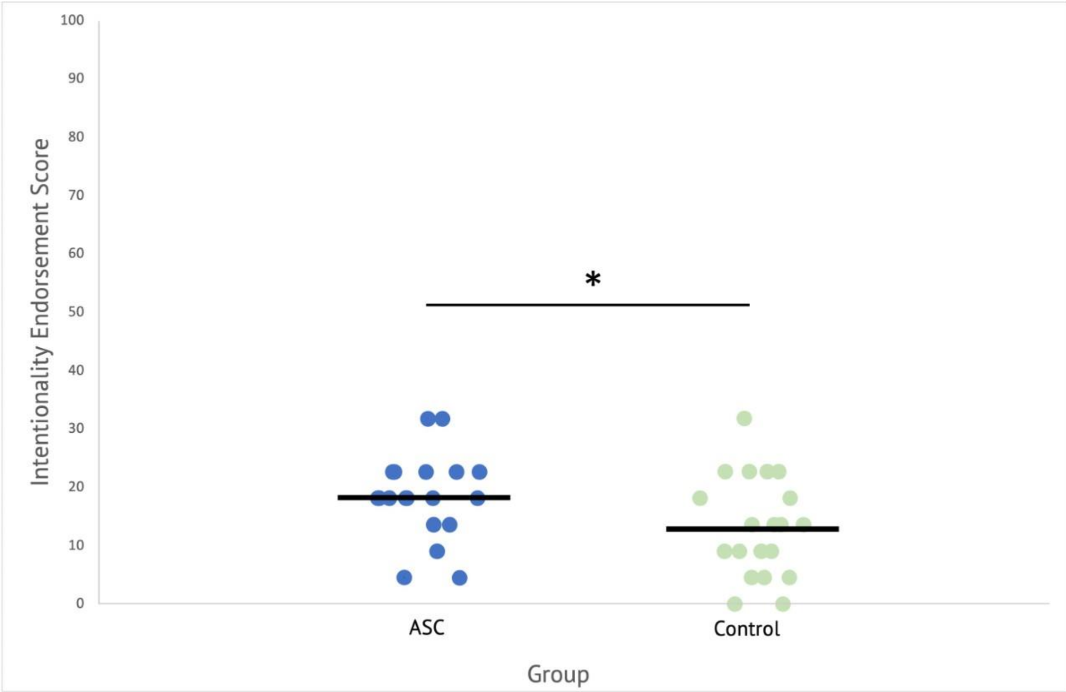

Figure 1. Intentionality Endorsement Scores for Prototypically Accidental Test Sentences with group means marked. The asterisk marks the significant difference between groups, *p*=.048.

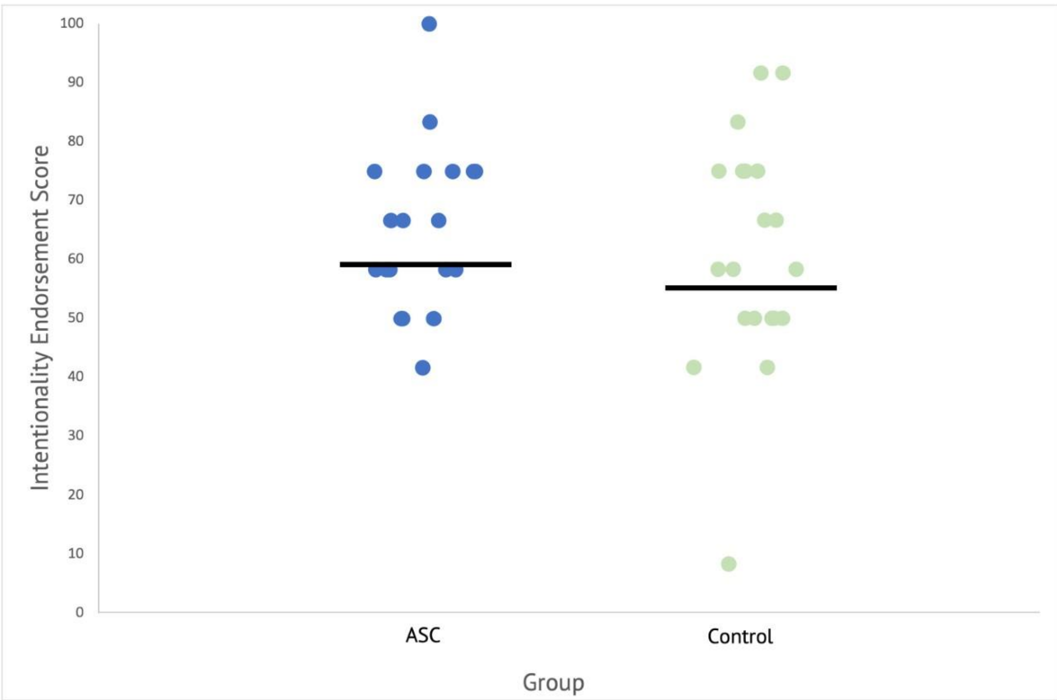

Figure 2. Intentionality Endorsement Scores for Prototypically Intentional Test Sentences with group means marked.

3.3 Sensitivity Analysis

A sensitivity analysis was performed using G*Power to establish the required effect size given desired power of 0.8 and the current sample size. Results indicated a required effect size of d=.92, which is higher than the observed effect size (d=.66). This shows that results from our main analysis need to be interpreted with caution, as the observed effect is below that which our study was able to detect reliably (see *4.4 Limitations*).

3.4 ToM and Intention Attribution of Ambiguous Actions

To explore the role of ToM in judging the intentionality of ambiguous but prototypically accidental actions, the association between ToM-accuracy scores and intentionality endorsement scores for Prototypically Accidental test sentences was investigated. ToM-accuracy, a ToM sub-component of the SSFt, measures the ability to accurately assess what others are thinking (Murray et al., 2017). This was assumed to be the most relevant of the three sub-components to intention attribution and was included in the following analysis. Simple linear regression analyses were conducted for both groups separately to examine whether ToM-accuracy scores would linearly predict intentionality endorsement scores. Results indicated that ToM-accuracy did not significantly predict intentionality endorsement scores in either group (ASC: $F(1,17)=3.61$, $p=.07$, $R^2=.18$, β =-.42; Controls: $F(1,18)=.37$, $p=.55$, $R^2=.02$, β =-.14). (Please note, however, that a p-value of .07 could be interpreted as a trend toward statistical significance, but extreme caution should be exercised in drawing any firm conclusions from this).

3.5 Verbal Reasoning and Intention Attribution of Ambiguous Actions

To explore the role of verbal reasoning ability on intention attributions for ambiguous actions, the association between verbal reasoning ability (VCI) and intentionality endorsement scores for Prototypically Accidental test sentences was examined. One participant from the control group was a significant outlier and was removed from the following analyses. The given participant was a statistically significant outlier on the ToM-interaction scale (using the inter-quartile range rule with a multiplier of 1.5; Hoaglin, Iglewicz, & Tukey, 1986) with a score of 1 (compared to $M_{Control}$=16.5 , $SD_{Control}=4.7$) and also had a comparably lower VCI than the rest of the sample of 73 (compared to $M_{Control}$=114.15, $SD_{Control}$=16.40).

Pearson's correlation analyses were conducted for both groups separately to assess whether VCI scores would be linearly associated with intentionality endorsement scores. Results suggested that VCI did not significantly correlate with intentionality endorsement scores in either group (ASD PA: p=.13; ASD PI: p=.26; Control PA: p=.74; Control PI: p=.53; Table 3).

3.5 Verbal Reasoning Ability and ToM

To explore the relationship between ToM scores and verbal reasoning ability (VCI), Pearson's correlation analyses were run in both groups separately. In the ASC group VCI significantly positively correlated with all three ToM sub-measures (MS accuracy: p=.01, MS interaction: p=.004, MS mental state: p=.03; Table 3). In the control group there was no significant correlation between VCI and either of the ToM sub-measures (MS accuracy: p=.7, MS interaction: p=.51, MS mental state: p=.85; Table 3).

Table 3. Correlation coefficients between verbal reasoning ability (VCI) and intentionality endorsement scores of Prototypically Accidental test sentences (PA) and Prototypically Intentional test sentences (PI), as well asTheory of Mind (ToM) sub-measures: accuracy, interaction, mental state language (MS)

	ASC N=19		Control N=19	
	r	p	r	p
PA	-.357	.13	.081	.74
PI	.27	.26	.152	.53
ToM-accuracy	**.621**	**.01**	-.095	.7
ToM-interaction	**.631**	**.004**	.160	.51
ToM-MS	**.499**	**. 03**	-.047	.85

4. Discussion

We investigated how individuals on the autism spectrum judge the intentionality of ambiguous actions. The results suggest that when presented with ambiguous but prototypically accidental actions, autistic adults show an increased tendency to perceive ambiguous behaviour to be intentional rather than accidental compared with neurotypical controls. Although this difference is only marginally significant, it is a noteworthy result and demonstrates group differences in intention attribution biases between autistic and neurotypical individuals.

Individuals on the autism spectrum often show impaired performance on mental state attribution tasks, which is sometimes understood as an indication of a deficit in ToM accuracy (Ciaramidaro et al., 2014). Our results add to this body of work by demonstrating differences in intention attribution processing between autistic and neurotypical individuals, in so far as individuals on the autism spectrum seem to over-attribute intention when judging ambiguous actions. Similar patterns can be seen in other disorders associated with social dysfunction such as schizophrenia or Tourette's syndrome (Peyroux et al., 2014; Eddy et al., 2010). Hence, atypical intention attribution processing may play a causal role in social difficulties.

4.1 ToM

In both the control and clinical groups, intentionality endorsement scores for ambiguous but prototypically accidental action were not related to ToM scores. This suggests that ToM abilities themselves may not be involved in discerning the intentionality of ambiguous actions, however our analysis was under-powered (n_{ASC}=19; $n_{Control}$=20). According to Klin (2000), it is an oversimplification to assume that ToM deficits can explain all aspects of social communication impairments in autism. In fact, good performance on ToM tasks does not necessarily guarantee good social adaption skills (see Klin, 2000; Klin, Volkmar, Schultz, Pauls, & Cohen, 1997).

One possible factor that might enable individuals on the autism spectrum to pass ToM tasks, but which does not necessarily lead to good naturalistic social adaption, is verbal scaffolding. Previous research suggests that individuals on the autism spectrum often use their verbal skills on ToM tasks (e.g., Happé, 1995). However, these may not be used to the same extent in our everyday social interactions in which situations change quickly; problems are not verbally formulated and learnt scripts are not suitable (Klin, 2000). In our ASC sample, performance on all three ToM sub-measures significantly and positively correlated with verbal IQ, whereas there was no relation between verbal IQ and ToM abilities in the control group (Table 3). This suggests that individuals in the ASC group may have relied more heavily on their verbal skills when solving the ToM task rather than genuine social skills. However, we found no significant correlation between verbal IQ and intentionality endorsement scores in either group indicating that both groups do not appear to be relying on their verbal skills when completing the Ambiguous Sentence Paradigm.

4.2 Role of Executive Functioning

Rosset and Rottman's (2014) framework suggests an ability to perceive behaviour as accidental is what indicates mature intentional reasoning. Understanding that an agent's behaviour does not necessarily correspond to their mental state requires more cognitive demand than simply perceiving an action to be intentional. This is because, 1) it entails processing additional sources of information such as the observer's past experience, alternative causes for the behaviour (e.g. environmental) and the agent's motivation, and 2) it requires inhibiting an automatic response whereby all behaviour is assumed to be intentional. Both aspects involve adept executive functioning. Individuals with ASC and those with high autistic traits have been found to exhibit executive functioning impairments (see Gokcen, Frederickson & Petrides, 2014; Hill, 2004). Autistic children have also been shown to have impaired performance on response inhibition tasks compared with their neurotypical peers (Robinson, Goddard, Dritschel, Wisley & Howlin, 2009). These executive function impairments could be contributing to the high intentionality endorsement scores in our ASC group. Therefore, future research could examine the role of executive functioning and impairments in inhibitory control in appraisals of intentionality in ASC.

It is worth noting, at this point, that a recent study on the detection of lies, showed autistic traits to be associated with lower attribution of intentionality (Cantarero, Byrka, & Król, 2021). In other words, these findings suggest that in the case of lying, autistic individuals might show a contrary intention attribution pattern than in our study. Although perhaps counterintuitive, these findings might be in line with ours, as they suggest that the difficulty of intention attribution lies in understanding that overt action (making a statement) and covert mental state (deceiving) do not necessarily align. Future research could, hence, explore whether different types of ambiguous actions lead to different patterns of judging intentionality. Similarly, the role of situational factors such as the relationship between agent and victim/receiver could be investigated. Zajenkowska and colleagues (2021) recently suggested that autistic individuals same as neurotypical controls attributed the greatest hostility to authority figures, and it might be of interest exploring whether the same applies to attribution of intentionality.

4.3 Ambiguous but Prototypically Intentional Action

Notably, there was no significant group difference in intentionality endorsement scores for Prototypically Intentional test sentences. We assume that this indicates an unsuitable test category rather than a meaningful finding. Results of work conducted by our research group consistently fails to detect group differences in intentionality endorsement scores of Prototypically Intentional tests sentences. A contributing factor for this could be the small number of stimuli (12 compared to 22 in the other test category), which means that a single item accounts for a bigger proportion of intentionality endorsement scores, therefore the variability within each group is inflated. This could make it more difficult to detect any differences. Another possible reason for why we do not see a difference between groups for Prototypically Intentional test sentences is that automatic as well as analytical processing of action leads to the same judgment of intentionality. Prototypically Intentional test sentences contain cues marking the action to be intentional (e.g., choice of words: “She *ignored* the question”) and as analytical processing of intentionality is reactive towards such cues, analytical processing - same as automatic processing - would lead to an ‘intentional’ judgement. In light of Rosset’s dual-process model, this means that there would be no difference in response due to executive functioning deficits (as common in ASC). Therefore, in future investigations, we suggest excluding the category of Prototypically Intentional test sentences, as they do not seem to be an appropriate test category.

4.4 Limitations

The sample size of the current study was small and as a result our analysis may be underpowered. A follow-up study with a larger sample should be considered to replicate group differences and to re-test whether ToM skills can predict intentionality endorsement scores.

Furthermore, we did not include a measure of executive functioning skills. The reason for this was that our a priori hypothesis stated that ToM differences would drive group differences in intentional reasoning, a measure of executive functioning did not appear to be a crucial factor to our experimental design. However, based on reassessment of the literature as well as findings from this study, we acknowledge the potential role of other higher-level cognitive functions, such as executive control. Future research should, therefore, include a measure of executive functioning to investigate whether deficits in executive functioning can explain a greater tendency to judge ambiguous action to be intentional in ASC.

Lastly, our ASC group consists of adults without intellectual disabilities. This allowed us to match the groups in terms of IQ, although it does mean that our sample only represents a specific group within the ASC population. Furthermore, as we did not gather additional sociodemographic information, we cannot rule out that factors such as level of education or social background could have affected intentional reasoning.

4.5 Conclusion and Future Directions

The current study investigated the intention attribution biases of autistic individuals when judging ambiguous actions. The ASC participants tended to over-attribute intention compared to neurotypical controls, which could not be explained by deficits in ToM abilities. Future research should aim to replicate the effect in a larger sample and explore the cognitive mechanisms that may be driving this information-processing bias. One direction could involve exploring if inhibitory functions play a role in driving the group differences we observed in intentionality bias scores between the ASC and neurotypical participants. Understanding how autistic people navigate real world social interactions is an important prerequisite for being able to better facilitate positive social interactions for autistic individuals.

Data Availability

The dataset generated and/or analysed during the current study have been made publicly available at OSF and can be accessed using the following link: https://www.osf.io/j2xem

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