Brief Report: Autistic adults assign less weight to affective cues when judging others' ambiguous emotional states

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ABSTRACT

Understanding other people's emotional states involves integrating multiple sources of information, such as someone's smile (affective cue) with our knowledge that they have passed an exam (situational cue). We explored whether autistic adults display differences in how they integrate these cues by showing participants videos of students receiving their exams results. Our results suggest autistic adults generally perform as neurotypical participants when identifying and integrating affective and situational cues. It was only in certain unfamiliar and ambiguous social situations that autistic adults assigned less weight to affective cues compared to situational cues when judging other people's emotional states.

Key words: emotions, faces, theory of mind

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INTRODUCTION

Understanding others' emotional states involves integrating multiple sources of information, such as someone's smile (affective cue) with our knowledge that they have passed an exam (situational cue). Autistic people display differences in their understanding of others' emotional states (American Psychiatric Association, 2013) which may include differences in how they integrate these situational and affective cues (Bird and Viding, 2014), especially if these two sources of information do not align (Tell and Davidson, 2015). This is what we explored in the current study.

Meta-analyses have shown that many autistic individuals can successfully identify a range of facial expressions with mean accuracy only marginally lower than neurotypical groups (Uljarevic and Hamilton, 2013). Autistic individuals can also integrate different types of affective cues, such as facial expressions with affective cues from body posture (Brewer, Biotti, Bird and Cook, 2017). Yet, we do not rely exclusively on affective cues when understanding others' emotional states. Rather, we are often privy to the situation someone finds themselves in.

Bird and Viding (2014) argued that there could be reduced attention and/or motivation towards situational and affective cues in autism (Chevallier, 2012). This results in a reduced probability of conflict arising between these different types of cues. Moreover, if there is an incongruency between affective and situational cues, autistic individuals are less effective in arbitrating between these cues and understanding others' emotional states. Tell and Davidson (2015) presented children with pictures in which the characters' facial expressions were incongruent with the situation (e.g. frowning whilst opening a present). They found that autistic children relied more on the facial expression when identifying the character's emotional state, whereas non-autistic children relied more on the situation. This suggests that there may be differences in understanding other's emotional states in autism when arbitrating between conflicting sources of information. Tell and Davidson used drawings of unambiguous facial expressions, yet, facial expressions during everyday social interactions are usually dynamic, subtle and fleeting (Motley & Camden, 1988). Thus, our study investigated how autistic adults integrated subtle and dynamic affective cues (videos of low intensity facial expressions) with situational cues (knowledge of students' exam performance). Additionally, rather than identifying the emotion, we asked participants to rate the intensity of the students' emotional state, thus providing a more sensitive measure of how participants weighted situational and affective cues.

METHOD

TD (n=27)	**Age**	**VIQ**	**PIQ**	**FSIQ**	**AQ**			
7 female, 2 left-handed								
Mean	32	118	115	118	14			
SD	11	10	14	12	6			
Max	62	138	146	143	28			
Min	20	96	91	99	4			
ASC (n=25)	**Age**	**VIQ**	**PIQ**	**FSIQ**	**AQ***	**ADOS**		
5 female, 3 left-handed						**Comm**	**RSI**	**Total**
Mean	34	116	110	115	33	3	6	8
SD	7	10	15	12	9	2	2	3
Max	54	135	132	136	48	9	11	17
Min	22	91	80	86	10	0	2	2
p-value	0.34	0.40	0.27	0.30	<.001			

*one autistic participant did not provide an AQ score

Participants

28 neurotypical and 25 autistic participants were recruited from a database of autistic and neurotypical participants at the authors' institution. One neurotypical participant responded with the same rating on over 90% of trials so was removed from the final sample. This resulted in a final sample size of 27 in the neurotypical group and 25 in the autism group (Table 1). The groups were matched on age, handedness, gender, and verbal and performance IQ as measured by Wechsler Adult Intelligence Scale (WAIS-III UK; Wechsler, 1999a; WASI-II, Wechsler, 1999b). Autistic participants completed Module 4 of the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000; ADOS-2; Lord et al. 2012): nine met the ADOS criteria for autism, ten for autism spectrum and six did not meet the classification for either autism or autism spectrum. Five of these six participants met the cut-off for an autism spectrum classification on one of the subscales and all autistic participants had a diagnosis of Asperger's Syndrome

(21) or Autism Spectrum Disorder (4) from an independent clinician. Three autistic participants (dyslexia, ADHD and dyspraxia) and one neurotypical participant (dyslexia) reported an additional diagnosis. Both autistic and neurotypical participants completed the Autism Quotient (Baron-Cohen et al., 2001).

Procedure

Participants sat 60 cm from a monitor and watched students' reactions to receiving their exam results (note, the term "students" refers to the actors in the videos, not the participants). On each trial, the participants saw the student's name and the grade they expected (expected grade) followed by a short video of them opening their exam results. Participants then saw the student's reaction to their grade (emotion video) before seeing the grade they achieved (achieved grade). They were then asked, "How does the student feel?" and indicated this on a 9-point Likert scale ('extremely unhappy' to 'extremely happy'). The emotion videos were from the Amsterdam Dynamic Facial Expression Set – Bath Intensity Variations (ADFES-BIV; Wingenbach et al. 2016) a database of short videos showing a range of facial expressions at three intensities (low, medium and high). We used low intensity videos from nine different actors displaying happiness and sadness.

The students could do better than expected (e.g. expected C, achieved B), worse than expected (e.g. expected B, achieved C) or perform as expected (e.g. expected C, achieved C). Unless the student performed as expected, the difference in grade between the achieved and expected grade was always one grade. Each student did 12 exams creating a total of 108 trials presented in a pseudorandomised order across 3 blocks. Only trials during which the student performed better or worse than expected were analysed. We included the 'as expected' trials to increase ecological validity, as participants would have found it unusual if none of the students ever achieved their expected grade. Moreover, if there were only ever two outcomes following the expected grade (i.e. better or worse), this would have made the catch trials much easier for participants. Catch trials followed 27 of the trials and participants indicated what grade the student expected, achieved and whether they displayed a positive or negative facial expression.

RESULTS

Participants' ratings of the students' emotional state were subject to a repeated measures ANOVA with emotion (happy, sad), expectancy (better, worse) as factors.

Neurotypical

Neurotypical participants showed a main effect of emotion ($F_{1, 26}$=109.8, p<0.001, η_p^2 = 0.809), with ratings higher for happy (mean[SD]=4.24[0.366]) compared to sad (3.28[0.386]) emotional expressions (95%CI: 0.778, 1.158). There was a main effect of expectancy ($F_{1, 26}$=31.43, p<0.001, η_p^2 = 0.547), with higher ratings when students did better (4.33[0.668]) compared to worse (3.188[0.532]) than expected (95%CI: 0.724, 1.562). The interaction between emotion and expectancy was not significant (p > 0.81).

Autism

Autistic participants showed a main effect of emotion ($F_{1, 24}$=34.02, p<0.001, η_p^2 = 0.586), with ratings higher for happy (4.17[0.407]) compared to sad (3.36[0.547]) emotional expressions (95%CI: 0.525, 1.098). There was a main effect of expectancy ($F_{1, 24}$=30.37, p<0.001, η_p^2 = 0.559), with higher ratings when students did better (4.42[0.750]) compared to worse (3.10[0.612]) than expected (95%CI: 0.824, 1.811). The interaction between emotion and expectancy was also significant ($F_{1, 24}$=5.51, p=0.028, η_p^2 = 0.187). When students did better than expected, the difference between the ratings when students displayed a happy compared to sad facial expression was 0.700[0.648], whereas this difference was 0.922[0.810] when students did worse than expected (t_{24}=2.35, p=0.027, 95%CI: 0.028, 0.417).

Group comparison

To compare differences between the groups, we included group (autism/neurotypical) as a between-subject factor in the model. This revealed a main effect of emotion ($F_{1, 50}$=116.8, p<0.001, η_p^2 = 0.696), with ratings higher for happy (4.207[0.385]) compared to sad (3.315[0.467]) emotional expressions (95%CI: 0.728, 1.058). There was a main effect of expectancy ($F_{1, 50}$=61.91, p<0.001, η_p^2 = 0.552), with higher ratings when students did better (4.375[0.703]) compared to worse (3.147[0.568]) than expected (95%CI: 0.916, 1.539). The interaction between emotion and expectancy was significant ($F_{1, 50}$=4.186, p=0.046, η_p^2 = 0.073). When students did better than expected, the difference between the ratings when students displayed a happy compared to sad facial expression was 0.834(0.588), whereas this difference was 0.951(0.669) when students did worse than expected (t_{51}=1.96, p=0.055, 95%CI: -0.0027, 0.236).

The three-way interaction between emotion, expectancy and group showed a trend towards significance ($F_{1, 50}$=3.098, p=0.084, η_p^2 = 0.054). This was driven by the significant emotion x expectancy interaction in the autistic group, which was absent in the neurotypical group. To explore this potential group difference further, we separated the data into trials where students did better than expected (left panel of Fig 1) and those where they did worse than expected (right panel of Fig 1). For each participant, we examined the difference in rating between seeing a happy and sad facial expression in this condition, to test how much influence the facial expression had on the emotion judgement task. For 'better-than-expected' trials in the neurotypical group, the mean (SD) difference was 0.959 (0.508) compared to 0.700 (0.648) in the autistic group and this effect showed a trend towards significance (t_{50}=1.61, p=0.114, 95%CI: -0.064, 0.582). One autistic participant showed a difference of 2.389 between these two conditions (Figure 1), which was over 2.5 SDs from the group average. Removal of this outlier produced a mean of 0.620 (0.556) in the autistic group and revealed a significant difference between the groups (t_{49}=2.21, p=0.032, 95%CI: 0.030, 0.629). For 'worse-than-expected' trials, the mean (SD) difference in the neurotypical group was 0.977 (0.520) and in the autistic group it was 0.922 (0.810. This difference was not significant (p>0.76). Finally, the interaction between emotion and group (p>0.34), and, expectancy and group (p>0.57) were not significant.

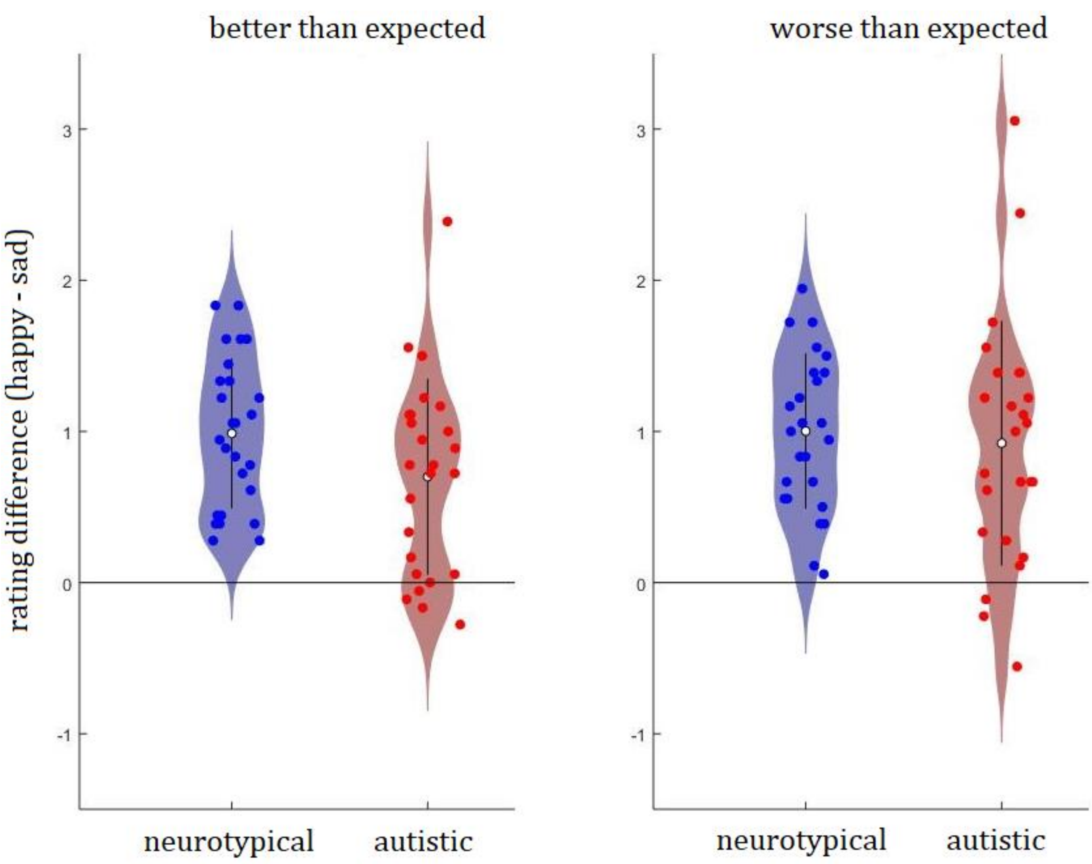
Catch Trials

There were no significant differences between the autistic and neurotypical participants in how accurate they were at recalling the achieved and expected grades or the valence of the facial expressions (Table 2). For the emotion identification task, participants made 27 binary choices (positive or negative). A permutation test revealed that the 5% cut off for performing above chance was 66.7%. On average, neither autistic nor neurotypical participants performed above this cut off and there were also no significant differences in how many autistic (7) compared to neurotypical (10) participants performed above this cut-off [$X^2 = 0.628$, $p = 0.428$].

Table 2. Mean and SD for the catch trials for each group

% correct	Neurotypical (n=27)		Autism (n=25)	*p*
Achieved	88.8 (9.83)		85.3 (13.3)	0.295
Expected	93.42 (7.22)	91.9 (8.49)	0.476	
Emotion	66.26 (8.68)	63.1 (12.1)	0.285	

Figure 1. The difference in rating between the happy and sad condition when students did better and worse than expected. The mean for each participant is represented by a blue (neurotypical) or red (autistic) dot. The white dot and black lines show the overall means and SDs.



DISCUSSION

Autistic adults and a matched neurotypical group rated how happy students were after receiving their exams results. On each trial, participants saw the grade the student expected to achieve, their emotional reaction followed by the grade they achieved. Both autistic and neurotypical participants used students' grades and emotional reactions to inform their ratings of the students' emotional state. Both groups rated the students as happier when they did better than expected and showed positive facial expressions. However, autistic and neurotypical participants sometimes differed in how much weight they assigned to affective and situational cues. In particular, when students did better than expected, the facial expression displayed by the student had a greater impact on neurotypical participants' ratings than those of autistic participants. Thus, autistic individuals may sometimes assign less weight to affective cues compared to situational cues when judging others' emotional states.

Our findings support studies showing that autistic individuals can identify and use a range of cues when judging others' emotional states (Uljarevic and Hamilton, 2013; Brewer et al., 2017). However, autistic participants showed some subtle differences in how they integrated affective cues with situational cues (Bird and Viding 2014). The differences between the autistic and neurotypical participants were restricted to trials in which students did better than expected. When students did worse than expected, the presence of a sad, compared to happy, facial expression had a comparable effect on the ratings of both groups. A possible explanation for this difference, is that there is a social norm to "put on a brave face" when things turn out worse than expected. However, situations in which someone looks sad when things turned out *better* than expected are less common. Thus, our findings broadly support Bird and Viding's (2014) proposal that there are differences in autism when integrating conflicting affective and situational cues. However, these differences are not pervasive and may be restricted to less frequent and more ambiguous social situations.

Our findings could have implications for eyewitness testimonies from autistic individuals. A review on this topic argued autistic people show "marked abnormalities in emotional behaviours and do not process emotional stimuli such as faces and social scenes in the same way that typical individuals do" (Maras and Bowler, 2014; p. 2685). Our data do not support such a strong claim. The autistic adults involved in our study were able to integrate affective and situational cues when judging the emotional states of others, and their performance was largely comparable to neurotypical participants. If differences do exist in judging the emotional states of others, they are likely to be subtle in nature and restricted to unusual or unfamiliar social situations. It is important to note, however, that the participants involved in our study all had average or above average IQ. Yet, approximately half of autistic people have developmental delays in global cognitive functioning (< 70 IQ; Baird et al., 2006; Mpaka et al., 2016; O'Brien and Pearson, 2004). Thus, further studies with larger and more diverse samples are required to examine whether our findings generalise to the autistic population as a whole.

To conclude, our results suggests autistic adults generally perform as neurotypical participants when identifying and integrating affective and situational cues. It is only in certain unfamiliar and ambiguous situations, that autistic adults may assign less weight to affective cues when judging others' emotional states.

COMPLICANCE WITH ETHICAL STANDARDS

The authors declare no conflicts of interest. All procedures were approved by the local Research Ethics Committee and were in accordance with the Declaration of Helsinki. Informed consent was obtained from all participants in the study.

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