HHS Public Access

Author manuscript

Autism. Author manuscript; available in PMC 2015 October 01.

Published in final edited form as:

Autism. 2015 April ; 19(3): 308–315. doi:10.1177/1362361314520755.

Misinterpretation of Facial Expressions of Emotion in Verbal Adults with Autism Spectrum Disorder

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Abstract

Facial emotion perception is significantly affected in autism spectrum disorder (ASD), yet little is known about how individuals with ASD misinterpret facial expressions that result in their difficulty in accurately recognizing emotion in faces. This study examined facial emotion perception in 45 verbal adults with ASD and 30 age- and gender-matched volunteers without ASD to identify patterns of emotion misinterpretation during face processing that contribute to emotion recognition impairments in autism. Results revealed that difficulty distinguishing emotional from neutral facial expressions characterized much of the emotion perception impairments exhibited by participants with ASD. In particular, adults with ASD uniquely misinterpreted happy faces as neutral, and were significantly more likely than typical volunteers to attribute negative valence to non-emotional faces. The over-attribution of emotions to neutral faces was significantly related to greater communication and emotional intelligence impairments in individuals with ASD. These findings suggest a potential negative bias toward the interpretation of facial expressions and may have implications for interventions designed to remediate emotion perception in ASD.

Autism spectrum disorder (ASD) is a severe neurodevelopmental disorder characterized by significant impairments in social interaction, verbal and non-verbal communication, and by repetitive/restricted behaviors. Individuals with ASD also experience significant cognitive impairments in social and non-social information processing (Eack et al., in press-a; Boucher, Mayes, & Bigham, 2012; Minshew & Goldstein, 1998; Ozonoff et al., 2004; Rosenthal et al., 2013), although there are domains that are enhanced in the disorder (e.g., Samson, Huber, & Gross, 2012). One of the most common cognitive impairments reported in studies of ASD involves the identification and labeling of facial expressions of emotion (Harms, Martin, & Wallace, 2010).

There are over 50 empirical studies investigating difficulties in facial emotion perception in ASD that include more and less verbal individuals, those with and without comorbid intellectual disability, and youth and adults. The majority of emotion perception studies conducted have consistently observed challenges in either the matching or labeling of

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emotions in faces, with an average effect size of $d = -.80$ (Uljarevic & Hamilton, 2013). However, the degree of impairment in identifying specific types of emotion has varied widely across studies. A recent study by Kennedy and Adolphs (2012) found that verbal adults with ASD had more difficulty distinguishing between emotions and were less reliable in their ratings of emotional intensity over time. Further, studies also suggest that people with autism tend to rely on individual facial features rather than whole-face configurations (Behrmann et al., 2006), and use rule-based rather than template-based strategies to recognize emotion in faces (Rutherford & McIntosh, 2007).

Despite all of the evidence that has accumulated on impairments in facial emotion perception in ASD, less is known about how individuals with autism interpret facial expressions that result in impairments or whether their pattern of misinterpreting such stimuli is significantly different from those without ASD. Humphreys, Minshew, Leonard, and Behrmann (2007) found that in 20 verbal adults with autism, individuals with ASD confused disgust and anger, and fear for surprise, although whether this pattern was different from non-ASD individuals was not tested. A study by Jones and colleagues (2011) examined 99 adolescents with ASD and found that people with the disorder confused disgust for anger and fear for surprise. However, comparisons with a typical sample of individuals were not conducted and thus it was not clear whether this pattern of misinterpretation was unique to those with ASD. Wallace and colleagues (2011) studied 41 verbal adolescents with ASD without intellectual disability and 31 typically developing adolescents, and found that individuals with ASD misattributed anger as disgust, and interpreted sad faces as angry. Again, statistical comparisons of whether these patterns were significantly different from the typically developing children were not conducted, although the investigators noted that the error patterns appeared to be similar to those that occurred in typical individuals.

Taken together, current evidence on emotional misinterpretation of facial expressions in ASD is quite limited. Studies conducted to date do reveal interesting patterns of emotion perception errors in autism, but the absence of statistical comparisons with the performance of typical individuals makes it difficult to determine if these impairments are specific to autism and whether they account for the lower accuracy rates for emotion perception in this population. All studies conducted to date have relied on visual inspection of confusion matrices to examine similarities and differences in misinterpretations compared to individuals with ASD. While informative, this method is limited by its subjectivity and inability to determine whether error patterns that may appear different in autism are in fact greater than what can be expected by chance differences between groups. Consequently, conclusions regarding misinterpretations observed during emotion perception tasks have been mixed and ranged widely. More rigorous and focused comparisons are needed to provide clarity to the nature of emotion perception errors made by people with ASD to provide guidance for intervention design.

It is also important to note that none of these previous investigations of emotion misinterpretation have included an assessment of neutral facial expressions, which is an important and frequent category of expression in everyday life that might be particularly confusing to individuals with autism. The exclusion of such faces or even a neutral category of response could artificially distort previous findings by introducing random responding

due to forcing individuals to attribute an emotion to a face when no emotion is recognized. In addition, previous research on the misinterpretation of emotions in facial expressions has paid little attention to the functional consequences of errors made when attempting to perceive the emotions of others. Studies indicate that lower accuracy in recognizing some emotional expressions is related to poorer living skills (García-Villamisar, Rojahn, Zaja, & Jodra, 2010), social skills (Williams & Gray, in press), social communication (Wallace et al., 2011), and other emotional impairments, such as alexithymia (Cook, Brewer, Shah, & Bird, 2013). These findings generally indicate that misunderstanding the emotional cues people provide through their facial expressions are associated with important outcomes in autism, but how specific aspects of emotional misinterpretation are associated with social and emotional impairments in ASD has not been examined. Understanding how people with autism misinterpret emotional cues and the functional consequences of these misinterpretations has important implications for treatment development efforts by identifying the precise misinterpretations that lead to recognition impairments in this population as well as those errors that have the largest association with outcome.

In an effort to achieve a greater understanding of facial emotion perception impairments in autism that could inform intervention development efforts, we conducted a study of the patterns of misinterpretation of basic emotional and neutral facial expressions in a well-characterized and age- and gender-matched sample of 45 verbal adults with ASD and 30 typical volunteers. Specifically, we sought to examine the degree to which differences in the misinterpretation of facial expressions were present between those with autism and typical controls, and the association such emotional misinterpretations had with social, emotional, and communication impairments in the condition.

Method

Participants

Study participants included 45 verbal adults with ASD and 30 age- and gender-matched typical volunteers. Individuals with ASD were included if they met autism or autism-spectrum criteria on the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1989), had developed non-echoed sentence language, were between the ages of 16 and 45 years, had an IQ ≥ 80, were not abusing substances within 3 months prior to study enrollment, and displayed significant cognitive and social disability on the Cognitive Styles and Social Cognition Eligibility Interview (Hogarty et al., 2004). Participants with ASD were enrolled in a trial of Cognitive Enhancement Therapy (Hogarty & Greenwald, 2006) for this population, and the eligibility requirements regarding cognitive and social disability were included to ensure that individuals experienced enough impairment to indicate a need for treatment. In the over 100 potential participants with ASD screened for this study, none failed to meet these eligibility criteria on the Cognitive Styles and Social Cognition Eligibility Interview. Typical volunteers were age- and gender-matched to individuals with ASD and included if they were free from a current psychiatric diagnosis verified by the Structured Clinical Interview for DSM-IV (SCID; First, Spitzer, Gibbon, & Williams, 1996) and were not abusing substances within the past 3 months. Enrolled participants were young, predominantly male, mostly Caucasian, and well-educated (see Table 1). Of those with

ASD, 58% met ADOS criteria for autism, with the remaining 42% meeting autism spectrum criteria. There were no significant differences between adults with ASD and typical volunteers with regard to age or gender. The controls were more likely to have attended college, and it was notable that individuals with ASD demonstrated higher IQ scores than typical controls.

Measures

Penn Emotion Recognition Test—Facial emotion recognition was assessed using the Penn Emotion Recognition Test-40 (Kohler et al., 2003). This is a computerized test that presents participants with a series of 40 happy, fearful, angry, sad, and neutral faces. A single stimulus set of facial expressions is balanced to include an equal number of faces for each gender and emotional valence, as well as an equal number of extreme and mild expressions of emotion. The stimuli were developed from pictures of paid actors in a previous study of emotion perception and brain function (Gur et al., 2002). The test authors characterized the expressions as either as extreme or mild in intensity. Color stimuli (approximately 356x356 px) are presented in random order and include whole-face regions, including both the mouth and eyes, and are set on a black background. During the presentation of each face, participants are positioned within comfortable seated viewing distance from the computer screen and asked to complete a forced-choice task identifying whether the individual is displaying a happy, fearful, angry, sad, or neutral expression. The facial expression remains on the screen during the force-choice task, with the response categories displayed together at the right-hand side of the screen next to the face. Individuals respond to the task using a mouse pointer, and the accuracy and speed of the response are recorded into an electronic database. Once a response is selected for a given face, the next face is presented, and participants are not able to revise their responses. Importantly, the response selected is recorded, allowing for a detailed examination of error patterns that reflect emotional misinterpretation. Individuals are allowed as much time as they need to complete the task, and were supervised and provided with standardized instructions by a trained research associate. The Penn Emotion Recognition Test-40 has been extensively used in psychiatric research (Kohler et al., 2003), has been shown to have good psychometric properties (Carter et al., 2009), and to recruit neural circuitry involved in the processing and interpretation of emotion (Gur et al., 2002) that is likely to be deficient in ASD (Baron-Cohen et al., 2000).

Mayer-Salovey-Caruso Emotional Intelligence Test—To examine the association between emotional misinterpretations made during facial emotion recognition and other emotional impairments experienced by people with ASD, the Mayer-Salovey-Caruso Emotional Intelligence Test (Mayer, Salovey, Caruso, & Sitarenios, 2003; MSCEIT) was used as a broad assessment of emotional functioning. The MSCEIT is a 141-item, computerized performance-based test that assesses the four domains of emotional intelligence outlined by Salovey and Mayer (1990). These domains include the ability to accurately perceive emotions (emotion perception), the ability to use emotion to facilitate cognition (emotion facilitation), the ability to understand emotions (emotion understanding), and the ability to manage emotions in oneself and others (emotion management). The test is performance-based in that rather than self-reporting emotional abilities, participants are

asked to solve emotional problems and their responses are scored based on a large pool of consensus norms from the general population. Example tasks include reading scenarios to identify which actions would be most useful in achieving a given emotional outcome, and identifying which emotion results from combining several basic emotions. The MSCEIT has been shown to be a reliable and valid measure of emotional intelligence in typical individuals (Mayer, Salovey, Caruso, & Sitarenios, 2003), as well as people with schizophrenia (Eack et al., 2010a).

Procedures

Potential participants with ASD were recruited from support groups, community programs, psychiatric clinics, and ongoing studies at the University of Pittsburgh. Upon recruitment, participants were assessed for eligibility by research staff trained in the aforementioned measures. The ADOS was administered by research associates experienced with autism from the Subject Assessment Core of the NIH-funded University of Pittsburgh Autism Center of Excellence, and were supervised by a study psychologist affiliated with the center. The SCID was administered to typical volunteers by trained staff experienced in schizophrenia research and psychiatric assessment, and were supervised by a clinical nurse specialist. Intelligence tests (Wechsler Abbreviated Scale of Intelligence [Wechsler, 1999] or Quick Test [Ammons & Ammons, 1962]) were administered by trained research technicians supervised by a psychologist. Videotaped interviews using the Cognitive Style and Social Cognition Eligibility Interview were rated in consensus teams by trained raters. The Penn Emotion Recognition Test-40 and MSCEIT were administered via the computer and overseen by a neuropsychological tester, who was trained and supervised by a study psychologist. Data for this study were collected before participants with ASD began treatment in the Cognitive Enhancement Therapy trial. All participants provided written informed consent prior to study participation, and the study was approved by the University of Pittsburgh Institutional Review Board.

Data Analysis

Analysis of impairments in the recognition of facial expressions of emotion in verbal adults with ASD proceeded by first constructing a series of general linear models to examine differences in performance for each emotional condition, collapsed across intensity, of the Penn Emotion Recognition Test between participants with ASD and typical volunteers. These models adjusted for IQ differences between affected and non-affected individuals and examined both speed and accuracy metrics of emotion perception performance. The underlying misinterpretations of facial expressions that individuals ASD made that resulted in behavioral impairments in emotion perception were then examined by computing a 5×5 concordance matrix between the type of stimulus presented and the response provided. This matrix was calculated separately for those with ASD and typical individuals, and significant differences in the off-diagonal elements (representing an emotional misinterpretation or mismatch between the stimulus and response provided) between these two groups were tested using a χ^2 test adjusting for the hierarchical nature of these per trial data (Rao & Scott, 1992). Finally, the association between misinterpretations during facial emotion perception in ASD and social, emotional, and communication problems were examined in a series of linear regression models predicting ADOS domain scores (communication and reciprocal

social interaction algorithm scores) and MSCEIT emotional intelligence scores (total scores) from error patterns (e.g., identification of neutral faces as sad) during the Penn Emotion Recognition Test, after adjusting for IQ.

Results

Performance differences in the recognition of facial expressions of emotion in verbal adults with ASD compared to typical volunteers across the five types of facial expressions studied are presented in Table 2. Overall, adults with ASD were significantly less accurate than controls, with the largest difficulties observed in the identification of happy and neutral faces. Significant impairments were also observed in the ASD group in accurately recognizing facial expressions of sadness compared to typical individuals. Large differences in latency of response were not observed between typical individuals and those with autism, although adults with ASD were significantly slower to respond overall, particularly for the recognition of neutral expressions, compared to typical individuals.

Having found significant impairments in the accurate recognition of happy, sad, and neutral facial expressions in verbal adults with ASD compared to typical individuals, we proceeded to investigate the patterns of emotional misunderstanding that contributed to these challenges. Table 3 presents accuracy rates and error patterns for responses to emotional and non-emotional faces across adults with ASD and typical volunteers. Errors made by typical individuals most commonly consisted of misinterpreting angry as neutral or fearful faces, a pattern that was also frequent in adults with ASD. With regard to misinterpretation differences between typical individuals and those with ASD, adults with ASD were significantly more likely than typical individuals to interpret happy faces as neutral, $\chi^2(1) = 4.34$, $p = .037$, a response error that was not represented in the typical individuals. In addition, facial expressions of sadness were more frequently confused as fearfulness in those with ASD compared to typical individuals, $\chi^2(1) = 6.42$, $p = .011$, which again, rarely occurred among those without autism. Individuals with ASD also more frequently labeled sad faces as neutral compared to controls, $\chi^2(1) = 5.20$, $p = .023$. Finally, the correct identification of neutral faces appeared to be particularly challenging for those with ASD, with affected individuals more frequently identifying neutral faces as angry, $\chi^2(1) = 4.87$, $p = .027$, or sad, $\chi^2(1) = 3.66$, $p = .056$, in comparison to typical individuals.

Analysis of the correlates of these impairments in facial emotion perception indicated that only misinterpretations of neutral judgments of facial expressions were associated with ASD symptomatology and other emotional challenges. Individuals with ASD demonstrated significantly lower levels of emotional intelligence on the MSCEIT compared to typical individuals (see Table 1). Further, overall confusability of neutral vs. non-neutral faces (i.e., total errors made in confusing neutral faces as emotional and emotional faces as neutral) was significantly greater in the ASD ($M = 4.60$, $SD = 2.68$) versus typical ($M = 2.60$, $SD = 1.55$) group, $t(73) = -3.70$, $p < .001$, and was significantly associated with poorer emotional intelligence ($\beta = -.37$, $p = .012$) on the MSCEIT total score in those with ASD, but not any of the symptomatology domain scores on the ADOS (all $p > .370$). The under-interpretation of emotional faces as neutral was not associated with either emotional intelligence or ASD symptoms (all $p > .190$). However, the over-attribution of neutral faces as emotional was

related to both increased communication impairments on the ADOS communication algorithm score (β = .34, p = .034) and reduced emotional intelligence on the MSCEIT total score (β = −.34, p = .034). No other significant relationships were found between emotion perception impairments, ASD symptomatology, and emotional intelligence.

Discussion

Difficulty identifying and understanding facial expressions of emotion is one of the most commonly observed social-cognitive impairments in ASD (Harms, Martin, & Wallace, 2010). This study examined the error patterns in response to an emotion perception task in a sample of verbal adults with ASD and an age- and gender-matched sample of typical volunteers. As expected, significant impairments in the accuracy and speed with which adults with ASD were able to correctly identify emotional and neutral faces were observed compared to typical individuals. Prominent impairments were observed in the identification of happy, sad, and neutral faces, but not expressions of fear or anger. Findings revealed two consistent patterns of misinterpretation of facial expressions of emotion in those with the disorder that were significantly different from typical volunteers. First, individuals with ASD more frequently misinterpreted happy faces as neutral. Second, participants with ASD confused neutral and some negative (sad and angry) facial expressions at rates that were significantly greater than typical volunteers, most frequently over-attributing these negative emotions to neutral expressions. Further, the confusion of neutral and emotional faces was significantly related to poorer emotional intelligence and communication abilities.

Generally, these findings suggest that an important challenge individuals with ASD have in understanding facial expressions of emotion centers around discriminating neutral and emotional faces. Some previous studies have shown that people with ASD have difficulty differentiating emotional from neutral faces (Dalton et al., 2005), whereas others have observed small, non-significant differences in the recognition of neutral faces (Lindner & Rosén, 2006), although samples have generally been small. Despite, on average, high levels of intelligence among our ASD sample, participants were significantly less adept at understanding whether an emotion was present in a given facial expression, which may be the result of differential attention to facial features (Pelphrey et al., 2002) and neural abnormalities in social-cognitive structures involved in emotion (Daly et al., 2012) and face processing (Pierce, Müller, Ambrose, Allen, & Courchesne, 2001).

Furthermore, participants with autism tended to misinterpret positive emotions (happy) as neutral, and over-attribute neutral faces as negative compared to typical individuals. These findings are consistent with other studies demonstrating impairments in the recognition of happy emotions in body movements, prosody, and facial expressions (Atkinson, 2009; Grossman & Tager-Flusberg, 2008; Philip et al., 2010). However, many have not observed impairments in the recognition of happy faces in autism (Harms, Martin, & Wallace, 2010), and the primary difficulty observed in the current research was more associated with the distinguishing of happy from neutral faces rather than confusing happy faces for other emotional expressions. Overall, this might suggest a bias toward the interpretation of facial expressions as negative in the disorder, which might explain some findings regarding aversion to facial expressions of emotion and eye contact in autism (e.g., Kliemann,

Dziobek, Hatri, Baudewig, & Heekeren, 2012; Tottenham et al., in press). Although this pattern of emotional misinterpretation was not highly frequent, it is easy to understand how even an occasional negative reaction to a person who is responding neutrally could have significant functional consequences. As such, treatments designed to address impairments in emotion perception in ASD may need to focus on helping individuals learn to increase their understanding of when an individual is expressing emotions versus neutral facial expressions, and to shift away from negative interpretations of ambiguous stimuli.

Despite the implications of this research, this study is characterized by several limitations. First, while participants with ASD and typical volunteers were well-matched with regard to age, gender, and racial characteristics, these individuals were not matched with regard to level of intellectual functioning. This issue was explicitly addressed by including IQ as a covariate in analyses of accuracy and latency differences in emotion perception, which did not appreciably affect the results. Second, this study was characterized by a moderate sample of verbal adults with ASD without intellectual disability, and the degree to which these results generalize across other individuals along the autism spectrum who are less intellectually capable is not clear. Third, the over-attribution of negative emotion to neutral expressions may stem from a variety of sources, including the comorbid experience of mood and anxiety disorders (Mazefsky, Folstein, & Lainhart, 2008), which will be important assess in future studies.

Fourth, typical volunteers performed largely at ceiling in a number of emotion perception domains, and in the presence of a more difficult task for typical individuals, error patterns may have been different in comparison to those with autism. Finally, the range of emotional categories covered in this research was admittedly limited. In particular, facial expressions of the basic emotions surprise and disgust were not included, and impairments have been shown in the accurate identification of these emotions in other studies of ASD (Harms, Martin, & Wallace, 2010). It will be important for future research to expand the range of emotions studied. This is also critically important due to the general underrepresentation of positive emotions in this study, which may have led individuals with ASD to develop a negative response bias to the task. Consequently, the greater tendency to interpret neutral emotions as angry or sad in this group may not reflect a true attributional bias toward negative emotions in autism, but a bias specific to this task characterized by a greater number of negatively valenced faces.

In summary, this research found some significant impairments in the discrimination between neutral and emotional faces in verbal adults with ASD compared to typical individuals. Adults with ASD were less likely to identify happy faces as emotional and more likely to interpret neutral faces as negative compared to typical individuals. Although more research is needed, these findings may suggest a potential negative bias toward the interpretation of facial expressions in ASD, which could hold implications for the treatment of the disorder.

Acknowledgments

This work was supported by NIH grants MH-85851 (SME and NJM), MH-95783 (SME), RR-24154 (SME), and HD-55748 (NJM), as well as grants from Autism Speaks (5703, SME and NJM), the Department of Defense (AR100344, SME and NJM), and the Pennsylvania Department of Health (NJM).

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Table 1

Sample Demographic and Clinical Characteristics.

Variable	Typical Control (*N* = 30)		ASD (*N* = 45)		
	M (SD) / *N* (%)	Range	*M (SD)* / *N* (%)	Range	*p* [a]
Age	26.40 (5.80)	20 - 48	24.64 (5.72)	16 - 44	.200
Male	22 (73%)		40 (89%)		.119
White	25 (83%)		36 (80%)		.772
Attended College	28 (93%)		33 (73%)		.036
Employed	17 (57%)		18 (40%)		.167
IQ	105.53 (7.01)	94 - 120	112.76 (15.74)	80 - 157	.021
MSCEIT Total Score	102.16 (12.51)	71.18 - 121.50	93.39 (18.23)	9.55 - 116.60	.025
ADOS Diagnosis					
Autism	-		26 (58%)		-
Autism Spectrum	-		19 (42%)		-
ADOS Subscale					
Communication	-		3.62 (1.27)	2 - 7	-
Reciprocal Social Interaction	-		7.02 (2.28)	4 - 13	-
Stereotyped Behaviors/ Restricted Interests	-		2.58 (1.62)	0 - 7	-
Cognitive Style and Social Cognition Eligibility					
Interview[b]					
Impoverished Style	-		3.74 (.66)	2.33 - 5	-
Disorganized Style	-		3.52 (.83)	1.67 - 5	-
Rigid Style	-		3.57 (.78)	2 - 5	-
Vocational Ineffectiveness	-		3.91 (.70)	3 - 5	-
Interpersonal Ineffectiveness	-		4.20 (.46)	3 - 5	-
Lack of Foresight	-		3.87 (.59)	3 - 5	-
Gist Extraction Deficits	-		4.07 (.33)	3 - 5	-
Adjustment to Disability	-		3.44 (.62)	2 - 5	-

Note. ASD = Autism Spectrum Disorder; ADOS = Autism Diagnostic Observation Schedule; MSCEIT = Mayer-Salovey-Caruso Emotional Intelligence Test

[a] Results from χ^2 or independent sample *t*-tests (two-tailed)

[b] Scores range from 1 (“rare”) to 5 (“very severe”)

Table 2

Accuracy and Speed of Response to Labeling Facial Expressions of Emotion in Verbal Adults with Autism Spectrum Disorder and Typical Volunteers.

	Typical Control (*N* = 30)		ASD (*N* = 45)				
Domain	***M***	***SD***	***M***	***SD***	***t***	***p***	***d***
Accuracy							
Overall[a]	34.36	2.50	30.96	4.08	−3.91	< .001	−.96
Happy[b]	7.91	.31	7.37	.68	−3.82	< .001	−.94
Fearful	7.22	1.05	6.59	1.64	−1.81	.074	−.44
Angry	5.18	1.30	4.90	1.55	−.77	.443	−.19
Sad	6.77	1.14	6.04	1.70	−2.08	.041	−.48
Neutral	7.27	1.18	6.20	1.79	−2.93	.005	−.68
Speed (ms)							
Overall	1847.21	354.15	2077.65	507.50	2.12	.038	.51
Happy	1518.71	336.48	1664.35	417.99	1.59	.117	.38
Fearful	2158.32	742.16	2521.60	996.36	1.65	.104	.40
Angry	2468.45	813.58	2623.03	1163.72	.61	.545	.15
Sad	2063.60	946.10	2488.77	1316.66	1.51	.136	.36
Neutral	2027.55	695.02	2441.62	909.33	2.03	.046	.50

Note. Results are from general linear models adjusting for IQ.

ASD = Autism Spectrum Disorder

[a] Scores range from 0 to 40, with higher scores indicating better performance

[b] Scores range from 0 to 8, with higher scores indicating better performance

Table 3

Error Patterns in Labeling Facial Expressions of Emotion in Verbal Adults with Autism Spectrum Disorder and Typical Volunteers.

	Trial Type									
	Typical Control					ASD				
Response	**Happy**	**Fearful**	**Angry**	**Sad**	**Neutral**	**Happy**	**Fearful**	**Angry**	**Sad**	**Neutral**
Happy	**98.75**	.42	2.92	.83	2.50	**90.56**	1.67	2.78	3.61	1.39
Fearful	.42	**89.58**	11.25	1.25	.00	.56	**82.78**	10.28	5.00*	.56
Angry	.42	1.25	**65.42**	4.58	1.67	2.78	2.22	**60.83**	4.17	5.28*
Sad	.42	5.42	9.17	**86.67**	7.08	1.39	6.39	14.44	**74.17**	13.89
Neutral	.00	3.33	11.25	6.67	**88.75**	4.72*	6.94*	11.67	13.06*	**78.89**

Note. Values represent the percentage of trials for which each emotional label was selected. Accuracy rates, where the response matches the trial type, are presented in boldface across the diagonal.

ASD = Autism Spectrum Disorder

To conserve statistical power only error differences > 3% were tested for differences between adults with ASD and typical controls.

* $p < .05$ for significant difference from typical controls

Autism. Author manuscript; available in PMC 2015 October 01.