

Review Report

Detection of Negative Emotions in Autistics: Questioning the ‘Amygdala Hypothesis’

Neha Khetrpal
University of Allahabad

Autism and Asperger’s Syndrome (AS) are neurodevelopmental conditions that are marked by social and communication problems that involve difficulties with facial emotional processing, as well as restricted interests and behaviors. There have been conflicting reports in the literature regarding the perception of basic emotional expressions with some studies showing differences between the autistics and normal participants while others show no such differences. There have also been some reports of deficits in the processing of basic negative emotions in autism like fear, sadness and anger. These deficits shown by autistics are comparable to deficits shown by people with amygdala damage. These comparable deficits have led to the formulation of the ‘amygdala theory in autism’. However, a strong form of the amygdala hypothesis in autism still requires experimental evidence of distinctions between ‘subjective’ and ‘objective’ awareness of negative emotional stimuli. In some studies the activation in the amygdala is found when participants are subjectively unaware of the fearful faces but not when they are objectively unaware. Previous studies that have been conducted to investigate the facial emotion recognition deficits in autism in order to support the amygdala hypothesis have relied on the percentage correct values of the autistic subjects, which are known to be highly sensitive to response bias. Performance when evaluated according to standard signal detection methods provides a measure of sensitivity that is independent of a subject’s response bias. Only the latter methodology can provide a stringent test of the amygdala hypothesis.

Keywords: signal detection, facial-emotion recognition, response bias

Autism and Asperger’s Syndrome (AS) are neurodevelopmental conditions that are marked by social and communication problems as well as restricted interests and behaviors (American Psychiatric Association [APA], 1994). These two disorders fall under the rubric of autistic spectrum conditions (ASC). The social and communication problems involve difficulties with facial emotional processing (Grelotti, Gauthier, & Schultz, 2002). There have been conflicting reports in the literature regarding the perception of basic emotional expressions, with some studies showing differences between the autistics and the normal participants (Celani, Battacchi, & Arcidiano, 1999; Davies, Bishop, Manstead, & Tantam, 1994), while others show no such differences (Adolphs, Sears, & Piven, 2001; Ozonoff, Pennington, & Rogers, 1990).

There have also been some reports of deficits in the processing of basic negative emotions in autism, like fear, sadness and anger (Teunisse & de Gelder, 2001). These deficits shown by autistics are comparable to deficits shown by people with amygdala damage (Howard et al., 2000). These comparable deficits have led to the formulation of the amygdala theory of autism (Schultz, 2005). The autistics

also show other deficits besides the difficulties of negative emotion recognition that are also shown by people with a damaged amygdala—for instance, perception of direct eye gaze (Grice et al., 2005) and erratic ratings of the trustworthiness of faces (Adolphs et al., 2001), consistent with the amygdala theory of autism. Additionally, functional neuroimaging studies have shown decreased amygdala activation in autistics during the processing of negative emotional expressions (Critchley et al., 2000) and neuropathological studies of the autistic brain at autopsy have shown cell abnormalities in the amygdala (Bauman & Kemper, 1994).

Neuropathological studies of patients with amygdala damage show that earlier onset of and more extensive damage to the amygdala lead to deficits in recognizing multiple basic facial negative emotional expressions. Consistent with this claim of early and extensive damage, Ashwin, Chapman, Colle, and Baron-Cohen (2006) have shown that autistics suffer from broad impairments in recognizing all the basic negative emotions, such as fear, anger and sadness. The amygdala has been found to play a major role in the perception and processing of these three emotions (Yang et al., 2002), providing further support for the amygdala theory of autism since the features of the disorder begin early in life. Ashwin et al. showed deficient performance of autistic participants on the emotion recognition task after ruling out the effects of task difficulty, age and IQ. Their autistic participants also did not differ significantly from the nor-

Correspondence concerning this article should be addressed to Neha Khetrpal, Centre for Behavioural and Cognitive Sciences University of Allahabad, Allahabad 211002, India. Phone: (91-532) 2460738 Fax: (91-532) 2460738. Email: nehakhetrpal@gmail.com

mal participants on a face discrimination task or a task that involved the recognition of non-negative basic expressions.

A strong form of the amygdala hypothesis of autism still requires experimental evidence for autism as it is important to distinguish between 'subjective' and 'objective' awareness of negative emotional stimuli. Recently, Pessoa, Japee, and Ungerleider (2005) have distinguished between the roles played by subjective and objective awareness for the detection of fearful faces. They parametrically varied the duration of fearful faces that were masked by neutral faces. They employed receiver operating characteristic curves from signal detection theory to evaluate awareness of fearful faces. Performance was evaluated according to standard signal detection methods as these provide a measure of sensitivity that is independent of a subject's response bias. Their results showed that no universal objective awareness threshold existed for the detection of such faces. The majority of their subjects could detect the faces when these were flashed for 33 ms and were subsequently masked. Few of the subjects could even detect the fearful faces when these were presented only for 17 ms. These results imply that the amygdala might be activated when participants are subjectively unaware of the fearful faces but not when they are objectively unaware. This is a speculation that is consistent with the results of Yang et al. (2002), who showed that the amygdala was differentially active depending upon whether the participants were subjectively or objectively unaware of the fearful face stimuli.

Previous studies conducted to investigate the facial emotion recognition deficits in autism in order to support the amygdala hypothesis of autism have traditionally relied on the percentage correct values of the autistic subjects, which are known to be highly sensitive to response bias (Macmillan & Creelman, 1991). In the cases where weak and noisy signals are present participants may not be able to detect the target stimuli and thus it might appear that they are unable to detect these, a conclusion which is not valid. Unless this methodology is employed to investigate the emotion recognition capabilities of autistics, a strong case for the amygdala hypothesis cannot be supported.

References

- Adolphs, R., Sears, L., & Piven, J. (2001). Abnormal processing of social information from faces in autism. *Journal of Cognitive Neuroscience*, *13*, 232-240.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.
- Ashwin, C., Chapman, E., Colle, L., & Baron-Cohen, S. (2006). Impaired recognition of basic negative emotions in autism: A test of the amygdala theory. *Social Neuroscience*, *1*, 349-363.
- Bauman, M., & Kemper, T. (1994). *The neurobiology of autism*. Baltimore, MD: Johns Hopkins University Press.
- Celani, G., Battacchi, M. W., & Arcidiacono, L. (1999). The understanding of the emotional meaning of facial expressions in people with autism. *Journal of Autism and Developmental Disorders*, *29*, 57-66.
- Critchley, H. D., Daly, E. M., Bullmore, E. T., Williams, S. C., Van Amelsvoort, T., Robertson, D. M., et al. (2000). The functional neuroanatomy of social behaviour: Changes in cerebral blood flow when people with autistic disorder process facial expressions. *Brain*, *123*, 2203-2212.
- Davies, S., Bishop, D., Manstead, A. S., & Tantam, D. (1994). Face perception in children with autism and Asperger's syndrome. *Journal of Child Psychology and Psychiatry*, *35*, 1033-1057.
- Grelotti, D. J., Gauthier, I., & Schultz, R. T. (2002). Social interest and the development of cortical face specialization: What autism teaches us about face processing. *Developmental Psychobiology*, *40*, 213-225.
- Grice, S. J., Halit, H., Farroni, T., Baron-Cohen, S., Bolton, P., & Johnson, M. H. (2005). Neural correlates of eye-gaze detection in young children with autism. *Cortex*, *41*, 342-353.
- Howard, M. A., Cowell, P. E., Boucher, J., Broks, P., Mayes, A., Farrant, A., et al. (2000). Convergent neuroanatomical and behavioural evidence of an amygdala hypothesis of autism. *Neuroreport*, *11*, 2931-2935.
- Macmillan, N. A., & Creelman, C. D. (1991). *Detection theory: A user's guide*. New York: Cambridge University Press.
- Ozonoff, S., Pennington, B., & Rogers, S. J. (1990). Are there emotion perception deficits in young autistic children? *Journal of Child Psychology and Psychiatry*, *31*, 343-363.
- Pessoa, L., Japee, S., & Ungerleider, L. G. (2005). Visual awareness and the detection of fearful faces. *Emotion*, *5*, 243-247.
- Phillips, M. L., Williams, L. M., Heining, M., Herba, C. M., Russell, T., Andrew, C. et al. (2004). Differential neural responses to overt and covert presentations of facial expressions of fear and disgust. *NeuroImage*, *21*, 1484-1496.
- Schultz, R. T. (2005). Developmental deficits in social perception in autism: The role of the amygdala and fusiform face area. *International Journal of Developmental Neuroscience*, *23*, 125-141.
- Tounis, J. P., & de Gelder, B. (2001). Impaired

- categorical perception of facial expressions in high functioning adolescents with autism. *Child Neuropsychology*, 7, 1-14.
- Yang, T. T., Menon, V., Eliez, S., Blasey, C., White, C. D., Reid, A. J. et al. (2002). Amygdalar activation associated with positive and negative facial expressions. *NeuroReport*, 13, 1737-1741.