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Early processing of emotional faces in children with autism: An event-related potential study

Magali Batty [a,*], Emilie Meaux [a], Kerstin Wittemeyer [b], Bernadette Rogé [c], Margot J. Taylor [d]

[a] UMRS Inserm U930, CNRS ERL 3106, Université François Rabelais de Tours, CHRU de Tours, 37044 Tours, France
[b] School of Education, University of Birmingham, Birmingham B15 2TT, UK
[c] Unité de Recherche Interdisciplinaire Octogone (EA 4156), Centre d'Etudes et de Recherche en Psychopathologie, Université Toulouse II Le Mirail, 31058 Toulouse, France
[d] Diagnostic Imaging and Research Institute, Hospital for Sick Children, University of Toronto, Toronto, Ontario, Canada M5G 1X8

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ABSTRACT

Social deficits are one of the most striking manifestations of autism spectrum disorders (ASDs). Among these social deficits, the recognition and understanding of emotional facial expressions has been widely reported to be affected in ASDs. We investigated emotional face processing in children with and without autism using event-related potentials (ERPs). High-functioning children with autism (n = 15, mean age = 10.5 ± 3.3 years) completed an implicit emotional task while visual ERPs were recorded. Two groups of typically developing children (chronological age-matched and verbal equivalent age-matched [both ns = 15, mean age = 7.7 ± 3.8 years]) also participated in this study. The early ERP responses to faces (P1 and N170) were delayed, and the P1 was smaller in children with autism than in typically developing children of the same chronological age, revealing that the first stages of emotional face processing are affected in autism. However, when matched by verbal equivalent age, only P1 amplitude remained affected in autism. Our results suggest that the emotional and facial processing difficulties in autism could start from atypicalities in visual perceptual processes involving rapid feedback to primary visual areas and subsequent holistic processing.

* Corresponding author. Fax: +33 2 47 47 38 46.
E-mail address: m.batty@chu-tours.fr (M. Batty).

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Introduction

The popular image of autism is still one of a person who is not interested in others, communicates poorly, engages in stereotypical behaviors, and does not express emotions. However, people with autism can demonstrate enthusiasm, motivation, and excitement or strong dissatisfaction. The problem is that often these emotions are not understood by people they encounter because they are not adapted to the social norms. The abnormal modulation of emotion and expression seems to be more characteristic of autism than does the absence of emotion.

The classic work of Kanner (1943) described emotional abnormalities in autism, and since then researchers have published numerous studies confirming the emotional deficits in this population (Adolphs, Sears, & Piven, 2001; Baron-Cohen, Tager-Flusberg, & Cohen, 1993; Celani, Battacchi, & Arcidiacono, 1999; Dawson, Meltzoff, Osterling, Rinaldi, & Brown, 1998; Deruelle, Monin, Gepner, Tardif, & Rondan, 2001; Gepner, Deruelle, & Grynfeltt, 2001; Hobson, Ouston, & Lee, 1988; Teunisse & De Gelder, 1994; Weeks & Hobson, 1987). Understanding the affective state of others is crucial for the appropriate adaptation to social situations and the development of relationships with others. People with autism often fail to understand the mental state of others, and this can cause them to be socially inappropriate and constitute a real impairment in their everyday lives. This deficit is significant enough to be part of the diagnostic criteria defined by the DSM-IV (*Diagnostic and Statistical Manual of Mental Disorders*–fourth edition) (American Psychological Association [APA], 1994).

Although most reports have focused on difficulties in understanding facial expressions, individuals with autism have also been found to display fewer expressions than matched controls (Snow, Hertzig, & Shapiro, 1987), and they also seem to be relatively unaffected by other people's expressions of feelings (Sigman, Kasari, Kwon, & Yirmiya, 1992). Furthermore, a deficit in matching visual and/or auditory stimuli was found in autism only when the stimuli were emotional (Baron-Cohen, Wheelwright, Hill, Raste & Plumb, 2001; Celani et al., 1999; Hobson, 1986). Baron-Cohen and colleagues showed that participants with autism had poor discrimination of emotions expressed by the eyes, a more subtle but important aspect of facial emotions (for a review, see Itier & Batty, 2009). Baron-Cohen (1995) used the word "mindblindness" for explaining difficulties in making sense and predicting others' feelings, thoughts, and behaviors. However, even low-functioning children with autism show expectancies concerning the social behaviors of close family members or caregivers. A study using an adaptation of the still face paradigm revealed that children with autism were positively expressive when expected contacts appeared and negatively expressive when the contacts did not occur (Escalona, Field, Nadel, & Lundy, 2002). Thus, despite a deficit in emotional processing, the data do not reveal a total insensitivity to social and emotional cues in autism (see also Lacroix, Guidetti, Rogé, & Reilly, 2009).

The perception of emotional facial expressions involves an extensive neural network that includes posterior and temporal cortical areas, such as the fusiform gyri and superior temporal sulci (STS), as well as the amygdalae and orbital frontal cortices. Nonhuman primate models report that lesions in these areas produce difficulties in evaluating potentially threatening situations and reduction in social interactions, which are core symptoms defining autism (Amaral, Bauman, & Schumann, 2003; Bachevalier, 1991; Machado & Bachevalier, 2003). Structural and functional imaging studies have found abnormalities or dysfunction in these regions in autism spectrum disorder (ASD) participants (Baron-Cohen et al., 2000), particularly in the temporal lobes (Carper, Moses, Tigue, & Courchesne, 2002; Zilbovicius et al., 2006). Hypoperfusion in children with autism has been reported in the STS (Zilbovicius et al., 2000) as well as hypoactivation of the fusiform gyri (Dalton et al., 2005; Dapretto et al., 2006; Schultz et al., 2000), areas well known to be involved in processing social stimuli (Allison, Puce, & McCarthy, 2000). In a working memory task involving faces with high-functioning adults with ASDs, Koshino and colleagues (2008) reported lower functional connectivity between the fusiform and the frontal areas as well as lower activation of prefrontal areas. Activation abnormalities were also found in the amygdalae (Amaral et al., 2003; Kemper & Bauman, 1993; Kleinhans et al., 2009; Lombardo, Chakrabarti, & Baron-Cohen, 2009; Pierce, Muller, Ambrose, Allen, & Courchesne, 2001), regions implicated in assigning affective significance to events, particularly those involved in fear processing (Adolphs, Damasio, Tranel, Cooper, & Damasio, 2000; Breiter et al., 1996; Morris et al., 1996; Phillips et al., 1997; Young, Hellawell, Van De Wal, & Johnson, 1996).