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Neutral versus emotional human stimuli processing in children with pervasive developmental disorders not otherwise specified

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ABSTRACT

Pervasive developmental disorder not otherwise specified (PDD-NOS) represents up to two-thirds of autism spectrum disorders; however, it is usually described in terms of the symptoms not shared by autism. The study explores processing of neutral and emotional human stimuli (by auditory, visual and multimodal channels) in children with PDD-NOS ($n = 10$) compared to typically developing children ($n = 35$). The neutral human stimuli consisted of faces and common first names. The emotional human stimuli consisted of happy, sad, angry, and neutral faces and vocalizations. The results confirmed previous findings and led to others. The PDD-NOS group (a) accurately processed neutral human stimuli; (b) had difficulty processing emotional stimuli in general and more easily identified happy compared to angry or neutral faces and vocalizations; (c) had a strong discrepancy between emotional and neutral human stimuli processing; (d) used the multimodal channel to compensate for unimodal deficits, especially for angry faces; and (e) was strongly heterogeneous.

1. Introduction

Some children have trouble with social interaction, communication and/or rigid behavior patterns that do not fulfill criteria for autism. Their pathology is usually diagnosed as pervasive developmental disorder not otherwise specified (PDD-NOS; APA, 1994). Similar to autism, Rett syndrome, Asperger syndrome and childhood disintegrative disorder, the DSM-IV classifies PDD-NOS as a subtype of PDD. The prevalence of PDD-NOS is higher than autism (20.8 PDD-NOS/10,000 vs. six children with autism/10,000; Fombonne, 2005), but its associated literature is approximately 100× smaller based on an EBSCO bibliographic estimation. Two factors explain this difference. First, PDD-NOS is a vague category, mainly defined by exclusion criteria related to autism (Lord et\ al., 2006; Volkmar, Paul, Klin, Cohen, & Hoboken, 2005). Second, several studies have pointed out that the diagnosis stability over time was significantly weaker in PDD-NOS compared to autism (Charman et al., 2005; Cox et al., 1999; Moore & Goodson, 2003; Stone et al., 1999). Rondeau et al. (in press) confirmed this assumption using a meta-analytic approach. Thus, most studies on autism spectrum disorder (ASD) do not specify whether participants are especially high-functioning people with autism, Asperger Syndrome (Rondeau et al., in press) or PDD-NOS (de Bruin, de Nijs, Verheij, Hartman, & Ferdinand, 2007). Conversely, the Utrecht Group (based on proposals from the Yale Child Study

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Center) uncovered a set of syndrome patterns in children with PDD-NOS that appear as a specific group called "multiple complex developmental disorder". This subgroup is defined by the following: (a) important social and communication difficulties; (b) emotional dysfunction; (c) cognitive troubles; and (d) a risk of schizophrenia in adolescence (Buitelaar & Van der Gaag, 1998; de Bruin et al., 2007; Van der Gaag et al., 1995). Using a complementary perspective, the present study focuses on the PDD-NOS category to characterize some of its components. We used an original methodology that considers human stimuli processing in neutral and emotional conditions using visual, auditory and cross-modal channels.

Social cognition is the ability to detect cognitive, meta-cognitive and emotional processes within human interactions, involves consciousness of the self and others, and combines all the skills necessary to understand and react to emotions, especially those transmitted by faces (Grossmann, Striano, & Friederici, 2006). Social cognition includes (but is not limited to) initiating social contact with people through eye contact and language. It also includes looking at and remembering the faces of others, being empathetic and Theory of Mind (Baron-Cohen, 1991; Baron-Cohen et al., 2000).

In humans, emotion identification requires audition (e.g., vocalization, prosody and semantic features) and vision (e.g., facial expressions). Because the brain integrates information from different modalities to produce accurate and meaningful representations unobtainable from either modality taken in isolation (Molhom, Ritter, & Lakatos, 2002; Ross, Prodan, & Monnot, 2007), multimodal connections optimizes visual or auditory processing in normal and pathological people (Collignon et al., 2008). Object identification is more accurate in audiovisual than separate auditory or visual conditions (Giard & Peronnet, 1999). With regard to emotion, a similar multimodal facilitating effect has been observed (Campanella & Belin, 2007). Multimodal integration increases the speed and accuracy of emotional recognition (Collignon et al., 2008; Dolan, Morris, & de Gelder, 2001; Kreifelts, Ethofer, Grodd, Erb, & Wildgruber, 2007). Thus, remediation protocols should reinforce multimodal processing to compensate for deficiencies in sensation or perception, especially in children with autism (Massaro & Bosseler, 2006; Williams et al., 2004).

Social interaction and emotion-processing difficulties are predominant in ASD (Serra, Minderaa, van Geert, & Jackson, 1999). Children with autism have difficulty identifying emotional states, although they correctly recognize neutral human stimuli (Hobson, 1993; Hobson, Ouston & Lee, 1988). This finding suggests that children with autism have primary and specific deficits in emotional processing.

The few studies on children with PDD-NOS showed that these participants have difficulties in comprehending and interpreting social information (Gillberg, 1991; Serra, Loth, van Geert, Hurkens, & Minderaa, 2002). Focusing on visual perception, De Wit, Falck-Ytter, and von Hofsten (2008) noted that children with PDD and PDD-NOS spent less time looking at emotional faces than normal children. These children also looked less at facial features that transmit emotional (i.e., eyes, nose, and mouth). Because salient combined "action units" of low, medium or high levels support facial emotions (Ekman & Friesen, 1976), the greater the fixation on the mouth, the more severe the social deficit (Klin, Jones, Schultz, Volkmar, & Cohen, 2002; Merin, Young, Ozonoff, & Rogers, 2007; Pelphrey & Sasson, 2002).

Sicotte and Stemberger (1999) showed that people with autism had more difficulty processing facial emotion than people with PDD-NOS. Thus, social cognition studies delineate the emotion processing difficulties in the different clinical populations and are able to specify the emotional disorders that interfere with attention (Lee & Ousley, 2006). Emotion can disrupt attention by directing it toward (vigilance) or away (avoidance) from emotional stimuli. In the context of anxiety disorders, the influence of emotional threat on attention is called "threat-related attention bias" in which the presence of specific features produces a change in attention location (Monk et al., 2006; Pine et al., 2005). However, there is uncertainty regarding the direction of attention to threatening faces. Some studies have found vigilance effects, and others have found avoidance effects. These conflicting results may be due to the task paradigm, the nature of the stimuli, stimulus duration, and heterogeneity in the clinical population (Stirling, Eley & Clark, 2006).

We aimed to identify specific psychological patterns in children with PDD-NOS by comparing them to typically developing children. To characterize emotional processing in children with PDD-NOS, we contrasted neutral with emotional human stimuli (e.g., happy, angry, sad and neutral) across different perceptual modalities (visual, auditory and multimodal). We used two experimental paradigms; to avoid verbal production, we required that children (1) recognize targeted faces, first names and face/first name pairs among distracters; and (2) match facial or vocal emotions expressed by two people and judge whether a voice and a face expressed congruent emotions. Thus, children had to judge similarities and dissimilarities between visual, auditory and multimodal neutral human stimuli, and match emotion expressions using visual, auditory and multimodal channels.

Consistent with previous studies, we hypothesized that children with PDD-NOS would accurately process neutral human stimuli but have difficulty processing emotional information, in particular visually. In addition, we hypothesized that children with PDD-NOS would compensate for visual/auditory discrepancies using multimodal processing.

2. Method

2.1. Participants

A total of 10 children with PDD-NOS (9 males and 1 female) and 35 typically developing children (30 males and 5 females) participated in this study. Table 1 summarizes the socio-demographic and clinical characteristics of the participants.

Three trained child-psychiatrists clinically assessed the children with PDD-NOS (age range = 7–13 years, $M = 9.6$, SD = 1.7). We based a PPD-NOS diagnosis on the Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition