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Intramodal and cross-modal matching of emotional expression in young children with autism spectrum disorders

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ABSTRACT

Children with autism spectrum disorders (ASDs) exhibit difficulties in their comprehension of others' emotions. According to a variety of experimental procedures, many of them can be classified into two types according to the modality of their stimuli and responses. These are intramodal (visual stimulus–visual stimulus) and cross-modal (auditory stimulus–visual stimulus) matching. Previous studies tested both intramodal and cross-modal matching only in adolescents with ASD, although young children with ASD have also been found to have difficulties with cross-modal matching but not intramodal matching. The purpose of this study was to compare the intramodal and cross-modal matching of emotional expression in young children with ASD and typically developing (TD) children. Ten children with ASD aged 4–8 and 22 developmental age (DA)-matched TD children aged 3–6 participated in this study. Pictures of facial expressions were used as visual stimuli, and affective prosodies were used as auditory stimuli. The results showed that the children with ASD were less accurate than the TD children in cross-modal matching but equally accurate on intramodal matching. These findings are discussed along with the modality of stimuli and responses, and the ages of the participants.

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1. Introduction

Autism spectrum disorders (ASDs) are neurodevelopmental disorders characterized by distinct social deficits ([American Psychiatric Association, 2013](#)). Individuals with ASD have difficulties particularly in their comprehension of others' emotions conveyed from nonverbal cues, such as facial expressions or affective prosodies (e.g., [Braverman, Fein, Lucci, & Waterhouse, 1989](#); [Hobson, 1986a, 1986b](#); [Macdonald et al., 1989](#); [Tantam, Monaghan, Nicholson, & Stirling, 1989](#)). However, the results of previous studies have yielded inconsistent findings. Some studies found that individuals with ASD face difficulties in understanding other's emotions (e.g., [Bormann-Kischkel, Vilsmeier, & Baude, 1995](#); [Celani, Battacchi, & Arcidiacono, 1999](#); [Davies, Bishop, Manstead, & Tantam, 1994](#)). Other studies did not find such deficits (e.g., [Capps, Yirmiya, & Sigman, 1992](#); [Gepner, Deruelle, & Grynfeldt, 2001](#); [Prior, Dahlstrom, & Squires, 1990](#)). [Matsuda and Yamamoto \(2013, 2014\)](#) suggested that these inconsistencies occurred due to variations in the experimental tasks and ages of the participants.

Abbreviations: ASD, autism spectrum disorders; TD, typically developing; CA, chronological age; DA, developmental age; KSPD, Kyoto Scale of Psychological Development 2001.

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Previous emotion comprehension studies can be classified into two types according to the modality of their stimuli and responses. These are intramodal (i.e., visual stimulus–visual stimulus) and cross-modal (i.e., auditory stimulus–visual stimulus) matching. In some studies where intramodal matching was used, pictures or movies showing facial expressions were presented as sample stimuli, and either facial expressions or texts were used as response choices. In other studies where cross-modal matching was used, affective prosodies representing different emotional states were presented as sample stimuli, and illustrations, texts, or both were used as response choices.

To date, few studies have used both intramodal and cross-modal matching (Jones et al., 2011; Loveland et al., 1997). Jones et al. (2011) tested adolescents with ASD (mean age: 15 years, 6 months), and as did Loveland et al. (1997) (mean age: 12 years, 2 months). In both studies, the results showed no difference in intramodal and cross-modal matching between adolescents with ASD and typically developing (TD) adolescents. However, to our knowledge, no study has compared the intramodal and cross-modal matching of emotional expressions in younger children with ASD.

It is possible that the difficulties children with ASD experience in cross-modal matching of emotional expressions are related to their age. Studies of older children with ASD, aged 12–16 years, have found that they have no difficulty in cross-modal matching (Baker, Montgomery, & Abramson, 2010; Grossman, Bemis, Plesa-Skwerer, & Tager-Flusberg, 2010; Jones et al., 2011; Paul, Augustyn, Klin, & Volkmer, 2005). Meanwhile, studies of younger children with ASD, aged 9–10 years, have reported significant group differences (Boucher, Lewis, & Collis, 2000; Peppé, McCann, Gibbon, O'Hare, & Rutherford, 2007). These results suggest that younger children with ASD might have difficulties in cross-modal matching of emotional expressions.

On the other hand, in intramodal matching of emotional expressions, children with ASD might have no difficulties regardless of their age. Previous studies on intramodal matching have reported that both younger (aged 6–11 years; Fink, de Rosnay, Wierda, Koot, & Bageer, 2014; Grossman, Klin, Carter, & Volkmar, 2000; Lacroix, Guidetti, Rogé, & Reilly, 2009; Rosset et al., 2008) and older (aged 12–15 years; Castelli, 2005; Loveland et al., 1997) children with ASD, and TD children performed equally well. These results indicate that intramodal matching is not difficult for either young or old children with ASD.

The purpose of the present study was to compare intramodal and cross-modal matching of emotional expressions in young children with ASD and TD children. Ten boys with ASD (mean age: 6 years, 2 months) participated in this study. They were younger and had lower developmental ages (DAs) than the participants in previous studies. The intramodal matching required the children to match pictures of facial expressions across different facial identities. The cross-modal matching required them to match an affective prosody to the corresponding picture of the facial expression. We used four basic emotions, happy, surprised, angry, and sad, for both intramodal and cross-modal matching.

2. Methods

2.1. Participants

Ten boys with ASD participated in this study. The diagnosis for nine children was autistic disorder, and for one was PDD-NOS. Their diagnoses were provided by an outside professional, according to the criteria of the DSM-IV-TR (American Psychiatric Association, 2000). The average chronological age (CA) of this group was 6.31 years (SD: 1.20, range 4.5–8.3 years), and the average DA was 5.48 years (SD: 1.12, range 3.4–6.8 years). The eight participants' DA was assessed by the Kyoto Scale of Psychological Development 2001 (KSPD; Ikuzawa, Matsushita, & Nakase, 2002). The remaining two participants' DA was assessed by the Japanese version of the Stanford–Binet Intelligence Scale (Tanaka Institute for Educational Research, 2003). KSPD and the Japanese version of the Stanford–Binet Intelligence Scale have high correlation in young children with ASD (Koyama, Osada, Tsujii, & Kurita, 2009).

There were 22 TD participants without a psychological diagnosis (16 males and 6 females). They were matched by their average age to the DA of the ASD group. The average CA was 5.47 years (SD: 0.77, range 3.8–6.9 years).

The difference between the mean CA of each group approached significance; children in the ASD group were older than children in the TD group ($t = 2.40$, $p = 0.023$, $r = 0.40$). There were no significant differences between the mean DA in the ASD group and CA in the TD group ($t = 0.05$, $p = 0.960$, $r = 0.01$).

2.2. Stimuli

2.2.1. Visual stimuli (facial expressions)

The visual stimuli comprised eight pictures of facial expressions. The pictures comprised two different faces representing each of the four emotions: happy, surprised, angry, and sad. The two faces were male and Japanese. These were six emotions from Ekman (1992). Based on the results by Ekman et al. (1987), fear and disgust emotions were excluded from this study because Japanese people had difficulty identifying them. The pictures were printed on 9.5 cm × 13.0 cm white laminated cards.

2.2.2. Auditory stimuli (affective prosodies)

The auditory stimulus used was the word *sensei* (“teacher” in Japanese). It was spoken in a voice representing each of the four emotions. These words were spoken in vivo by a male in his twenties.

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