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Mirroring effect in 2- and 3-year-olds with autism spectrum disorder

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ABSTRACT

Previous studies have suggested that being imitated by an adult is an effective intervention with children with autism and developmental delay. The purpose of this study wais to investigate whether "mirroring" interaction, which includes being imitated by an adult, can facilitate the social responsiveness of toddlers with autism spectrum disorder (ASD). Participants were 16 toddlers (2- and 3-year-olds) with ASD. This study consisted of three experimental phases: in the first baseline phase, the experimenter manipulated toys in front of the participant; in the second phase, the experimenter reproduced (mirrored) all of the child's behaviors; and in the third phase, the first baseline phase was repeated. Our results demonstrated that although the mirroring effect differed by age, the effect was observed in both 2- and 3-year-olds with ASD. In addition, the overall magnitude of the mirroring effect differed by IQ, but not by the severity of autistic symptoms. Mirroring interaction is promising as an early intervention for a wide range of children with ASD.

1. Introduction

Imitation problems have been reported in individuals with autism spectrum disorder (ASD), and it is these problems which may be responsible for the communication and learning impairments seen in ASD (e.g. DeMeyer et al., 1972; Ohta, 1987; Rogers, 1999; Rogers & Pennington, 1991). Some researchers have proposed that impairments in imitation and other autistic symptoms might be caused by a mirror system deficit (Avikainen, Wohlschlager, Liuhanen, Hanninen, & Hari, 2003; Williams, Whiten, & Singh, 2004). However, since the imitation tasks used in previous studies demanded general cognitive abilities, poor performance on the tasks does not necessarily indicate the inability to imitate. Indeed, recent studies using elaborate tasks have demonstrated that the automatic mechanism of imitation is intact in individuals with ASD (Leighton, Bird, Charman, & Heyes, 2008). The question is raised, therefore, of whether impairments in imitation are in fact due to a mirror system deficit in ASD.

In the context of therapeutic intervention for children with ASD, it has been reported that being imitated may stimulate social responsiveness in low-functioning children with limited imitation abilities (Dawson & Galpert, 1990; Escalona, Field, Nadel, & Lundy, 2002; Nadel et al., 2000). Dawson and Adams (1984) demonstrated that children with autism exhibited more social behaviors in response to being imitated by an adult, and similarly Tiegerman and Primavera (1981), Tiegerman and Primavera (1984) demonstrated enhanced social responsiveness in terms of frequency and duration of gaze behavior. Later studies using a modified still-face paradigm also reported that the social responsiveness of children with autism was increased by being imitated by an adult (Escalona et al., 2002; Field, Field, Sanders, & Nadel, 2001; Heimann, Laberg, & Nordøen, 2006).

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Recent advances in the early diagnosis of ASD mean that high-functioning toddlers with ASD who would previously have been overlooked can now be detected and receive intervention. While previous studies have examined the imitation effect in children with autism and those with developmental delay, this effect for high-functioning toddlers with ASD detected as young as 2-year-olds has yet to be reported.

The purpose of this study was to examine whether the social responsiveness of 2- and 3-year-olds with ASD could be facilitated through being imitated by an adult. In such case, the association between such imitation effect and children's characteristics, such as age, IQ, or autistic symptoms was to be explored. In this study, the adults' behaviors that reproduce everything the child does are referred to as "mirroring" behaviors, since the term "imitation" has been used equivocally in the literature.

2. Method

2.1. Participants

Twenty-five toddlers with ASD who were from a consecutive case series of a community-based early detection study of ASD were eligible for this study. Among them, 9 (8 boys, 1 girl) were excluded from the following analyses because they moved outside the observable zones for the majority of the time due to their severe hyperactivity. The remaining 16 toddlers with ASD (4 with Autistic Disorder, 12 with Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS)) were diagnosed by a research team including an experienced child psychiatrist (Y.K.) and a licensed clinical psychologist (N.I.) according to DSM-IV-TR criteria (American Psychiatric Association, 2000) based on direct observations and parental interviews including a full developmental history. The severity of autistic symptoms was evaluated using the Japanese version of the Childhood Autism Rating Scale-Tokyo Version (CARS-TV, Kurita, Miyake, & Katsuno, 1989). General developmental functions were assessed using the Tanaka–Binet Intelligence Scale V (Tanaka Institute for Educational Research, 2003) and/or Enjoji's Analytical Developmental Test (Enjoji & Goya, 1981). The former is a widely used intelligence test that was developed from the Stanford–Binet Intelligence Scale and standardized in Japan. The latter is a parent interview scale, widely used in Japan, that assesses the psychomotor development of infants and toddlers, including locomotion, hand movement, self-help, socialization, language production, and comprehension. IQ was measured for the 12 high-functioning toddlers, while DQs instead of IQs were measured for 4 developmentally delayed toddlers (Koyama, Osada, Tsujii, & Kurita, 2009).

The participants were grouped according to age into two groups: the 2-year-old group ($n = 7$, 6 boys, 1 girl; mean age (range): 23.7 months (22–27); mean CARS score (range): 33.3 (29–41.5); mean IQ (range): 78.4 (60–100)), and the 3-year-old group ($n = 9$, 4 boys, 5 girls; mean age (range): 37.7 months of age (37–40); mean CARS score (range): 34.3 (28–51.5); mean IQ (range): 92.3 (55–135)). The two groups did not differ on either CARS score ($t(14) = 0.2$, $p = .85$) or IQ ($t(14) = -0.82$, $p = .43$). The sex did not differ significantly by CARS score ($t(7) = -0.74$, $p = .94$) and IQ ($t(7) = 0.49$, $p = .64$), although the sex ratio was significantly different.

2.2. Procedure

The study was conducted in a testing room during comprehensive evaluations of ASD. Two sets of identical toys, including balloons, small cars, stuffed frogs, cups, plates, and a pair of drumsticks were placed on the floor mat in front of both the child and the experimenter in a mirror-image arrangement. The session consisted of three phases: a 2-min baseline phase (BL1), a 3-min mirroring phase, and a second 2-min baseline phase (BL2). In the first and last phases, the experimenter manipulated toys different from those the child manipulated. Once the child took the toy identical to the experimenter's toy, the experimenter switched toys. In the mirroring phase, the experimenter reproduced everything that the child did (including actions, facial expressions and vocalization) as quickly and accurately as possible. The end of each phase was indicated orally by an assistant. The sessions were videotaped for later coding. Informed consent was obtained from the participants' parents. The experimental procedures were approved by the ethics committee of the National Center of Neurology and Psychiatry.

2.3. Coding and analysis

Behaviors during the sessions were coded directly from videotapes by 3 coders including one of the authors (M.K.). Because we were interested in social behaviors, they were categorized into social attention and socio-emotional behaviors: social attention implied *gazing at the experimenter's face*, and socio-emotional behaviors included *giving positive socio-emotional signals* (smiling, verbalizing, vocalizing, approaching, touching) *to the experimenter*; *offering toys to the experimenter*, and *requesting the experimenter to imitate his/her own action*. The video record for each child of 7 min in total was broken down into 5-s intervals, and the social behaviors described above during each interval were coded using the partial-interval time-sampling method. Thus, a total of 84 intervals were divided into either ones coded as social attention, socio-emotional behaviors or no social behaviors for each child. The number of the former two coded sampling intervals was used as the number of social behaviors in the analysis. When two behaviors occurred within the same interval by chance, the behavior with the longer duration was chosen. Reliability of the coders was examined using Cohen's Kappa. Mean Kappa coefficient of intercoder agreement was .73.