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Research in Autism Spectrum Disorders

Journal homepage: <http://ees.elsevier.com/RASD/default.asp>

Developmental chronology of preverbal social behaviors in infancy using the M-CHAT: Baseline for early detection of atypical social development

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ARTICLE INFO

Article history:

Received 30 November 2009

Accepted 17 December 2009

*Keywords:*Preverbal social behaviors
Developmental chronology
M-CHAT
Autism spectrum disorders
Infancy

ABSTRACT

This study aimed to identify the age of emergence and subsequent order of preverbal social behaviors, which have not yet been fully clarified. This was accomplished using 16 items of social behaviors extracted from the Modified Checklist for Toddlers with Autism (M-CHAT). The Japanese version of the M-CHAT was completed voluntarily by the parents of 318 infants aged 8–20 months. The 16 social behaviors can be divided roughly into three behavior sets based on the age at which 75% of the answers to the corresponding items were positive: the first set of 6 items emerged before 8 month old; the second set of 6 items, did between 11 and 12 month old; and the third set of 4 items, did after 15 month old. In addition, the subsequent order and synchrony among items were determined: Imitation, Point following, and Attracting parent's attention emerged earlier than Pretend play and Imperative/Declarative pointing in the second set; further, Gaze following and Social reference emerged earlier than Bringing objects to show and Functional play in the third set. This study provides an evidence-based developmental chronology of a wide range of preverbal social behaviors, which can serve as a baseline for assessing atypical social development in infants.

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1. Introduction

Autism Spectrum Disorders (ASDs) are developmental disorders characterized by qualitative impairments in the three domains of reciprocal social interaction, language and communication, and flexibility. The standard diagnostic criteria of ASD, such as that provided by the Diagnostic and Statistical Manual, Fourth Edition, Text Revision (American Psychiatric Association, 2000), are based on clinical observations of children aged 3–4 years and older, and as such they cannot be applied to infants under 3 years of age. Evidence of social abnormalities in infants who later develop ASD has accumulated based on retrospective home video analysis (Maestro et al., 2005; Osterling & Dawson, 1994; Osterling, Dawson, & Munson, 2002; Werner & Dawson, 2005) and prospective studies (Charman, Swettenham, Baron-Cohen, et al., 1997; Wetherby et al., 2004; Wetherby, Watt, Morgan, & Shumway, 2007). These infants show reduced reciprocal social interaction such as playing with others, looking at others' faces, imitation, joint attention (pointing/bringing objects to show others, point following, shifting gaze from objects to others), and responding to their name, compared to children with typical development or those with developmental disorders without ASD.

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Although social developmental abnormalities in early life have been reported, the earliest developmental trajectory remains unclear and seems to be diverse in ASD (Kamio, Tobimatsu, & Fukui, *in press*; Landa, Holman, & Garrett-Mayer, 2007; Sauter et al., 2007). Taking into consideration such large individual differences in the early developmental trajectories seen in ASD, it is important to clarify the developmental trajectories of preverbal social behaviors in infants with typical development (TD) in order to understand the clinical significance of social development in children with ASD.

In previous studies of preverbal social behaviors, these behaviors have not been examined as a whole but separately. Therefore, it is difficult to grasp the relations between and the ordering of emergence of different types of social behaviors. To our knowledge, two studies have comprehensively examined the age and the ordering of the emergence of preverbal social behaviors around the first year of life (Carpenter, Nagell, & Tomasello, 1998; Tanaka, Kuroki, & Saita, 2006). This first is by Carpenter et al. (1998) who assessed nine different measures of social behaviors in structured settings on monthly visits to 24 infants between the ages of 9–15 months: (a) Joint engagement, (b) Proximal declarative gestures (Showing/Giving), (c) Reaction to social obstacles, (d) Imitation of instrumental acts, (e) Imitation of arbitrary acts, (f) Point following, (g) Gaze following, (h) Declarative pointing, and (i) Imperative pointing. The authors assigned the behaviors into three categories: (I) Behaviors that require the sharing/checking of adult attention in close proximity (a, b, c), (II) behaviors that require following adult attention to more distant external entities (d, e, f, g), and (III) behaviors that require directing adult attention to external entities (h, i). It was found that behaviors in categories (I), (II), and (III) emerged in 80% or more of infants aged between 9–12 months, 11–14 months, and 13–15 months, respectively (see also Tomasello, 2000). Moreover, 20 of the 24 infants showed a consistent ordering of emergence from (I) through (II) to (III). Thus, the social behaviors studied were found to emerge in close developmental synchrony with highly consistent order across infants.

The second study, by Tanaka et al. (2006), used a parent-report questionnaire to investigate longitudinally the emergence of 11 joint attention behaviors in 1518 infants on 2-monthly community visits between the ages of 8–18 months: (a) Gaze following, (b) Point following, (c) Point-backward following, (d) Alternating gaze between object and adults with gaze/point following, (e) Imperative pointing, (f) Alternating gaze between object and adults with imperative pointing, (g) Declarative pointing, (h) Alternating gaze between object and adults with declarative pointing, (i) Showing/Giving a response to others, (j) Spontaneous showing/giving, and (k) Imitation of acts. A total of 5876 pass/fail responses were analyzed by cluster analysis and Tanaka et al. demonstrated that behaviors according to Carpenter et al.'s three categories (I, II, III) emerged in order of (II) at 8–10 months, (I) at 11–12 months, and (III) at 12–14 months.

Thus, the time of emergence of these preverbal social behaviors was found to be consistent between the two studies. As for the order of emergence of them, Point following, Imitation of acts, and Showing/Giving were consistently followed by the emergence of Imperative pointing and Declarative pointing, for which both studies adopted similar definitions. On the other hand, the inconsistency between the two sets of findings might be attributable to the difference in behaviors investigated and the defining criteria. For example, Carpenter et al. used stringent criteria to ensure that the infants followed the adult's gaze and/or pointing, while Tanaka et al. used less stringent criteria which allowed for just reacting to the adult's gaze and/or pointing. Accordingly, the behaviors that Carpenter et al. judged not yet to have emerged might have been interpreted by Tanaka et al. to have emerged.

Leekam, Lopez, and Moore (2000) reported that some basic dyadic problems underlie the difficulties infants with ASD experience with triadic joint attention. Therefore, in order to evaluate the early social development of infants with ASD appropriately, it is necessary to determine the baseline for typical development of a wide range of social behaviors across a wider time frame.

Recent reports in the literature indicate that infants with ASD can be reliably diagnosed as young as age 2 on the basis of various social abnormalities (Johnson & Myers, 2007; Landa et al., 2007; Zwaigenbaum et al., 2009), and many checklists have been developed to screen for infants with ASD (Baron-Cohen, Allen, & Gillberg, 1992; Dietz, Swinkels, van Daalen, van Engeland, & Buitelaar, 2006; Robins, Fein, Barton, & Green, 2001). The Modified Checklist for Autism in Toddlers (M-CHAT) developed by Robins et al. (2001), which is widely used in the USA, Europe and Asia, is a parent-report questionnaire composed of 23 items used to screen infants with ASD at around 2 years old. The social behavior items included in the M-CHAT cover a wide range of variety of behaviors than the Checklist for Autism in Toddlers (CHAT, Baron-Cohen et al., 1992). In addition, the M-CHAT items are considered to have a wider range of emergence age compared with the Early Screening of Autistic Traits Questionnaire (ESAT, Dietz et al., 2006), which is designed for 14-month-old infants and where most of the items are have a greater than 75% passage rate by 11 months old. For these reasons, and because the Japanese version of the M-CHAT (Kamio & Inada, 2006) has been demonstrated to have clinical validity as a screening tool for ASD at the age of 18 months, we adopted the M-CHAT in our attempt to determine the baseline developmental chronology of early social development. In Japan, the health check-up system ensures that all children can receive free check-ups from birth through 18 month of age and then again at 36 month of age. Therefore, the baseline developmental chronology of early social development should cover these check-ups times in order to alert professionals to the need for further detailed examinations for children at high risk of developing ASD.

In the present study, to determine the baseline developmental chronology of early social development, we investigated the age and the ordering of emergence using 16 items extracted from the M-CHAT in a general infant population sample.

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