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Autism published online 6 August 2013
DOI: 10.1177/1362361313479832

Article

autism

Autism
0(0) 1–8

DOI: 10.1177/1362361313479832
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The developmental sequence of social-communicative skills in young children with autism: A longitudinal study

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Abstract

To explore the different developmental trajectories of social-communicative skills in children with autism and typically developing infants, two longitudinal studies were conducted. In Study 1, we examined the developmental sequence of social-communicative skills in 26 typically developing infants when they were 9 months old and reexamined them when they were 12 and 15 months old. The results indicated a reliable developmental sequence of social-communicative skills in infants with typical development. In Study 2, we explored the emergence sequence of social-communicative skills of 23 children with autism and 23 children with developmental delay between the ages of 2 and 4 years. The results demonstrated that the developmental sequence of social-communicative skills in young children with autism and children with developmental delays was different.

Keywords

autism, developmental sequence, social-communicative skills

Introduction

Autism spectrum disorder (ASD), or autism, is a developmental disorder with innate neurobiological deficits that are believed to cause permanent lifelong dysfunction (Gotham et al., 2011). One of the most powerful predictors of positive long-term prognosis for children with autism is the acquisition of spoken language, and early language ability can predict later academic achievement and social competence (Howlin et al., 2000). Several early social-communicative skills are believed to be associated with and to predict language development including joint attention, imitation, and play in typically developing (TD) infants and children with autism (Adamson and Bakeman, 1991; Carpenter et al., 1998; Charman et al., 1997; McCune, 1995). As joint attention, imitation, and play have been shown to be impaired in children with autism (Dawson et al., 1998; Rogers et al., 2003), it implies that children with autism may show a different pattern of social-communicative development than other children without autism. Therefore, exploring the developmental sequence of early social-communicative skills of young children with autism is advantageous not only for further understanding of the psychopathology of autism but also for expanding the practical implications for early diagnosis and intervention in autism.

So far, few studies examined the developmental sequence of the emergence of early social-communicative behaviors in TD and atypically developing children. Carpenter et al. (1998) first explored the issue in 24 TD infants and assessed them monthly between the ages of 9 months and 15 months. The results suggested that the TD infants showed a reliable developmental trajectory in which initiating joint attention (IJA) appeared first, followed by communicative gestures, responding to joint attention (RJA), object imitation, and referential language. Striano and Bertin (2005) adopted a simpler criterion to measure IJA and RJA in TD infants between the ages of 5 and 10 months with a cross-sectional method. The results did not support the fact that IJA developed earlier than RJA and implicated that the two skills appeared almost simultaneously. The two above-mentioned studies used different criteria to define IJA and RJA, and hence yielded different developmental milestones.

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Table 1. Demographic characteristics of TD infants.

	9 months	12 months	15 months
n	26	31	28
Mean	9M 14D	12M 10D	15M 10D
SD (days)	8.63	8.54	6.82
Range	9M 2D to 9M 29D	12M to 12M 26D	15M to 15M 26D

TD: typically developing; M: months; D: days; SD: standard deviation.

Regarding the development of social-communicative behaviors in atypical children, Carpenter et al. (2002), using a cross-sectional method, found that most of the 4-year-old children with autism performed object imitation first, followed by referential language, IJA, RJA, and communicative gestures. In comparison, the same study found that joint attention (including IJA and RJA) emerged first and referential language developed last in both TD infants and children with developmental delays (DDs). The findings of this study suggested that there might be a different developmental trajectory in social-communicative skills in children with autism. However, the Carpenter et al. (2002) study has the following weaknesses: the chronological age (CA) of the children was too large for a reliable establishment of their early development, and the study was not a longitudinal design.

In a longitudinal study, Turner et al. (2003) examined the developmental sequence of four social-communicative behaviors in children with autism who were 30 months old as Time 1 and followed up at 54 months old as Time 2. Their results demonstrated a different sequence of social-communicative behaviors in young children with autism. That is, imitation appeared first, followed by referential language, RJA, and IJA. However, one of the limitations of this study was lack of a control group. Furthermore, the study, which calculated object imitation and motor imitation together, could be problematic regarding the dissociation between imitation of actions on objects and imitation of body/facial actions (Stone et al., 1997), and different types of imitation correlated with different cognitive or social abilities (Hepburn and Stone, 2006).

For a deeper understanding of the developmental trajectory of early social-communicative abilities in young children with autism, the purposes of this study were to examine the developmental sequence of emergence of IJA, RJA, motor imitation, object imitation, play, and language skills in both TD and atypically developing children. Play ability was included because literature has demonstrated that it correlates with joint attention and imitation and is also associated with and predicted language development in TD and atypically developing children (Dawson et al., 1998; McCune, 1995; Sigman and Ruskin, 1999). In addition, we did not use the item of communicative gesture that was included in Carpenter et al. (2002) because the item is overlapped with IJA and its function is difficult to define. Two longitudinal studies were conducted to reveal the reactions. In Study 1, the developmental sequence of social-communicative skills in TD infants from 9 to 15 months was investigated as the comparison norm. In Study 2, we evaluated the developmental order of social-communicative skills in young children with autism and with DD from 2 to 4 years.

Study 1: developmental sequences of social-communicative behaviors in TD infants

Methods

Participants. A total of 26 TD infants participated in the study and were observed every 3 months from the age of 9 to 15 months. Through the study period, 3 TD infants did not finish the last test when they were 15 months old because of their parents' moving or changing contact information without informing us beforehand. In addition, 5 more TD infants were invited to join in the 12- and 15-month-old examinations to expand the sample size (see Table 1).

Procedure. Parents of the TD infants were invited to bring their children to participate in the study in a university playroom. The study information and methods were provided and explained to the parents in advance. The consent forms were signed by the parents before their participation. All the research measures were carried out in every session. During the 9-month-old session, the TD infants sat on the laps of their caregivers who sat in chairs or on the floor while the study was proceeding. During both the 12- and 15-month-old sessions, each infant individually sat in a chair or on the floor in front of his or her caregivers while being tested. The TD infants were given snacks or praises as rewards for being cooperative.

Measures. The research method of Turner et al. (2003) was duplicated by this study. In addition, an extra item, play skills, was added to this study. The data from both modified Screening Tool for Autism in Two-Year-Olds (STAT (Stone et al., 2000) and Autism Diagnostic Observation Schedule (ADOS; Lord et al., 1999) were recorded while the tasks were implemented. The STAT is an interactive measure that is administered individually about 20 min into a play-

ful context. The modified STAT consists of 14 items assessing behaviors in four social-communicative domains: Play, Requesting, Joint Attention (including IJA and RJA), and Imitation (including motor imitation and object imitation). The ADOS is a semistructured observational assessment of play, social interaction, and communicative behaviors that was designed as a diagnostic tool for ASD.

IJA and RJA. There were four IJA items applied in modified STAT, including balloons, puppets, a bag of toys, and noisemakers. Both puppets and noisemakers were given only once to the child, while the balloons and the bag of toys were used three times. We also used the IJA task, the "free play" from ADOS module 1 or module 2. During STAT and ADOS, the experimenter would elicit the infants' social interaction to accomplish the tasks. The criterion for passing the IJA task stated that the infants needed to look at an object, then turn their gaze to face of the experimenter or the caregiver, and finally turn their gaze back to the same object, which was similar to the one used by Carpenter et al. (2002).

For measuring RJA, two posters were posted on the two sides of the upper wall of the playroom used for the modified STAT. If an infant could follow the examiner's pointing and looked at the object after his or her name had been called three times in 3 s, the response would be rated as "pass." In addition, to supplement the research method, the RJA task—the "bunny toy" from ADOS (Lord et al., 1999)—was employed as well. The infants who scored 0 or 1 point in the RJA task from ADOS would be categorized as "pass." Applying the same criteria adopted by Turner et al. (2003) and Striano and Bertin (2005), the infants were considered to have succeeded in the RJA task when they accomplished either the gaze- or the point-following in one of the trials from either of the tasks.

Object imitation and motor imitation. Originally, three tasks for testing object imitation and one for testing motor imitation were employed to implement STAT (Stone et al., 2000). In our study, "shakes a rattle" was excluded from testing object imitation; "opening and closing fist" was added for testing motor imitation in the modified STAT. Thus, object imitation and motor imitation were tested with 2 items each. To carry out the trial, the examiner demonstrated a targeted object action or a motor action with vocal sound simultaneously and then encouraged the infants to imitate it. If the infant imitated the targeted action properly in any trial of each of the tasks, the object or motor imitative skill would be regarded as "pass."

Other/doll-directed play. Based on the modified STAT, 2 play items—turn-taking and doll-play—were applied to conduct the test; however, we only focused on doll-play and executed it in all five trials. The item of turn-taking was not included because it was a routine activity and did not measure the functional or symbolic play. In addition, we also gave infants toys and materials included in the "free play" items from ADOS (Lord et al., 1999) and coded their play behaviors *while they engaged in* free play. The other/doll-directed play used same criteria from Christensen et al. (2010) and verified by whether the infants fed the doll with a pacifier, put the doll on chair, or gave the experimenter (parent) or doll a cup for drinking during the administration of modified STAT or ADOS.

Referential language. During the whole course of the modified STAT and "free play" of ADOS (Lord et al., 1999) observation, the participants were recorded closely. If the infants spontaneously spoke any meaningful words, referential language would be defined as emerged. However, "mom," "pa," and imitated words that were used by the examiners were considered as speaking about or calling parents without definitely referent intention and, therefore, were not considered as referential language. The criterion was taken from the suggestion of Autism Diagnostic Interview–Revised (ADI-R; Rutter et al., 2003).

Reliability. The TD infants with emerged social-communicative behavior were coded as "passed," whereas the others whose social-communicative behavior did not emerge were coded as "failed." To obtain inter-rater reliability, 6 out of 26 (23%), 7 out of 31 (23%), and 6 out of 28 (21%) TD infants were selected randomly from the 9-month, 12-month, and 15-month periods, respectively, and were rated by two raters independently. Cohen's kappa for all the measures was 1.

Results. The emerging order of social-communicative skills was determined by the passing rate based on the premise that the skills that are easier to achieve will appear earlier. The passing rates were analyzed by the Cochran Q test. In addition, the scalability of the developmental sequence in social-communicative skills was tested with the Guttman scalogram technique (Guttman, 1950). The scalogram analysis tested the degree of the reliability of the emergence order in the sample. The coefficient of reproducibility (Crep) was an index of reliable ordering and the value .90 or higher indicated the convincing order.

The 9-month-old session. The results of the Cochran Q test demonstrated a significant difference among the passing rates of the social-communicative skills, $Q_{(5,\ N = 26)} = 93.44$, $p < .001$. Through post hoc comparison, obvious differences were found from one child to another among IJA, RJA, and object imitation. From the highest to the lowest, the order of the passing rates of social-communicative skills was IJA, RJA, and object imitation. Yet, remarkably, motor imitation, other/doll-directed play, and referential language did not emerge in this session. The Crep value of .95 showed that this order was highly scalable.

The 12-month-old session. The results of the Cochran's Q test also confirmed a significant difference among the passing rates of the social-communicative skills, $Q_{(5,\ N = 31)} = 125.34$, $p < .001$. The results of the post hoc comparison showed that the passing rates of IJA, RJA, and object imitation were not significantly different; moreover, the children's passing rates of all these three skills were higher than the rest of the social-communicative skills. In addition, the

Table 2. Performance of social-communication skills in TD infants.

	IJA	RJA	Object imitation	Motor imitation	Other/doll-directed play	Referential language
9 months old (n = 26)						
Passed:failed	26:0	16:10	8:18	0:26	0:26	0:26
Rates	100%	61.5%	30.8%	0%	0%	0%
12 months old (n = 31)						
Passed:failed	31:0	31:0	29:2	10:21	2:29	0:31
Rates	100%	100%	93.5%	32.3%	6.5%	0%
15 months old (n = 28)						
Passed:failed	28:0	28:0	28:0	17:11	12:16	4:24
Rates	100%	100%	100%	60.7%	42.9%	14.3%

TD: typically developing; IJA: initiating joint attention; RJA: responding to joint attention.

passing rate for motor imitation was higher than other/doll-directed play and referential language, whose passing rates showed no significant difference. The Crep value of .94 also showed that this order was highly scalable.

The 15-month-old session. The Cochran's Q test results also showed a significant difference among the passing rates of the social-communicative skills, $Q_{(5,\,N=28)} = 84.23$, $p < .001$. The results of a post hoc comparison illustrated that the passing rates of IJA, RJA, and object imitation were not significantly different; moreover, the infants' passing rates of all these three skills were higher than the rest of the social-communicative skills. Finally, motor imitation and other/doll-directed play, whose passing rates demonstrated no significant difference, were higher than referential language (see Table 2). The Crep value of .94 also indicated that this order was highly scalable.

To summarize, this study showed a reliable developmental sequence of the emergence of social-communicative skills in TD infants. IJA skill emerged first and was followed by RJA, object imitation, motor imitation, other/doll-directed play, and referential language (see Figure 1). In this study, although extra items, namely, motor imitation and other/doll-directed play, were included in the measuring list, the results still exhibited an order in which IJA skill appeared first and referential language appeared last. The results were consistent with the study of Carpenter et al. (1998) and will be discussed in detail in the section "Discussion."

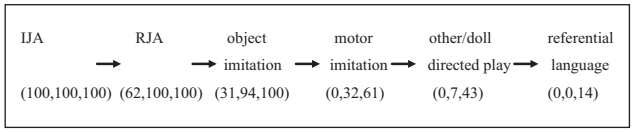

Figure 1. Developmental sequence of social-communicative skills in TD infants.
TD: typically developing; IJA: initiating joint attention; RJA: responding to joint attention.
Values in parentheses represent passing rate at 9, 12, and 15 months.

Study 2: developmental sequences of social-communicative behaviors in young children with autism

Methods

Participants. A total of 46 young children participated in this study, including 23 toddlers with autism and 23 toddlers with DD. The participants of the longitudinal study had to meet the following requirements: (a) CA from 24 months through 36 months at Time 1, (b) absence of an identified genetic or metabolic disorder, and (c) absence of a severe sensory or motor impairment. Parents of all the participants were invited to join in this study. The study information was provided and explained to the parents in advance, and the consent form was presented and signed by the parents before their participation. After completing Time 1 study, all children were followed at age of 18 months for the Time 2 study, except one autistic child whose mother was pregnant and was unable to attend the Time 2 study.

During the Time 2 study, all the children with autism were assessed and diagnosed according to *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text rev.; *DSM-IV-TR*; American Psychiatric Association (APA), 2000), ADOS (Lord et al., 1999), and ADI-R (Rutter et al., 2003) by a multidisciplinary team that included senior psychiatrists and psychologists who work in a teaching hospital in southwestern Taiwan. The multidisciplinary team implemented an extensive assessment for children with autism and children with DD. The demographic characteristics of the sample are shown in Table 3.

To ensure that the developmental ability of children with autism and children with DD was similar, the Mullen Scales of Early Learning (MSEL, Mullen, 1995) was adopted for measuring. Independent t-tests demonstrated that the CA and mental age (MA), at Time 1, of the autism and DD groups were comparable ($t_{(44)} = 1.76$, $p = .09$ and $t_{(44)} = 1.92$, $p = .06$). There was no significant difference between the two groups in gender (Yates' correction), $\chi^2_{(1,\,N=46)} = 3.62$, $p = .14$. At Time 2, MA of the two groups were matched ($t_{(44)} = 1.57$, $p = .12$); however, the autism group's CA was more

Table 3. Demographic characteristics of children with autism and with DD.

	Autism (n = 23)	DD (n = 23)	p
Time 1			
CA (months)			
Mean (SD)	29.48 (3.86)	27.57 (3.53)	.09
Range	24–36	24–36	
MA (month)[a]			
Mean (SD)	16.45 (3.11)	18.11 (2.75)	.06
Range	12.75–25.50	10.50–21.25	
Gender			
Male:female	21:2	16:7	.14
Time 2			
CA (months)			
Mean (SD)	48.61 (4.40)	46.09	.04
Range	42–58	42–54	
MA (month)[a]			
Mean (SD)	31.96 (7.61)	35.41 (7.30)	.12
Range	15.50–45.00	16.50–46.75	
ADOS			
Mean (SD)	15.09 (2.76)	3.96 (1.99)	.00
Range	10–21	0–7	

ADOS: Autism Diagnostic Observation Schedule; CA: chronological age; MA: mental age; SD: standard deviation.
[a]Average of the age equivalents provided for the 4 subscales of the Mullen Scales of Early Learning (MSEL, Mullen, 1995).

than that of the DD group ($t_{(44)} = 2.11, p = .04$). As expected, more severe symptoms were found in the autism group ($t_{(44)} = 15.69, p < .001$).

Procedure. Apart from MSEL (Mullen, 1995), which was used to match MA between the autism and DD groups, all the procedures and measures were identical to the ones applied in Study 1. While conducting Study 2, MSEL was executed first, followed by modified STAT (Stone et al., 2000) and ADOS (Lord et al., 1999) at Time 1 and Time 2. ADI-R was administered for the parents of the two groups at Time 2.

Reliability. The duplicated coding criteria that were used for the TD infants in Study 1 were also applied in Study 2. To obtain inter-rater reliability, two raters independently rated 10 (22%) children who were randomly selected from all participants for each measure. Cohen's kappa for all the measures was 1.

Results. The performance of IJA, RJA, object imitation, motor imitation, other/doll-directed play, and referential language in young children with autism and with DD are presented in Table 4. At Time 1, the results showed that children with autism displayed significantly lower passing rates in IJA, RJA, motor imitation, other/doll-directed play, and referential language than DD children. However, at Time 2, the autism group had significantly lower passing rates only in IJA and other/doll-directed play when compared to that of the DD group.

For children with autism, the results of the Cochran Q test showed a significant difference among the passing rates of the social-communicative skills during Time 1, ($Q_{(5, N = 23)} = 45.0, p < .001$). The results of post hoc comparison demonstrated the following: (a) the passing rate of object imitation was much higher than the others and (b) the passing rate of RJA was higher than those of referential language, motor imitation, and IJA. Moreover, the passing rates of referential language, motor imitation, and IJA were not significantly different. Finally, the passing rate of other/doll-directed play was higher than motor imitation and IJA. The Crep value of .88 showed that this order was near highly scalable (comfortable value is .90 or above, Guttman, 1950).

Regarding Time 2, which took place 18 months after Time 1, for children with autism, the results of the Cochran's Q test also revealed a significant difference among the passing rates of the social-communicative skills ($Q_{(5, N = 23)} = 50.0, p < .001$). The results of the post hoc comparison showed that the passing rates of object imitation, RJA, other/doll-directed play, referential language, and motor imitation were the highest while there was no significant difference among them. The passing rate of IJA was the lowest. The Crep value of .89 indicated that this order was also near highly scalable. The emergence sequence of social-communicative skills in autistic children is shown in Figure 2.

For children with DD, the results of the Cochran Q test revealed a significant difference among the passing rates of the social-communicative skills at Time 1 ($Q_{(5, N = 23)} = 23.16, p < .001$). The results of the post hoc comparison showed that the passing rates of IJA and RJA are higher than those for motor imitation and referential language. However, the passing rates of motor imitation and referential language were not significantly different. Moreover, the passing rates of object imitation and other/doll-directed play were higher than that of motor imitation. The Crep value of .85 showed that this order was not highly scalable.

During Time 2, for children with DD, the results of the Cochran's Q test also showed a significant difference among the passing rates of the social-communicative skills ($Q_{(5, N = 23)} = 14.00, p < .001$). The results of the post hoc comparison demonstrated that while the passing rate of motor imitation was the lowest, there was no significant difference among the passing rates of IJA, RJA, object imitation, and other/doll-directed play. Besides, there was no significant difference found among referential language and the rest of the social-communicative skills. The Crep value of .98 showed that this order was highly scalable. The emergence sequence of the social-communicative skills in children with DD is shown in Figure 3.

Table 4. Passing rate in children with autism and with DD.

	Autism	DD	*p*
Time 1			
IJA	1:22 (4.3%)[a]	20:3 (87.0%)	Z = 5.56,[b] $p < .001$
RJA	11:12 (47.8%)	21:2 (91.3%)	Z = 3.17, $p < .01$
Object imitation	19:4 (82.6%)	16:7 (69.6%)	Z = 1.03, $p = 31$
Motor imitation	2:21 (8.7%)	9:14 (39.1%)	Z = 2.39, $p < .05$
Other/doll-directed play	8:15 (34.8%)	16:7 (69.6%)	Z = 2.34, $p < .05$
Referential language	4:19 (17.4%)	11:12 (47.8%)	Z = 2.18, $p < .05$
Time 2			
IJA	5:18 (21.7%)	23:0 (100%)	Z = 5.38, $p < .001$
RJA	21:2 (91.3%)	23:0 (100%)	Z = 1.43, $p = .15$
Object imitation	22:1 (95.7%)	23:0 (100%)	Z = 1.00, $p = .32$
Motor imitation	19:4 (82.6%)	19:4 (82.6%)	Z = 0.00, $p = 1.00$
Other/doll-directed play	18:5 (78.3%)	23:0 (100%)	Z = 2.34, $p < .05$
Referential language	21:2 (91.3%)	21:2 (91.3%)	Z = 0.00, $p = 1.00$

DD: developmental delay; IJA: initiating joint attention; RJA: responding to joint attention.
[a]Passed:failed (rates).
[b]Mann–Whitney *U* test.

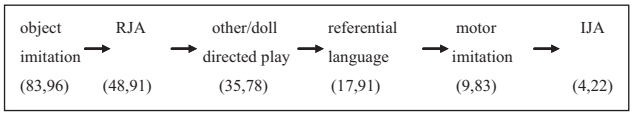

Figure 2. Sequence of emergence for social-communicative skill in autism.
RJA: responding to joint attention; IJA: initiating joint attention.
Values in parentheses represent passing rate at Time 1 and Time 2.

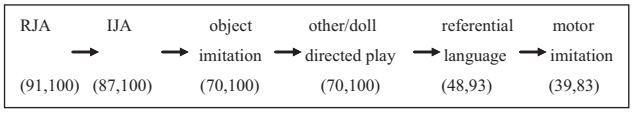

Figure 3. Sequence of emergence for social-communicative skill in DD.
DD: developmental delay; RJA: responding to joint attention; IJA: initiating joint attention.
Values in parentheses represent passing rate at Time 1 and Time 2.

Discussion

This study combined the modified STAT (Stone et al., 2000) and some items from ADOS (Lord et al., 1999) to test the developmental sequence of early social-communicative skills in children with autism. Comparing with the previous studies, this study enhanced the understanding of the impairment and the nature of autism because (a) the participants were younger than 3 years of age during Time 1, (b) the participants were tracked 18 months after Time 1, (c) the children with DD were invited to join in the control group, (d) the sample size was fairly large, and (e) IJA, RJA, motor/object imitation, play, and language skills were simultaneously measured in this study.

The result of Study 1 revealed that a sequence of early social-communicative skills in the TD infants emerged in a verifiable sequence. It showed that IJA emerged first, followed by RJA, object imitation, motor imitation, other/doll-directed play, and referential language. The finding was consistent with the result of Carpenter et al. (1998), namely, IJA skill appeared first, followed by imitation, and the referential language appeared last. The result was also consistent with the conclusion of the previous study of Adamson and Bakeman (2006) who claimed that joint attention skills could facilitate the development of representation and symbol abilities.

In Study 2, we found that even using an ordinal scale as the passing rate, most of the findings were consistent with the previous studies that used an interval scale at Time 1, that is, fewer 2-year-old children with autism displayed IJA, RJA, motor imitation, other/doll-directed play, and referential language than did children with DD (Charman et al., 1997; Chiang et al., 2008; Mundy, 1995). Results of this study also showed that 4-year-old children with autism still experienced deficits on both IJA and other/doll-directed play. However, the other social-communicative abilities were not impaired at Time 2. Although the results of Time 2 were not satisfied as we predicted, the lowest passing rate of IJA supported that the deficit of IJA in children with autism is still the strongest indicator across two time points, even by using the dichotomous scale.

This study found a different developmental trajectory in autistic children when compared to that in the TD infants and the DD children, a finding similar to the results of the previous studies (Carpenter et al., 2002; Turner et al., 2003). Both TD infants and children with DD developed joint attention first (either IJA or RJA first), followed by object imitation and play, and referential language appeared last. However, children with autism developed object imitation first, followed by RJA, play, referential language, and—lastly—IJA, and the sequence was seen at both ages of 2 and 4 years. The findings verified the emergence

sequence of the atypical development of early social-communicative skills in young children with autism.

At least two theoretical implications need to be discussed in depth about the atypical development in autism. First, why did children with autism display object imitation first and IJA last with referential language emerges in between them? Why object imitation is easier than motor imitation only in autism group and what is their role in early language development? Rogers et al. (2003, 2005) and Rogers and Williams (2006) proposed two imitative processes or mechanisms, namely, affective and apprenticeship or instrumental. The former modulates social exchanges with others, and the process might start with imitation of facial movement at birth and develop affectively related body movements seen in emotional contagion and mirroring of facial expressions, body postures, gestures, and tone of voice. The latter process might involve a more executively constructed, cognitively mediated system that allows one to learn instrumental means-end relations from others, developing in later infancy. Children with autism might use the instrumental imitation process without the benefit of the affective imitation process, resulting that they develop object imitation sooner but not motor imitation. Thus, even when they can learn language, Carpenter et al. (2002) noted that lack of mutuality or interpersonal engagement in language acquisition will account for many of the atypical features of language found in children with autism, such as echolalia, "metaphorical speech," pronoun reversal, and use of questioning intonation for statements.

Second, why such a different development between IJA and RJA happens only in the autism group? In other words, why does the impairment of RJA gradually remit but the impairment of IJA remains in autism group from ages 2 to 4 years? Mundy (2003) suggested that IJA reflects the trend to spontaneously initiate social attention coordination behavior, but RJA is a tendency to respond to another person's signal to shift attention. Hence, IJA might be more influenced by executive and social-motivation processes in the generation and self-initiation of behavioral goals than RJA. IJA disturbance in autism could be explained in terms of an attenuation of the tendency to initiate episodes of shared positive affect with a social partner. Dawson (2008) further proposed the social-motivation deficit hypothesis to explain the wide range of the impairment of social orienting, joint attention, imitation, and face processing are evident in the toddlerhood and preschool age in ASD. Due to the reduced social motivation, the high-risk children for ASD from early developing phase start to spend less time to engage with people socially, instead they spend a stronger focus on objects. The reduced interpersonal engagement would contribute to a failure to develop the expertise in language and other aspects of processing of social information.

There are some clinical implications that can be emphasized. First, in an early diagnostic context, this study revealed that signs of IJA and motor imitation are two important screening indices for autism at age 2 years, and IJA still is a cardinal indicator for autism at age 4 years. Second, although children with autism can benefit from traditional Applied Behavioral Analysis (ABA) training or Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH) program in early intervention that are more focused on rote imitation, play skills, and language learning based mainly on therapist- or teacher-directed approaches, findings of this study urge the early intervention program focusing on the child-directed approach that especially focuses on the IJA or joint engagement and reciprocal imitation. Fortunately, there are now early intervention programs, either comprehensive or target-oriented, which have developed such an approach that intervenes in the core deficits of early social-communication domains in young children with autism (Dawson et al., 2010; Ingersoll and Schreibman, 2006; Kasari et al., 2008).

The results of this longitudinal study suggested a quite atypical developmental pattern of social-communicative skills in children with autism. However, there are some limitations in this study. First, there is an 18-month gap between Time 1 and Time 2. Due to the limited number of available examiners for this study, shorter time interval measures could not be carried out to observe more detailed changes of social-communicative skills in children with autism during the time gap. Second, ADOS was used in both the diagnosis and the progress measurements. Such an approach should be avoided in the future study. Third, to verify the results of this study, the Cochran Q test was applied to examine the passing rate of social-communicative skills. However, the pass/fail method might not be able to exhibit the development sequence explicitly. Therefore, a variety of scoring methods will be needed for further research. Fourth, since the coefficients of reproducibility were not highly scalable in the autism group at both Time 1 and Time 2, the results might suggest that a heterogeneous pathway occurs in individuals with autism; this must be explored in the future in a larger group.

Funding

This research received a grant from the National Science Council in Taiwan (NSC-93-2413-H-194-017,NSC-94-2413-H-194-002, NSC-95-2413-H-194-001 and NSC-96-2413-H-004-021-MY3).

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