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# Linguistic Features of Japanese Twins at 3 or 4 Years of Age Evaluated by Illinois Test of Psycholinguistic Abilities

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In general, twins have delayed language development early in childhood compared with singletons. The purpose of this study was to clarify the overall linguistic features of twins. A Japanese version of the Illinois Test of Psycholinguistic Abilities (ITPA) was administered in 24 twin pairs (aged 3 to 4 years) at their own homes. The overall language abilities of the twins were in the normal range (based on ITPA normative data: mean scale score  $36.0 \pm 6.0$  points), and for the ITPA subtests only, Auditory Reception fell within the range of language disorder (mean scale score  $24.9 \pm 5.1$  points). The findings suggest that in 3- to 4-year-old Japanese twins, overall language abilities are not delayed. However, there may be specific difficulties with auditory reception skills.

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It has been reported that twins have delayed or atypical communication development compared with singletons early in childhood (Day, 1932; Dodd & McEvoy, 1994; Hay et al., 1984; Hua & Dood, 2000; Mittler, 1970). There has been some debate as to the extent to which environmental and hereditary factors influence language development in early childhood (Philip et al., 2000; Plomin et al., 1988; Rietveld et al., 2000). A number of studies have shown that the effects of a common environment account for a large proportion of the variation in language development in young twins (Day, 1932; Deary et al., 2005; Luria & Yudvich, 1959; Lytton & Conway, 1977; Mittler, 1970; Savic, 1980; Zazzo, 1960).

We have been intrigued by the role of these environmental factors, including the influence of the twins' relationship in their language development, as the language delay of twins is reported to disappear quickly when twins are separated and provided with alternative conversation partners (nonfamily members), such as when twins commence kindergarten (Luria & Yudvich, 1959).

In Japan, where the restricted language learning environment of twins is not common knowledge, few

systematic studies have investigated the overall linguistic characteristics of twins by examining them independently using an interview method. It was therefore thought that thorough evaluation of the communication style specific to twins was necessary to delineate the features of twin language development.

There is evidence that there are at least two important environmental factors that influence language development in twins (Lytton & Conway, 1977; Savic, 1980). First, twins may be in a poor environment for learning language due to the additional care burden on parents. These additional care responsibilities may result in parents of twins being less attentive to, and having less time to facilitate their language development. Therefore, twins tend to imitate each other's immature speech or make up the idiolect (Dodd & McEvoy, 1994; Hay et al., 1987; Thorpe et al., 2001).

Secondly, twins often have idiolect speech between themselves, variously known as *autonomous speech* (Luria & Yudvich, 1959), *twin language* (Hayashi & Hayakawa, 2004), *secret language* (Mittler, 1970) or *twin-talk* (Malmstrom & Silva, 1986), which is unintelligible to others, and gives the appearance of language delay (Day, 1932; Savic, 1980; Tomasello, 1986). This appears to be associated with the special language-learning environment, due to the close relationship of twins in which twins are liable to lack both opportunities and motivation for adult speech (Luria & Yudvich, 1959; Mittler, 1970). Although Mittler (1970) mentioned the presence of twin-talk in twin pairs, he did not analyze it in detail.

Therefore, in the present study, we attempt to clarify the overall characteristics of twin language, which consist of communication processes and psycholinguistic abilities. The Illinois Test of

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Psycholinguistic Abilities (ITPA), which has been shown to distinguish three psycholinguistic processes, was performed in 24 pairs of identical twins, some of whom were known to use twin-talk. Twins were examined separately in their own homes, and mothers were interviewed independently of the twins concerning the presence of twin-talk.

## Materials and Methods

### Participants

The participants in the present study were recruited from members of the Twin Stars Club (the Japanese Mothers' Organization for Twin and Higher Order Multiple Births, which has about 300 members in the Kansai area — the western part of Japan). A letter describing the purpose of the study and the nature of the testing procedure and confidentiality was sent to 30 members of the Twin Stars Club, who had given birth to twins between February 25, 1999, and April 30, 2001, asking them to participate in the study. The period of recruiting respondents was February to April 2004. Of the 30 mothers, 16 mothers of twins (53.3%) responded to the recruitment request. In addition, the same letter was sent to 14 mothers who were introduced by members of the Twin Stars Club, all of whom agreed to participate in the study. Thus, the mothers of a total of 30 pairs of twins agreed to participate in the study.

Exclusion criteria for entry into the study were: (1) a handicap affecting linguistic development such as cerebral palsy or autism or a mean scale score of less than 26 points (the cut-off point for distinguishing children with learning disabilities from normal children; Ueno et al., 1993), (2) the inability to complete the language test battery, (3) having parents who were not native Japanese speakers, and (4) pairs of opposite-sex as it has been reported that sex differences in language development during the early years tend to favor girls (Butterworth & Morissette, 1996; Fenson et al., 1994; Van Hulle et al., 2004).

As a result, six pairs of twins were excluded from the analysis because of cerebral palsy (one pair), autism (one pair), inability to complete the language test battery (two pairs), and opposite-sex pairs (two pairs). Finally, 24 same-sex pairs of twins were examined: 12 pairs from the Twin Stars Club and 12 pairs who were introduced by members of the Twin Stars Club.

The mean chronological age of all the twins at the time of the study was 45.3 months ( $SD = 5.6$ ; range = 36–55). The mean Psycholinguistic Age (PLA) of all the twins was 40.3 months ( $SD = 5.2$ ; range = 30–52). The mean birth weight was 2268 g ( $SD = 382$ ; range = 1060–2900).

In addition, one of the 24 pairs of twins had attended junior kindergarten before the age of 3, and six pairs had older siblings.

### Sex and Zygosity Classification of the Twins

The 24 pairs included two alike male pairs (four individuals), nine alike female pairs (18 individuals),

six nonalike male pairs (12 individuals) and seven nonalike female pairs (14 individuals). There were fewer alike male twins than alike female twins or nonalike twins; however, the chi-square test showed no statistically significant difference in the comparison of sex and similarity of physical features (Fisher's test,  $p = .065$ ).

### Determination of Zygosity

A questionnaire was used on the similarity of physical features that gives the zygotic diagnosis (monozygotic [MZ] or dizygotic [DZ]) with 90% reliability (Ooki, 2001). However, as a DNA zygosity diagnostic method was not used in the present study, the data concerning zygosity is presented such that MZ twins are alike twins, DZ twins are nonalike twins.

### Child Language Measures

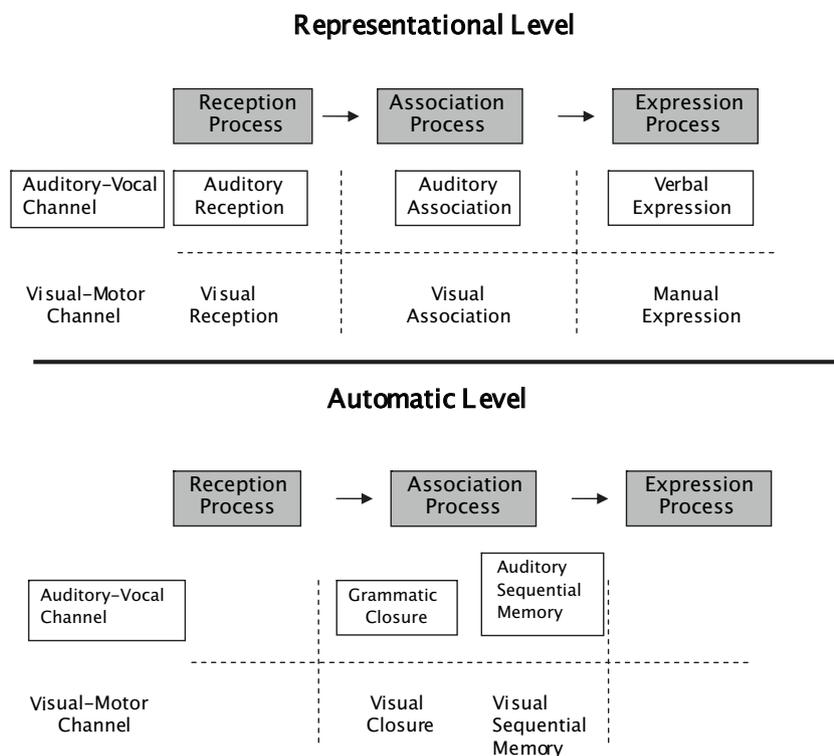
The instrument used in the present study was the ITPA (Kirk & Kirk, 1971). This test was originally developed based on a communication model devised by Osgood (1957), and includes 10 subtests designed to measure different aspects of language behavior.

A revised version of the ITPA was used which had a better goodness-of-fit to Japanese social culture, and included 10 subtests (Ueno et al., 1993). This test was constructed from ITPA normative data from children whose language development level was 3 to 9 years of age, and was developed to measure psycholinguistic abilities related to learning disabilities. Figure 1 depicts the model of the ITPA communication process, which consists largely of two parts: the representational level which focuses on language symbols, and the automatic level which focuses on highly organized and integrated habitual patterns of retention and retrieval of language.

Each level consists of two information-processing channels: the auditory-vocal channel and the visual-motor channel. Moreover, each level is divided into three processes: reception (the cognitive and comprehension processes of auditory and visual input), association (the inner regulatory process of the perceived concept and language symbols), and expression (the process of verbal and manual expression).

The ITPA subtests are designed to evaluate: (1) auditory reception, that is, the auditory comprehension of words related to the language comprehension, (2) auditory association, and (3) verbal expression in the auditory-vocal channel; and in the visual-motor channel: (1) visual reception, (2) visual association, and (3) manual expression at the representational level. The subtests in the automatic level are designed to evaluate grammatical closure and auditory sequential memory in the auditory-vocal channel, and visual closure and visual sequential memory in the visual-motor channel, both of which belong to the association process.

The ITPA score of each subtest is based on the scale scores, and a performance profile for each child can be drawn. The mean scale score of the ITPA normative data is 36 ( $SD = 6$ ). Scores less than 30 have been shown to indicate learning difficulties at school. Ueno et al. (1993) reported that the score on



**Figure 1**  
Model of communication process of ITPA (Ueno et al., 1993).

Note: Figure 1 was produced by translating and modifying data and information which appeared in the manual written in Japanese by Ueno et al.

‘intraindividual differences’ was a good index of learning disability. Intraindividual difference is expressed as the difference between the mean scale score (10 subtests in total) and the scale score of each subtest. A difference greater than -6 has been shown to indicate learning difficulties, and one greater than -9 is in the range of learning disorders (Ueno et al., 1993).

However, in the present study, as the aim was to compare language development and communication processes between twins with the ITPA normative data, the difference between the mean scale score of singletons (36 points) and that of each of the subtests for all twins was used to evaluate their delay in language development. In addition, the overall psycholinguistic ability of the twins was assessed by PLA, which can be obtained from the raw score by using a conversion table for various ages.

It was indicated that twin pairs with highly similar physical features had a significantly higher intraclass correlation coefficient ( $p < 0.01$ ) of the total raw score of the ITPA subtest. However, in order to clarify the overall characteristics of language development in twins, the twins were regarded not as 24 pairs but as 48 individual children, as in Mittler’s statistical analysis (Mittler, 1970).

The Mann-Whitney test was applied to distinguish language development between the two groups, that is, the current and noncurrent twin-talk groups, regarding

the scaled scores of the ITPA subtests. The chi-square test was applied to ascertain the distribution of categorical variables for the twins. The 5% significance level was used in the statistical tests. SPSS (Version 11.0, 2001) was used for all statistical analyses.

**Procedure**

Individual testing and interviews were performed in the children’s homes, after establishing rapport with the subjects, by the same examiner (Y. K.), who is a registered nurse and a doctoral student in the Department of Health Promotion Science and was trained by a speech therapist. The mother was allowed in the same room but was out of sight of the child being tested. Information on whether or not the twins had twin-talk was collected before the visit. On the day of the visit, the presence or absence of twin-talk was confirmed by asking the mother directly. During the test, the children were allowed to take a rest if they appeared to be fatigued or distracted.

The protocol of the present research was approved by the Ethics Committee of Osaka University Medical School.

**Results**

**ITPA in Twins and the ITPA Normative Data**

Table 1 shows the mean scale scores of the ITPA subtests and the difference in mean scale score between the ITPA

**Table 1**Means of Scale Score of Illinois Test of Psycholinguistic Abilities (ITPA) Subtests and Difference in Scale Score Between ITPA Normative Data and Twins at 3 and 4 Years of Age ( $n = 48$ )

		Subtests	Scale Score	Difference from normal mean scale score (36)
Representational level	Reception	Auditory reception	24.9 (5.1)	-11.1*
		Visual reception	36.8 (6.1)	0.8
	Association	Auditory association	34.2 (5.6)	-1.8
		Visual association	35.5 (6.1)	-0.5
	Expression	Verbal expression	31.5 (3.5)	-4.5
		Manual expression	33.3 (5.2)	-2.7
Automatic level	Automatic	Grammatical closure	28.3 (2.5)	-7.7
		Visual closure	37.2 (5.6)	1.2
	Sequential	Auditory sequential memory	36.4 (3.8)	0.4
		Visual sequential memory	32.1 (4.9)	-3.9
	Mean scale score of twins			33.0 (2.4)

Note: \* The criterion for learning disorder is defined as a difference from the normal mean scale score of greater than -9.

normative data (36) and twins at 3 and 4 years of age in the present study. The mean value of scale scores in the 10 subtests of all twins was 33.0 ( $SD = \pm 2.4$ ), and the difference from the mean scale score of the ITPA normative data was -3 points, which was within the normal range. The scale score of auditory reception was 24.9 ( $SD = \pm 5.1$ ) and the difference from the mean scale score of singletons was -11.1, which was in the region of language disorder.

#### Frequency of Current Twin-Talk According to Whether the Twins Were Alike or Not

Table 2 shows the frequency of current twin-talk according to whether the twins were alike or nonalike. Of the 24 pairs, 10 pairs (42%) exhibited twin-talk, all of whom were same-sex pairs, and included six individuals (three pairs) of nonalike male twins, six (three pairs) of alike female twins, and eight (four pairs) of nonalike female twins, but did not include any alike male twins. Although there were no alike male pairs, there was no significant difference in the comparison of sex and the similarity of physical features using a chi-squared test (similarity of physical features: Fisher's test,  $p = .083$ ; sex: Fisher's test,  $p = .763$ ).

#### Comparison of Scale Scores Between Current and Noncurrent Twin-Talk Groups

Table 3 shows the scale scores of subtests, the mean scale score, and PLA according to whether or not the twins had current twin-talk. There was no significant difference in the mean scale scores of the total of 10 subtests for the current twin-talk group ( $M = 33.3$ ,  $SD = \pm 2.7$ ) and noncurrent twin-talk group ( $M = 32.7$ ,  $SD = \pm 2.1$ ;  $ns$ ). There was a significant difference in the mean scale scores of the subtest for auditory reception between the current twin-talk group ( $M = 27.4$ ,  $SD = \pm 6.7$ ) and noncurrent twin-talk group ( $M = 23.1$ ,  $SD = \pm 2.5$ ;  $p < .001$ ).

Auditory reception is the neurophysiologic process which is affected by the neuroanatomical development

with chronological age. The PLA include reception process (Kirk & Kirk, 1971). The language development of 4-year-old twins showed association with the age of first words and the birthweight (Mittler, 1970). Therefore, the chronological age, PLA, the age at the first word and the birthweight were compared between the current twin-talk and noncurrent twin-talk groups.

The mean PLA of the current twin-talk group was 39.0 ( $SD = \pm 4.7$ ; 33 to 48) months and for the noncurrent twin-talk group 41.3 ( $SD = \pm 5.4$ ; 30 to 52) months ( $ns$ ). The response rate for the question concerning the age at which the first word was noted was 62% (30 individuals). Of the 30 individual twins, the mean age at the first word in the 14 individuals in the current twin-talk group was 13.9 ( $SD = \pm 2.2$ ; 12 to 18) months, and that in the noncurrent twin-talk group 14.2 ( $SD = \pm 2.5$ ; 12 to 18;  $ns$ ). The mean birth weight of the current twin-talk group was 2357  $\pm$  277 g and noncurrent twin-talk group was 2201 ( $SD = \pm 440$  g,  $ns$ ).

The relationship between the sex and scale score was examined for auditory reception, since it has been reported that there is a sex difference in language development during the early years

**Table 2**Frequency of Current Twin-Talk According to Whether the Twins Were Alike or Not ( $n = 48$ )

	Current Twin-Talk	
	(+)	(-)
	$n = 20$ (42%)	$n = 28$ (58%)
<Alike-pairs of same-sex $n = 22$ >		
Male ( $n = 4$ )	0	4
Female ( $n = 18$ )	6	12
<Nonalike pairs of same-sex $n = 26$ >		
Male ( $n = 12$ )	6	6
Female ( $n = 14$ )	8	6

**Table 3**

Scale Scores of Subtests, Mean Scale Score, and Psycholinguistic Age (PLA) According to Whether Twins Had Current Twin-Talk or Not

Subtests	Current Twin-Talk	
	Present ( <i>N</i> = 20) Mean ( <i>SD</i> )	Absent ( <i>N</i> = 28) Mean ( <i>SD</i> )
Auditory reception	27.4 (6.7)**	23.1 (2.5)
Visual reception	37.2 (5.9)	36.4 (6.2)
Auditory association	33.8 (5.5)	34.5 (5.8)
Visual association	35.1 (7.2)	35.8 (5.4)
Verbal expression	32.3 (3.9)	31.0 (3.3)
Manual expression	33.5 (6.5)	33.1 (4.1)
Grammatical closure	28.7 (2.6)	28.1 (2.5)
Visual closure	36.9 (4.3)	37.4 (6.4)
Auditory sequential memory	37.0 (3.8)	36.0 (3.8)
Visual sequential memory	31.7 (4.3)	32.4 (5.4)
Mean Scale Score	33.3 (2.7)	32.7 (2.1)
Chronological Age ( <i>SD</i> : range) months	45.2 (5.7 : 36–53)	45.4 (5.6 : 39–55)
PLA ( <i>SD</i> : range) months	39.0 (4.7 : 33–48)	41.3 (5.4 : 30–52)

Note: \*\*  $p < .01$ , \*  $p < .05$ 

(Butterworth & Morissette, 1996). There was no significant difference in the scale scores of auditory reception between male ( $M = 25.2$ ,  $SD = \pm 3.2$ ) and female ( $M = 24.8$ ,  $SD = \pm 5.9$ ) twins.

In view of a report on the association between left handedness and delayed speech development (Ingram, 1965), the appearance of twin-talk was compared with the scale score for auditory reception between the right-handed and non-right-handed (left-handed and mixed-handed) children. Assessments of handedness were performed with a two-item questionnaire for mothers: (1) Which hand does your child use to handle a spoon or throw a ball? (2) Which hand does your child use to paint? (cited from the Tsumori-Inage developmental test for children at the ages of 3 to 7; Tsumori & Inage, 2002). Observation of handedness during the ITPA session was used as a reference. As a result, there was no significant difference in the appearance of twin-talk between right-handed twins (85%) and non-right-handed twins (15% of them were left-handed, and 6% were mixed-handed; *ns*). Finally, there was no significant difference in the scale score for auditory reception between these two groups by handedness (right-handed,  $M = 25.2$ ,  $SD = \pm 5.4$ ; non-right-handed,  $M = 23.1$ ,  $SD = \pm 2.9$ ; *ns*).

## Discussion

In this study, we attempted to clarify the overall features of twin-language at 3 or 4 years of age using the ITPA (Kirk & Kirk, 1971; Ueno et al., 1993). In addition, we focused on the linguistic characteristics of the twins by comparing the current twin-talk group and noncurrent twin-talk group.

First, it was shown that the psycholinguistic abilities of twins as a whole was within the normal

developmental range and a marked retardation was noted only in auditory reception, by comparing the mean total score of twins with that of the ITPA normative data. In addition, it was indicated that the PLA of twins fell behind by 5 months as compared with their chronological age.

In Japan, there have been few systematic analyses of the overall features of twin-language from the aspects of the communication process and psycholinguistic abilities based on a thorough interview method. The results of the present study suggest that further investigation using this method may offer important guidance in the evaluation and analysis of twin language development.

Second, our results in which current twin-talk pairs performed better on the auditory reception scale are in conflict with previous reports that have suggested that current twin-talk pairs experience greater delays in the acquisition of language skills (Bakker, 1987; McEvoy & Dodd, 1992; Savic, 1980). This disparity was not explained by differences in the neuroanatomical development with increasing age between the two groups. Interestingly, there were no other differences in neuroanatomical factors in subscale scores, or in total score between the current twin-talk and noncurrent twin-talk groups. Thus the difference between current twin-talk and noncurrent twin-talk twin pairs appears to be specifically in the domain of auditory reception.

Mittler (1970) reported results contrary to those of the present study, that twins had better auditory reception ability than other abilities, using the ITPA. However, the reception process is, by definition, the input process of physical energy from the environment, and auditory reception is located at the entrance of the

first input process of the auditory-vocal channel (Kirk & Kirk, 1971) suggesting that auditory reception is most closely related with environment and, in other words, is most possibly vulnerable to the paucity of environmental auditory input or stimuli. The results of the present study that auditory reception alone was affected in twins suggest that their language disorder may be closely related to an environment in which twins receive reduced auditory input from their mother who tends to use fewer words to take care of two children at once (Hua & Dodd, 2000).

Mittler (1970) reported that there was a significant difference in language retardation of twins, indicated by ITPA raw scores ( $p < .05$ ), between social classes. The family structure of the twin subjects differed between studies: in Mittler's study (1970), 70% of the twins were from non-working-class families (e.g., professionals such as physicians, lawyers, managers of organizations, and businessmen), while in the present study almost 100% of the twins were from middle-class families, which is one factor possibly contributing to the difference in the results of the two studies. Mittler (1970) reported that retardation of language development was more marked in twins from middle-class families, whose parents were highly educated and had a higher income: they showed much more severe language retardation than singletons and twins whose parents were working class and had a lower educational background.

Bernstein et al. (1969) reported that the verbal expression of middle-class families was more easily affected by environmental factors than that of working-class families, as the syntax of middle-class families has a more complex structure than that of working-class families. Therefore, Mittler (1970) proposed that the development of verbal expression of middle-class twins must have been more severely damaged by their parents, who use more complicated syntax than the parents of working-class twins. It is clear that there is a large societal time lag between today's Japan and England in the 1960s: Japan has much better economic conditions, which may account for the different results of the two twin studies.

The present study has some limitations. One is its small sample size and the low number of alike male twins in the comparison of sex and similarity of physical features, which might weaken the credibility of the results. We expect that reliability could be enhanced in the future by increasing the sample size and having a sample with a more even distribution. In addition, we could not compare the current twin-talk group and noncurrent twin-talk group completely, as twin-talk is unintelligible speech to us and we could not analyze the semantics of twin-talk using the Japanese items, even using the revised version of ITPA.

## Conclusions

The present study demonstrated that among the 10 subtests of ITPA only the auditory reception of psy-

cholingistic abilities was shown to be in the region of language disorder. As the ITPA is equipped with procedures for treating each learning disability, we hope the present study will contribute to establishing more effective countermeasures for the language retardation of twins.

The present study suggested that auditory reception in the current twin-talk group was less retarded than that in the noncurrent twin-talk group. However, the cause of this discrepancy was not attributable to increasing age, handedness, sex, or heredity, and it remains to be elucidated in a future study.

Several psychological factors in addition to cognitive function affect language comprehension ability, such as feelings, emotions and conation (Gillum & Camarata, 2004; Mayes & Calhoun, 2004). However, the present statistical methods are unable to analyze psychological factors. The present study suggests the necessity for active research in the area of psychological factors in the language development of twins, and these problems will be overcome by advances in the methods of brain function measurement in the future.

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