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Speech and language development in six infants adopted from China

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Abstract

Children adopted from China currently represent the largest group of newly internationally adopted children in the US. An exploratory investigation of the communicative development of six young females adopted at ages 9 to 17 months from China by US families was conducted. Children were followed longitudinally from approximately three months post-adoption to age three years. English language skills were assessed at approximately three-month intervals, detailed communicative analyses were conducted at six months post-adoption, and outcomes were measured at three years of age. Results indicated wide variability in rates of English language development. Phonological, social-communicative, and lexical bases of communication were intact for each child at six months post-adoption. At age three years, four of the children demonstrated speech and language skills within one standard deviation of standardized test norms, one child demonstrated skills above the normal range, and one child's skills were below the normal range. This study provides evidence of the resiliency of children's language learning abilities.

Keywords

Second first language aquisition; international adoption; speech and language development

Introduction

The number of international adoptions in the US has increased considerably, rising from 7000 in 1991 to nearly 23,000 in 2005 (US Department of State, 2006). The population of interest in this investigation is children adopted from China, who have represented the largest group of newly internationally adopted (IA) children in the US each year since 2000. IA children face a unique language learning situation that provides a "natural experiment" (Cicchetti, 2003) in which to study children's language learning capacity.

A number of factors may influence the language development of internationally adopted children. First, most IA children have been institutionalized in countries that are poor and provide inadequate health care (Johnson & Dole, 1999). This can have a negative impact on nearly every aspect of children's development, including physical, motor, cognitive, social, and language development (Johnson, Miller et al., 1992; Chisholm, Carter, Ames &

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Morison, 1995; Morison, Ames & Chisholm, 1995; Johnson, Albers et al., 1996; Albers et al., 1997; Fisher, Ames, Chisholm & Savioe, 1997; Sloutsky, 1997; Rutter et al., 1998; Johnson & Dole, 1999; Ames, Morison, Fisher, & Chisholm, 2000; Miller & Hendrie, 2000; Mason & Narad, 2005).

Secondly, internationally adopted children experience an abrupt switch in the language of their environment. Even before children begin to understand words (around 8 to 10 months of age) and produce words (around 12 months of age), they are influenced by the ambient language. For example, newborns prefer utterances in their mother's language, indicating an awareness of prosody very early in life (Juscyzk, 1997). Furthermore, infants are able to perceive segmental contrasts that are not present in their native language and are typically undetected by older children and adults. As infants gain more experience with a particular language, their perceptual abilities are modified and they learn to ignore the sounds that are not relevant to their own language (Werker & Tees, 1984; Best, 1994; Werker, 1994). However, it appears that the bias towards native language can be reset, depending on the infants' listening experience (Juscyzk 1997, 2001). Precisely how speech perception in young IA children is affected by the language switch they experience is unknown.

For children who are adopted internationally after they have begun to understand and produce words, language development may have similarities to bilingual development. This special case of language development seems especially related to *subtractive bilingualism*, in which the development of L1 is not valued and adequately supported after the introduction of a second language, resulting in the gradual loss of L1 (Hakuta, 1986). However, language in international adoptees differs in that they experience an abrupt loss of L1. In addition, institutionalized children are likely to exhibit delays in their original language. The language learning process for internationally adopted children may be more accurately termed *second first language acquisition* (Roberts, Pollock, Krakow, Price, Fulmer & Wang, 2005) or *new adopted first language acquisition* (Glennen, 2002).

A small but growing body of research has explored this second first language development in IA children. The majority of research to date has documented language development in children adopted from Russia and Eastern Europe whose second first language is English (e.g., Fisher et al., 1997; Glennen & Masters, 2002). However, these findings may not apply to Chinese children, whose birth language differs greatly from European languages and who may have better health and orphanage conditions (Miller & Hendrie, 2000; Cecere, 2001).

Studies of the English language development of children adopted from China indicate that while most children "catch up" to English language norms, there are differences in the rate of language growth related to age of adoption. In a study of 15 children adopted between the ages of 7 and 11 months, Krakow and Roberts (2003) utilized parent report measures to follow expressive vocabulary growth from 19 to 30 months of age and found that most children's expressive vocabularies were within normal limits by one and one-half years post-adoption. Krakow, Tao and Roberts (2005) reported expressive language growth, via parent report, for a group of 6 infants (ages 7 to 9 months) and 6 toddlers (ages 24 to32 months), all adopted from the same orphanage in China. The toddlers exhibited faster rates of growth in all areas (i.e., expressive vocabulary, production of irregular nouns and verbs, and complex morphology) when compared to the infants according to months postadoption. However, when the children's language skills were compared to English language expectations, the toddlers were further behind for their age than the infants were, indicating that the toddlers had further to go to catch up. Similarly, in a much larger longitudinal survey study of 141 children adopted from China between the ages of 7 and 43 months, Pollock (2005) found that children adopted at older ages produced more words and longer sentences in the first years after adoption than children adopted at younger ages; however, the older children lagged further behind English language norms.

In a study of speech and language outcomes of 55 children ages 3 to 6 years who had been adopted at least 2 years prior to testing, Roberts et al. (2005) found that most children scored within or above normal limits on tests of overall receptive and expressive language abilities, receptive and expressive vocabulary, and articulation. Sixty-seven percent of children scored within 1.25 *SD*s of the mean on 4 of the 5 measures, 27% scored 1.25 *SD*s or more above the mean on at least 2 measures, and 5% scored 1.25 SDs or more below the mean on at least 2 measures. Furthermore, age at time of adoption and length of exposure to English predicted language scores, with children adopted at younger ages and children who had been exposed to English longer receiving higher scores.

In a study that combined longitudinal and outcome designs, Pollock, Price and Fulmer (2003) followed the development of two children from time of adoption (13 months and 20 months of age) to approximately 27 months post-adoption, when speech and language outcomes were measured. The two children exhibited differences in rates of early growth, with the child adopted at 13 months demonstrating faster growth. By 27 months post-adoption, both children's speech and language abilities were within normal limits, though there were notable differences in their skills (i.e., the scores of the child adopted at 13 months were mostly above normal, while the scores of the child adopted at 20 months were primarily at the lower end of the normal range).

In general, the literature indicates variability in rates of growth, with children adopted at relatively older ages demonstrating faster growth rates. However, these older children appear to have further to go to catch up to English language norms compared to children adopted at younger ages. By 18 to 24 months post-adoption, most children's English language development is within the range considered normal for monolingual English-speaking, US-born children. Previous work has primarily used standardized tests and parent-report measures but lacks data obtained from naturalistic communication samples.

The current investigation is an exploratory, descriptive investigation of the second first language development of 6 infants adopted from China. A descriptive design similar to that of Pollock et al. (2003) was used with a larger number of children. The children were followed longitudinally, from approximately 3 months post-adoption to age 3 years. Their communicative development was assessed over time using examiner-administered tests, parent report measures, and parent-child communication samples. Detailed analyses of the children's phonological, lexical, and social-communicative behaviors at 6 months post-adoption were conducted. Children's performances on the various measures of communicative development were compared to normative data of monolingual, US-born children, as well as data from other young internationally adopted children (Glennen & Masters, 2002).

Because relatively little is known about the course of second first language development in internationally adopted children, the descriptive findings of this study offer a valuable contribution to that body of knowledge. This is the first investigation of IA children to both utilize measures of speech, language, and social-communicative behaviors obtained from spontaneous communication samples and to follow communicative development over time. Furthermore, this natural experiment of second first language learning offers a unique window into the nature of children's capacity to learn language.

Methods

Participants

Six families with daughters adopted from China participated in this study. Participants were recruited from the local chapter of Families with Children from China, local adoption agencies, and word of mouth. All of the children lived in or around the Memphis, TN area. Each child was born in a different Chinese province. The children's ages at time of adoption ranged from 9 to 17 months. At study intake, each mother completed a detailed questionnaire regarding her daughter's medical and developmental history. (See Table I for a summary of background information.)

The children experienced a variety of living situations in China. Four of the six children (S1, S3, S5, and S6) lived in foster care for at least some amount of time, according to the information provided to parents by Chinese agencies. Of the two children who did not receive any foster care, one (S4) entered an orphanage at 2 months of age, and the other (S2) entered when she was 2 days old. Each of the four children who lived in foster care had a unique experience. S1 lived with a foster family from age 2 months until age 15 months, when she was adopted; she never lived in an orphanage. S6 was found at age 1 month, lived in an orphanage for approximately 2 weeks, and then resided in foster care for approximately 1 year, until she was adopted at 13 months of age. S5 entered an orphanage at age 3 months, resided there approximately 4 months, then lived with a foster family for 9 months, and finally was adopted at age 16 months. S3 entered an orphanage at age 4 days. From that time until the time of her adoption at 9 months of age, she stayed in the orphanage during the day and with a foster family at night.

According to the information provided to parents by the adoption agencies in China, none of the children had any developmental problems prior to adoption or had been identified by Chinese officials as having "special needs." S2 had a history of Hepatitis B; otherwise, no medical problems were reported. None of the children experienced any serious health problems from their arrival in the US until the completion of this investigation. In addition, each child received an audiological evaluation at study intake; each child's hearing was within normal limits. Approximate height and weight percentiles compared to other Chinese girls (Chang, Lee, Chui & Chow, 1965) at the time of the children's arrival in the US are given in Table I. Height percentiles ranged from below the 3rd (S3) to the 60th (S2), while weight percentiles ranged from 20th (S3) to 97th (S2).

At the beginning of the investigation, four of the six families reported no concerns regarding their child's speech and language development. S6's mother reported mild concerns, while S4's mother reported moderate concerns. None of the children had received a prior speech-language evaluation or early intervention services.

None of the children had been exposed to English prior to adoption. Some parents had received information regarding their child's native language development from a variety of sources, including adoption facilitators, orphanage caretakers, and foster families. Other parents received no information regarding their child's native language development and thus relied on their own judgment of their child's native language ability. According to parent report, four of the participants (S2, S3, S4, and S6) did not produce any words in their native language at the time of adoption, and S1 and S5 produced about 5 words in their native language, but used them less than 25% of the time, at study intake (i.e., 3 weeks post-adoption and 3 months post-adoption, respectively).

The parents in this investigation were a bit older than average US parents and were well educated. At the beginning of the study, the average age of the 12 parents was 41 years and ranged from 31 to 51 years. Eleven parents had a college and/or graduate school degree. The remaining parent was a high school graduate. All parents were born in the US and were native English speakers. English was the primary language spoken in each home.

Data collection

Longitudinal data collection occurred approximately every 3 months in each child's home, beginning in approximately the third month post-adoption and continuing until each child's third birthday. The data collection battery included investigator-administered speech-language assessments, parent-report measures of communicative development, and the collection of spontaneous communication samples. At age 3, a different assessment battery was administered and included measures of speech, language, and preliteracy skills. Complete results are reported by Price (2003). Selected measures that are representative of the children's speech and language abilities are described below.

Longitudinal

Parents completed *The MacArthur Communicative Development Inventory (CDI)* (Fenson et al., 1993) approximately every 3 months. The *CDI* assesses a variety of communication skills in young children, including expressive vocabulary development. There are two versions of the *CDI*: the *Words and Gestures* form (normed on ages 8 to 16 months) and the *Words and Sentences* form (normed on ages 16 to 30 months). Both forms include a list of words that are common in young children's vocabularies, and parents indicate words their child both understands and says.

The *Words and Gestures* form was designed for children ages 8 to 16 months; however, the authors of the *CDI* suggest that it may be useful for older children who are behind their age-matched peers in language development but whose *CDI* scores do not exceed the 50th percentile scores of 16 month olds. The expressive vocabulary score for 16 month olds at the 50th percentile is 49 words, according to the *CDI* norms. Therefore, all parents were given the *Words and Gestures* form initially and continued to fill out the *Words and Gestures* form until their child produced approximately 50 words. They were then given the *Words and Sentences* form at each remaining data collection point or until the child's expressive vocabulary reached approximately 600 words.

Six months post-adoption

In order to more thoroughly explore a variety of the children's early communicative behaviors (including infraphonological/phonological, lexical, and social-communicative abilities), detailed analyses of the communication samples collected at approximately 6-months post-adoption were performed. Data from the home visit at 6-months post-adoption was selected in order to allow an adequate period for the children to adjust to their families and new environments, permitting the investigator to obtain a sample representative of the child's typical behavior. For all but one child (S3), this was the second home visit made by the investigator. Additionally, for all children except one (S4), the mother was the primary interactor with the child during the play session. The father was the primary interactor with S4.

The communication samples were collected during an informal play session with the child, her parent(s), the first author, and occasionally the child's sibling(s). Parents were encouraged to interact with their child as they normally do, and a set of toys, including a doll and related toys, a Fisher-Price™ dollhouse with family, and a picnic set, was provided. Play sessions were video-recorded for later transcription and lasted approximately 30 minutes.

The first 100 vocalizations of each play session at 6 months post-adoption were transcribed, using both (1) the conventions of the International Phonetic Alphabet (IPA) implemented in coding schemes and analysis files available in Logical International Phonetics Program (LIPP; Oller & Delgado, 2000) and (2) the Global Symbols recommended by Oller (2000) and also implemented in LIPP. In keeping with the infraphonological framework of Oller (2000), the categories of sound that were coded using Global Symbols included unspecified vowels, quasiresonant nuclei, laughs, yells, grunts, and raspberries. Infraphonology is a recently developed theoretical framework that defines the elements of infants' vocalizations and describes the course of infants' vocal development (Oller, 2000).

After the data were coded, several phonological and infraphonological analyses were performed. Rate of vocalization was specified as the number of utterances per minute. An utterance consisted of the vocalizations contained in one breath group. Canonical babbling ratios were then calculated by dividing the number of canonical syllables by the total number of syllables (e.g., Oller, Eilers, Steffens, Lynch & Urbano, 1994). A canonical syllable consists of a nucleus (or vowel-like sound) and at least one consonant margin, with well-timed movements and a speech-like quality (Oller, 2000). The production of canonical syllables is a precursor to speech and an important milestone in children's vocal development. Utilizing LIPP analyses, each child's phonetic inventory was determined automatically. Initial and final consonant inventories consisted of consonant sounds that occurred at least twice in the initial and final positions, respectively (Stoel-Gammon & Cooper, 1984).

As a measure of lexical development, the number of words produced during the 100-vocalization sample was computed. In addition, the number of different words produced was calculated. A vocalization was determined to be a word based on its phonetic characteristics and the context in which it was produced, similar to the method specified by Vihman and McCune (1994).

In order to measure social-communicative development, whether or not the child was engaged in triadic communication during each vocalization was also coded. Triadic communication was deemed to have occurred when the child and mother (or examiner) were engaged simultaneously with a third entity. Eye contact coordinated with looking toward objects occurred often in events judged to include triadic communication, but eye contact was not treated as a necessary condition for the coding of triadic communication: if an interactional pattern surrounding a particular referential utterance from the child made clear that the child understood that the adult was attending to the same object (as judged by utterance context and/or prior looking behavior), then triadic communication would be judged to have occurred even in the absence of immediate eye contact and/or alternating gaze between object and listener. As an operational criterion to categorize child utterances as 'interactive' (and thus potentially showing triadic communication), we used a rough three-second rule: if the child's utterance occurred within three seconds of an adult utterance, and the two utterances seemed coordinated in content, the child utterance was judged to be interactive.

These criteria of judgment regarding triadic communication are notably different from those that are used with children at earlier developmental stages (e.g., Mundy, 1995). Triadic communication at earlier stages often occurs in the context of events that are termed joint attention. At these earlier stages (especially prelinguistic ones), strict criteria of triadic gaze (the child, as part one of the triad, looks towards an object, which is part two, and then toward the mother, who is part three) are often adhered to as indicators of joint attention which can be thought of as a very simple (and perhaps the developmentally earliest) form of triadic communication. However once individuals can speak referentially, triadic communication can occur without eye contact of any sort. In referential talking, it is often clear that very systematic joint attention occurs even in the absence of eye contact of any kind. In these cases the content of the utterances and their coordination across the mother and child make that clear. For example, if the mother points to an object and says “What’s that?” and the child answers immediately and correctly “ball,” there can be no doubt that triadic communication (and an advanced form of joint attention) occurred. Since the children in the study used referential words quite often, the judgment of triadic communication had to take into account their complex knowledge and conversation skills.

Reliability—A trained masters student in speech-language pathology transcribed portions of the data to obtain reliability measurements. To calculate agreement of utterance identification, both transcribers independently documented the time that each utterance occurred, until 100 utterances were reached, for one child’s sample. Identification of utterances was considered to be agreed upon when the two transcribers’ documentations of the time of utterance occurrence were within 2 seconds of each other. Agreement was 96%.

Thirty continuous vocalizations were randomly selected from 3 different children’s communication samples (90 total vocalizations) and were used in the remaining reliability calculations. Overall agreement (number of agreements/number of agreements +disagreements) of categorization of the vocalizations as canonical vs. non-canonical was 94%, with agreement rates of 97%, 87%, and 100% on the individual samples. To calculate phonological/infraphonological transcription reliability, an analysis implemented in LIPP (Kreliab; Oller & Delgado, 2000) compared two transcripts, and discrepancies were weighted. In the analysis for structural agreement, discrepancies weighted most heavily were those that involve adding or deleting syllables, followed by the addition or deletion of entire clusters, followed by the addition or deletion of individual consonants, then cluster reduction or creation, then differences in syllable strength, followed by diphthong creation or reduction, and finally replacements of articulated consonants with glides or vice versa. Structural agreement on the 3 samples was 94%, 73%, and 93%. In the analysis for consonant agreement, discrepancies involving major differences in place were weighted most heavily, followed by large differences in place and voice, then small manner and place differences, then small voice differences, and finally, very small place differences. Agreement on the transcription of consonants for each of the 3 samples was 97%, 95%, and 100%. For vowel agreement, the largest discrepancies in height were weighted most heavily, followed by large errors in height and frontness, then small differences in height and frontness, and finally, small discrepancies in nasality and roundness and very small discrepancies in height. Agreement on vowels was 90%, 94%, and 92%.

Agreement on the identification of children’s utterances as words was 90%. When utterances were judged as words by both transcribers, agreement on word identification was 100%. Agreement on whether each utterance was associated with triadic communication was 91%.

Age 3

Standardized measures—Children’s ability to produce speech sounds in words was evaluated using the *Goldman-Fristoe Test of Articulation-2* (*GFTA-2;* Goldman & Fristoe, 2000). Receptive and expressive language was measured with the *Clinical Evaluation of Language Fundamentals—Preschool (CELF-P*; Wiig, Secord & Semel, 1992). Receptive vocabulary was assessed using the *Peabody Picture Vocabulary Test III (PPVT-III*; Dunn & Dunn, 1997) and expressive vocabulary was evaluated with the *Expressive One Word Picture Vocabulary Test—Revised (EOWPVT-R*; Gardner, 1990).

Speech-language samples—To assess children's speech and language production in a more naturalistic manner, 30-minute speech and language samples were collected and videorecorded for later coding, transcription, and analysis. A subset of toys used in the longitudinal portion of the investigation were used to elicit the language samples at age 3 (i.e., a doll and related toys and a picnic set). Children sometimes played with their own toys and books as well. All children interacted with the investigator during the sample, and some interacted with their mother as well.

The language samples were transcribed orthographically according to the conventions provided by *Systematic Analysis of Language Transcriptions*, *Version 7.0* (*SALT;* Miller & Chapman, 2002). For 5 of the 6 children, 100 complete and intelligible child utterances from each language sample were analyzed in *SALT*. Following *SALT* guidelines, utterances were considered unintelligible if the transcriber could not understand the utterance after listening to it three times. For S6, only 75 complete and intelligible utterances from the 30-minute language sample could be obtained, due to both her high rate of unintelligibility and low rate of utterances per minute. *SALT* analyses were conducted in order to determine mean length of utterance (MLU), number of different words (NDW), and total number of words (TNW). These measures have been used as measures of grammatical development, semantic diversity, and overall verbal facility, respectively, for both children with normal language and children with language delays and disorders (Klee, Schaffer, May, Membrino & Mougey, 1989; Miller, 1991; Klee, 1992; Miller & Klee, 1995). Each child's MLU, NDW, and TNW were then compared to those of girls within 6 months of her age, according to the normative data available in the *SALT* database.

A portion of each sample was used for phonological analysis. At least 250 words of which 90 were different words, as recommended by Shriberg and Kwiatkowski (1982), were transcribed phonetically and then entered into *LIPP.* Due to the limitations of S6's sample, only 180 total words of which 77 were different words were transcribed and analyzed. Broad transcription was done in *LIPP*. Each child's percentage of consonants correct (PCC) and phonological process usage were then calculated automatically using *LIPP* analyses. Each phonological process that occurred in each child's speech sample in 20% or more of the opportunities for its occurrence and appeared at least twice was reported. Consonant occurrences in the word-initial and word-final positions were also determined. Following Ingram's (1981) criterion of frequency guidelines, phonemes that occurred at least 4 times were included in the inventories of S1, S2, S3, S5, and S6. Consonants that occurred at least 5 times were included in S4's inventory.

Reliability—Approximately 15% of the words from each child's *GFTA-2* (8 words per *GFTA-2*) were selected randomly and transcribed for reliability. Since scores on the *GFTA-2* are determined by how many of the targeted phonemes in the words on the test are produced correctly, reliability was calculated by determining the transcribers' agreement on whether the target phonemes were produced correctly. Agreement was 80%.

Approximately 15% of the language samples (i.e., 15 utterances from the middle of each child's sample, for a total of 90 utterances) were transcribed. Agreement on the transcription of individual words was 85%, and agreement on utterance segmentation was 92%.

Approximately 15% of each sample used for phonological analysis (38 continuous words per sample) was randomly selected for transcription. The *Kreliab* analysis was again used to determine agreement for the transcription of consonants, as described above. Overall consonant agreement was 98%, while agreement rates on the individual samples ranged from 96% to 99%.

Results

Longitudinal

Using results from the *CDI*, growth curves for each child were plotted according to age, depicting expressive vocabulary growth, as shown in Figure 1. In Figure 1, curves representing the 10th, 25th, 50th, 75th and 90th percentiles, as provided by the normative information in the *CDI* technical manual, were also plotted in order to illustrate how each child's development compared to that of US-born children. Additionally, growth curves for each child were plotted according to months post-adoption in Figure 2.

Growth curves for S1, S2, S3, and S5 were generally between the 10th and 50th percentile curves, while S4's and S6's were far below the 10th percentile curve (see Figure 1). S1's vocabulary production was generally in the 40th – 50th percentile range throughout the study, and S3's vocabulary was around the 15th percentile. S2's vocabulary fluctuated between the 15th and 55th percentiles, with notable increases from 19 months to 22 months to 26 months of age. S5's vocabulary shifted from the 25th percentile at 17 months of age, up to the 75th at 24 months, and down to the 20th at 28 and 30 months. S4 also experienced a vocabulary spurt: from age 32 months to 35 months, her vocabulary grew from 125 words to 418 words, an 8-month jump in age equivalencies. Though S6's vocabulary grew throughout the study, it remained low at the end of the study (303 words at age 36 months), and she did not appear to experience any large spurts in vocabulary growth.

When examined according to months post-adoption (see Figure 2), the children seem to fall into two groups. The first group (S1 and S5) experienced rapid vocabulary growth immediately after adoption. The other group (S2, S3, S4, and S6) demonstrated low vocabulary levels throughout the first year post-adoption. S2 and S4 then experienced dramatic vocabulary spurts. S2's was from 8 to 15 months post adoption, and S4 spurted from 16 to 19 months post adoption. S3's and S6's rates of vocabulary growth were more uniform.

In two cases (S2 and S5), the mother reported a decrease in number of words produced from one data collection point to the next one. In neither of these cases did the mother express that her child's vocabulary or any other area of language development had appeared to decline. At the time each mother returned the *CDI*, neither the examiner nor the mother was aware that a decrease in expressive vocabulary was being reported. Perhaps the mother simply completed the form less thoroughly and omitted words her daughter indeed produced. Alternatively, the mother may have overestimated her daughter's vocabulary production on previous *CDI* forms.

Six months post-adoption

Overall, the analyses of vocalizations at 6 months post-adoption indicated normal infraphonological and phonological development. Children's individual performances on each analysis are reported in Table II.

The children's rates of vocalization varied from 2.4 vocalizations per minute to 12.2 vocalizations per minute. S3's and S6's rates (2.4 and 2.7, respectively) were noticeably lower than the others' rates. S1's rate was noticeably higher than the others', at 12.2.

Canonical babbling ratios ranged from .22 to .83, indicating that all of the children had reached the canonical babbling stage (Lynch, Oller, Stephens, Levine & Basinger, 1995). S2's and S5's ratios were the highest at around .80, and S4's was the lowest at .22. The ratios of the three remaining children (S1, S3, and S6) were around .50.

Phonetic inventories for consonants in the initial and final positions are reported in Table II. Stops, nasals, and glides are among the most common consonants in young children's phonetic inventories, and anterior sounds are more common than posterior ones (Locke, 1983; Stoel-Gammon & Cooper, 1984; Stoel-Gammon, 1985; Vihman, Ferguson & Elbert, 1986; Locke, 1989). These types of sounds were common in the inventories of the children studied here. S2 and S5 also produced a fricative, /s/.

Each child produced at least 3 different phones in the initial position. Number of phones in the final position ranged from 0 to 2. These inventory sizes are comparable to those of typically developing, US-born young children (Stoel-Gammon, 1985). Stoel-Gammon reported that at 15 months of age, the number of different consonants in the initial position ranged from 2–5, with a mean of 3.4 consonants. S2 and S3, both 16 months old at this data collection point, produced 6 and 3 initial consonants, respectively. At 18 months, initial consonants increased to 2–10, with a mean of 6.3, for non-adopted children (Stoel-Gammon). S6 and S1, 18 months and 20 months, respectively, both produced 4 initial consonants. S5 (21 months) and S4 (23 months), the oldest children at 6 months post-adoption, produced 7 and 3 initial consonants, respectively. These inventories are similar to those of Stoel-Gammon's 21 month olds, who produced 2–13 initial consonants, with a mean of 6.7 consonants.

The internationally adopted children's final consonant inventories were also similar to those of US-born children (Stoel-Gammon, 1985). The 16 month olds, S2 and S3, produced 1 and 0 final consonants, respectively. This finding is very similar to that of Stoel-Gammon, who found that typically developing, US-born 15 month olds produced 0–2 final consonants, with a mean of .6 consonants. Stoel-Gammon's group of 18 month olds produced 0–6 final consonants, with a mean of 2.8 consonants. Similarly, S6 (18 months) and S1 (20 months) produced 1 and 0 final consonants, respectively. S5 (21 months) and S4 (23 months) produced 2 and 0 final consonants. Again, these findings were similar to those of Stoel-Gammon's group of 21 month olds, who produced a range of 0–7 final consonants (mean 3.6). Interestingly, though the number of different consonants in each child's inventory was within the range produced by Stoel-Gammon's groups of similar ages, four of the six children's (S1, S3, S4, and S6) initial inventories were below the mean, and five children's (S1, S3, S4, S5, and S6) final inventories were below the mean.

Children's lexical productions during the 6 months post-adoption communication samples were examined. (See Table II). The number of words produced in the 100-vocalization sample ranged from 7 (S4) to 41 (S5). The four other children produced approximately 25 – 30 words. The number of different words produced ranged from 3 (S3) to 18 (S2 and S5).

Instances of triadic communication (as defined above) that accompanied each vocalization ranged in number from 41 (S3) to 91 (S6). (Refer to Table II). It is difficult to compare these findings directly with those of many other researchers, whose measurements of triadic communication were not tied to children's vocalizations and whose operational definitions of triadic communication were narrower than the one used in this investigation (e.g., Wetherby, Cain, Yonclas & Walker, 1988; Mundy, 1995; Yoder et al., 1998). When the triadic communication definition was similar to the one used here, Bakeman and Adamson (1984) found that typically developing infants ages 12 to 18 months engaged in "passive joint attention" approximately 20% of the time in sessions with their mothers. The findings of the present investigation (i.e., that 41% to 91% of each child's vocalizations were associated with triadic communication) indicate that all of the children engaged in triadic communication with their parents, which is expected of typically developing children this age.

Age 3

Standardized Measures—As did the longitudinal data and early vocalization data, outcome data at age 3 indicated considerable variability in the speech and language skills of the children studied. (Refer to Table III and Figure 3). On the *CELF-P*, S1's Total Score (117) was greater than 1 *SD* above the mean, while S6's Total Score (69) was greater than 2 *SD*s below the mean. Of the 4 children whose scores were within 1 *SD* of the mean, there was some variation: S2, S3, and S5 all received scores of 104, and S4 scored 91. In addition, relative differences between receptive and expressive language abilities were detected in some children. While S3 scored the same on both the receptive and expressive scales of the *CELF-P*, S1 scored slightly higher on the receptive portion, S2, S4, S5, and S6 scored higher on the expressive subtests.

Children's scores on the receptive and expressive vocabulary tests showed a similar pattern. On the *PPVT-III*, a test of receptive vocabulary, S1 scored more than 1 *SD* above the mean, while S6 scored more than 2 *SD*s below the mean. S2, S3, S4, and S5 all scored within 1 *SD* of the mean on the *PPVT-III*. S4's score (86), however, was notably lower than the others' and was almost a full *SD* below the mean. With only one exception, all children's scores on the *EOWPVT-R*, a measure of expressive vocabulary, were within 1 *SD* of the mean. S1's score (119) was greater than 1 *SD* above the mean. S4's and S6's scores of 85 and 88, respectively, approached being 1 *SD* below the mean. Four children's (S1, S2, S5, and S5) performance on the expressive vocabulary test was better than their performance on the receptive one, relative to same-age peers. S3 and S4 demonstrated the opposite pattern, with higher scores on the *EOWPVT-R* than the *PPVT-III.*

The *GFTA-2* measured children's ability to produce sounds correctly in words. Once again, S6 scored more than 2 *SD*s below the mean, while the other children's scores were within 1 *SD* of the mean. Interestingly, S1, who scored above the normal range on the language measures, received a score on the *GFTA-2* that bordered on below normal. Her errors were mainly due to stopping fricatives. More specific information about the children's phonological development is given below.

Speech-language samples

Language analyses: On all measures of the spontaneous language samples, there was considerable variability. (Refer to Table IV). Mean length of utterance (MLU), a general measure of grammatical development, ranged from 1.9 (S6) to 4.0 (S2). While most of the children's MLUs were within 1 *SD* of the mean of girls' their age, according to the normative data available in the *SALT* database, one child's (S3) was 1–2 *SD*s below the mean and another's (S6) was more than 2 *SD*s below the mean. Number of different words (NDW), a measure of semantic diversity, ranged from 72 (S6) to 132 (S1). While S1, S2, and S3 were within 1 *SD* of the mean on this measure, S4, S5, and S6 were 1–2 *SD*s below the mean. Total number of words (TNW), a measure of overall verbal facility, ranged from 137 (S6) to 375 (S2). S1, S4, and S5 were within 1 *SD* of the mean on this measure. S2 scored 1–2 *SD*s above the mean. S3 was 1–2 *SD*s below the mean, and S6 was more than 2 *SD*s below the mean.

Phonological analyses: Analyses of spontaneous speech were used to determine each child's phonetic inventory. (See Table V). The number of consonants in each child's inventory varied from 9 (S6) to 15 (S3) in the initial position and 4 (S6) to 10 (S5) in the final position. By age 3, children are expected to produce sounds from all sound classes (Grunwell, 1985). All of the children in this study except S6 produced labials, alveolars, velars, and the palatal /j/. S6 did not produce velars. Most of the children's inventories also included a variety of stops, nasals, glides, fricatives, and the liquid /l/. S1 and S6, however, did not produce any fricatives in the initial position and only produced a minimal number of fricatives in the final position. S4 failed to produce any liquids.

Percentages of consonants correct ranged from 68% to 86%. (See Table V). When compared to reference data for three year olds (Austin and Shriberg, 1997), five of the children's PCCs were within 1 *SD* of the mean (M = 80.9; *SD* = 7.1). S6's PCC of 68% placed her nearly 2 *SD*s below the mean.

Phonological process use is also reported in Table V. The most frequently used processes were gliding, stopping, and cluster reduction, all common in the speech of 3 year olds (Grunwell, 1981; Stoel-Gammon & Dunn, 1985). S3 used only one process in more than 20% of the opportunities available in her speech sample: she used gliding 56% of the time. S5 used cluster reduction (20%) and frequently used gliding (60%). S2 also used 2 processes: stopping (25%) and gliding (33%). S4 used 3 processes: cluster reduction (20%), stopping (22%), and a high percentage of gliding (56%). S1 used the same 3 processes: cluster reduction (31%), a high percentage of stopping (61%), and gliding (27%). S6 used cluster reduction (40%) and stopping (47%). S6's speech sample also contained two uncommon patterns: she added initial consonants on 3 occasions and created clusters on 3 occasions.

Discussion

Of the six children adopted from China that were followed in this study, five demonstrated normal or above normal speech and language skills at age 3, when their performance was assessed using the normed data of monolingual, English-speaking children born in the US. The speech and language skills of S2, S3, S4 and S5 were within normal limits, and the majority of S1's abilities were above normal. S6's scores were below the normal range.

Children's expressive vocabulary development was measured longitudinally. Though their rates of vocabulary development varied, the size of their vocabularies generally increased over time. Four of the children's (S1, S2, S3, and S5) vocabularies were within normal limits when compared to monolingual, English-speaking, US-born children. S4 and S6 demonstrated the lowest levels of expressive vocabulary development, with scores well below the normal range for non-adopted children. S4's language abilities appeared to spurt around 1 year post-adoption. At age 3, her abilities were within normal limits, though some of them approached the lower limits of the normal range. S6's scores remained below the normal range throughout the longitudinal testing and at age 3 years.

The findings of this study can be compared to other recent investigations of language development in internationally adopted children. In an investigation of the early language development of young children adopted from Russia and Eastern Europe, Glennen and Masters (2002) found that the language development of children adopted prior to 12 months of age had caught up to that of non-adopted children by 24 months of age, and children adopted between ages 13 and 18 months caught up by 37–40 months of age. The findings of this investigation were similar. The language development of S2 and S3 (both adopted prior to 12 months of age) had caught up by 24 months of age. S6 was also adopted before 12 months of age; however, her language development had not caught up by 24 months of age, or even 36 months of age. The language development of S1, S4, and S5 (adopted between 13 and 18 months of age) had caught up by 36 months of age.

Detailed analyses of communication samples collected at 6 months post-adoption were conducted. A three-pronged approach was used to explore the children's early abilities across a range of communicative domains, including phonological, lexical, and social-communicative. The children's performances on these measures were varied. Perhaps the most important conclusion that can be drawn from these data is that all of the children appeared to display typical infraphonological, phonological, lexical, and social-communicative development 6 months after their adoption. At 6 months post-adoption, each child produced canonical syllables, a range of consonants, and at least a few words. Each child also appeared to engage in age-appropriate social communication. Interestingly, S6, whose performance was significantly below the normal range on nearly all measures at age 3, appeared to have an intact communicative foundation, based on the analyses of her 6 months post-adoption vocalizations.

An important factor that may have influenced the results at 6 months post-adoption is normal, day to day variability in young children's vocalizations. For example, canonical babbling ratios have been found to vary considerably from session to session in laboratory settings (Lewedag, 1995). Though parents were asked and verified that their child's behavior was typical at each home visit, the video recordings may have captured some children's optimal performance and others' suboptimal performance. Furthermore, internationally adopted children may have a higher risk for psychosocial difficulties (Gunnar, Bruce, Grotevant, 2000; Ames & Chisholm, 2001); therefore, it is possible that some of the children experienced the home visit and the examiner's presence as more stressful than non-adopted children would have, adversely affecting their communicative performance. Lastly, S4's father, rather than her mother, participated in her 6 months post-adoption home visit. This was the only session, for any child, in which the father was the primary interactor with the child. Since fathers' and mothers' communication with their toddlers differ (Ratner, 1988; Tomasello, Conti-Ramsden & Ewert, 1990), this factor may have affected S4's communication sample.

In previous research, children internationally adopted at younger ages and thus, institutionalized for shorter periods of time, have been found to fare better developmentally (e.g., Morison et al., 1995). However, in this small sample, neither age at adoption nor length of time institutionalized (vs. time spent in foster care) appeared to be related to outcome. For example, S3 was youngest at adoption (9 months of age); however, her age 3 outcome scores were not the highest. It should be noted, though, that the age range at time of adoption was rather restricted and spanned only 9 to 17 months.

Interestingly, level of parental concern regarding speech and language development at study intake, as indicated on the background questionnaire, appeared to be associated with outcomes at age 3. The mothers of S1, S2, S3, and S5 all indicated "no concern" about their child's communicative development. S4's mother indicated "moderate concern," while S6's mother indicated "mild concern." Though only S6's language remained behind that of her adopted and non-adopted peers at age 3, S4's caught up relatively late, and many of her age 3 outcome scores bordered on below-normal. When combined with language survey results, level of parental concern has been found to be a sensitive indicator of language-learning difficulties in young US born children (Klee, Pearce & Carson, 2000).

Another intriguing observation is that both S1 and S5 spoke about 5 words in their Chinese language at the time of adoption. The other children had not yet begun to produce words in Chinese. S1 and S5 had the fastest rates of English expressive vocabulary development. This suggests that once the *naming insight* was achieved (Kamhi, 1986), vocabulary development proceeded quickly, even when the child was suddenly exposed to a *second first language*.

Five of the six children studied demonstrated normal or better speech and language ability at age 3, regardless of age at time of adoption and foster care vs. institutionalization. Moreover, S6's profile at 6 months post-adoption indicated that her communicative foundation was intact. This may suggest that she has a very good chance of blooming into the normal range in the coming years, as many US-born *late talkers* do (Paul, 1996). These findings lend strong support to the notion of the resilience of children's language learning capacity, as described by Goldin-Meadows (1985, 1997). Despite the abrupt switch in language and cultural environments and, in some cases, residing in an orphanage in the very formative first year of life, five of the children had acquired normal communication abilities by age 3.

Because of the close relationship between "second first language" acquisition and bilingual acquisition, it is possible that some of the effects on cognitive development that have been associated with bilingualism may also be evident in second first language learners (Roberts et al., 2005). Some research findings indicate a positive association between bilingualism and cognitive development. For example, bilingual children have outperformed their monolingual peers on a variety of tasks, including those that require cognitive control and the ability to block out distraction (Bialystok & Majumder, 1998; Bialystok, 1999), as well as tasks that require children to seek out and apply rules (Ben Zeev, 1977). Bilingual children have also demonstrated greater metalinguistic awareness (Bialystok, 1988, 1991). This may help account for the positive results seen in some of the children in the current investigation.

The children's relatively good phonological performance may also be at least partially explained by their experience with their Chinese dialect. Dodd and colleagues reported that children learning Putonghua (Modern Standard Chinese) and Cantonese acquire consonants more quickly than English-learning children (So & Dodd, 1995; Hua & Dodd, 2000). Both Putonghua and Mandarin contain fewer phonemes than English, making each phoneme carry relatively more phonological saliency. Therefore, exposure to Chinese languages may have given the children a "head start" on the acquisition of phonemes, which may have, in turn, carried over to the children's acquisition of English phonemes. However, if syllables rather than phonemes are the primary organizational units in the phonologies of Chinese languages, as has been speculated, exposure to Chinese would not likely result in this advantage.

The findings of this investigation also support the notion that there are many paths of normal speech and language development. Each child's developmental path was truly unique. For example, some children acquired many words in English very rapidly after their adoptions. Others experienced slower growth rates initially and then "spurted" about a year after their adoption.

Several factors limit the conclusions that can be drawn from this study. Only six children were studied. Given the widespread individual variation in speech-language development, general trends may only become apparent when much larger groups are studied. In addition, the initial assessments of children's vocabulary only considered their knowledge of words in English. However, their vocabulary knowledge was possibly distributed across two languages, both English and their Chinese dialect, at this point, similar to the vocabularies of bilingual children (Oller, Pearson & Cobo-Lewis, in press). If the initial assessments had been conducted sooner after adoption, this possibility would be stronger. It also would have been interesting to assess the children's overall developmental status and consider their language development in a broader context.

Future investigations are also needed to explore internationally adopted children's speech-language development over longer periods of time. A major question that remains is whether or not the course of early language development in internationally adopted children sets the stage for typical development throughout the school-aged years, when language demands increase, or if language weaknesses undetected in the early years will surface later. Longer term outcomes in language and academic performance should be investigated.

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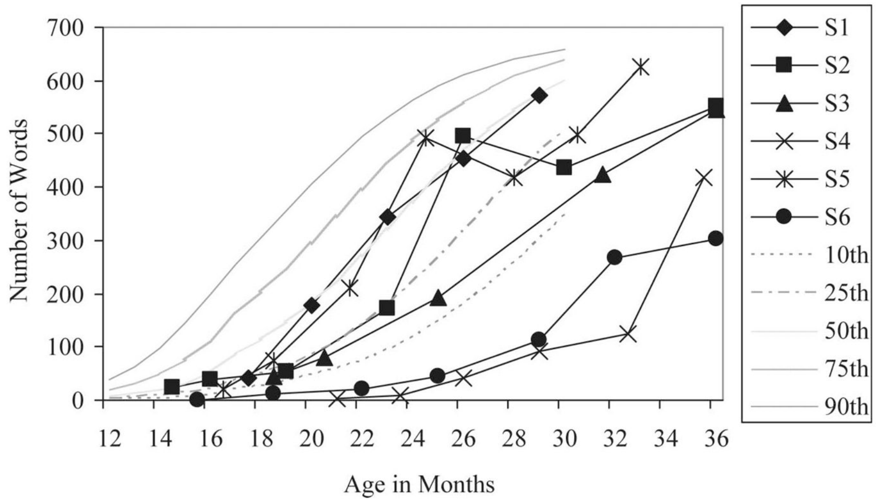

Figure 1.
CDI words produced by age in months.

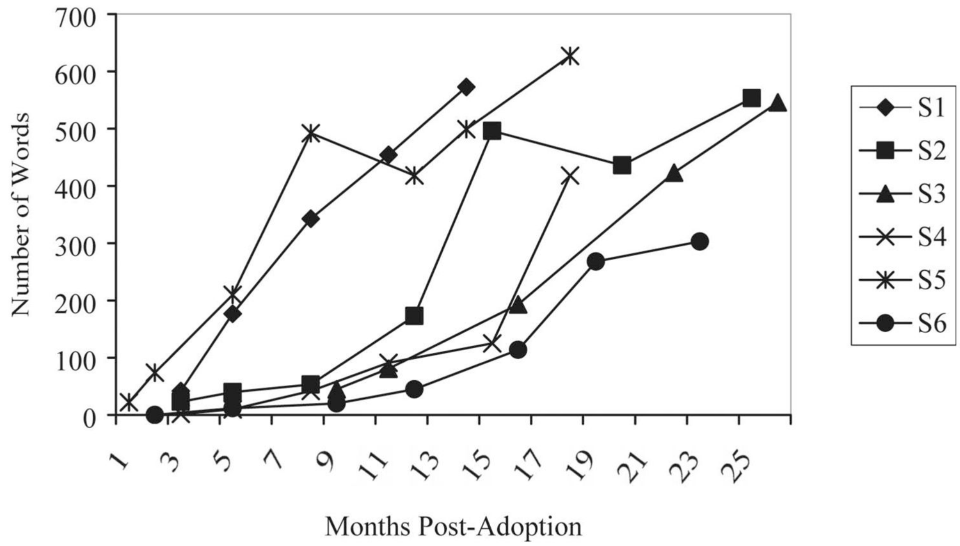

Figure 2.
CDI words produced by number of months post-adoption.

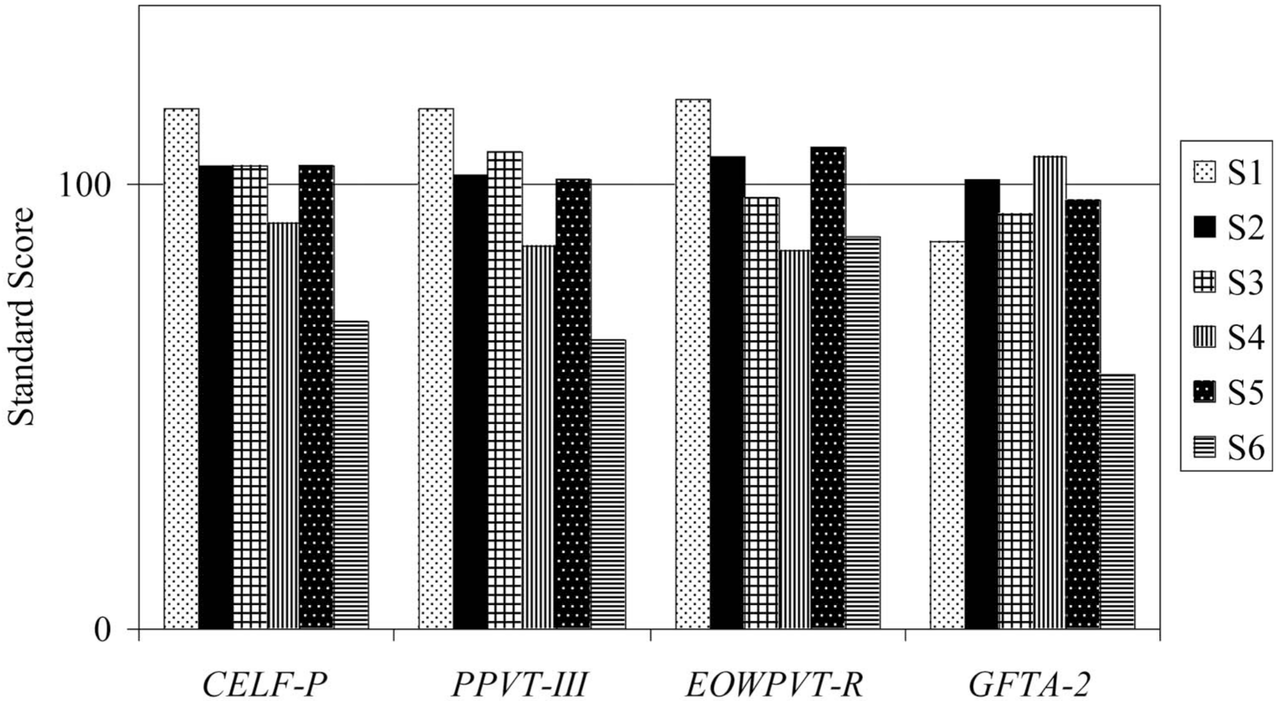

Figure 3.
Standard scores at age 3.

Table I

Summary of background information.

	Orphanage	Foster care	Adoption age	Words in chinese	Parental concern	Weight %ile at adoption	Height %ile at adoption
S1	None	13 months	15 months	5 words	None	35^{th}	25^{th}
S2	11 months	None	11 months	None	None	97^{th}	60^{th}
S3	Days	Nights	9 months	None	None	20^{th}	$<3^{rd}$
S4	14 months	None	17 months	None	Moderate	90^{th}	Not available
S5	4 months	9 months	16 months	5 words	None	45^{th}	50^{th}
S6	2 weeks	12 months	13 months	None	Mild	80^{th}	30^{th}

Table II

Communicative development at 6 months post-adoption.

	Infraphonological/Phonological				Lexical		
	Vocs/Min	CBR	Initial Cs	Final Cs	No. words	No. Diff. Words	Social Triadic communication
S1	12.2	.50	4 (b, d, m, w)	0	31	8	81
S2	5.8	.83	6 (b, d, t, g, s, w)	1 (s)	26	18	78
S3	2.4	.52	3 (b, p, t)	0	25	3	41
S4	4.1	.22	3 (b, k, n)	0	7	4	43
S5	7.0	.80	7 (b, d, t, k, m, s, j)	2 (t, s)	41	18	68
S6	2.7	.53	4 (b, m, n, j)	1 (m)	30	6	91

Table III

Age 3 standard scores.

Child	*CELF-P* Receptive *X* = 100; *SD* ± 15	*CELF-P* Expressive *X* = 100; *SD* ± 15	*CELF-P* Total *X* = 100; *SD* ± 15	*PPVT-III* *X* = 100; *SD* ± 15	*EOWPVT-R* *X* = 100; *SD* ± 15	*GFTA-2* *X* = 100; *SD* ± 15	Composite score
S1	120	114	117	117	119	87	111.4
S2	102	106	104	102	106	101	103.4
S3	104	104	104	107	97	93	101.0
S4	87	96	91	86	85	106	92.0
S5	96	114	104	101	108	96	103.0
S6	69	73	69	65	88	57	70.4

Note: Composite score based on average of five standard scores (*CELF-P* Receptive, *CELF-P* Expressive, *PPVT-III, EOWPVT-R,* and *GFTA-2).*

Table IV

Language sample results at age 3.

	MLU	NDW	TNW
S1	3.6	132	349
S2	4.0	123	375^
S3	2.7*	107	240*
S4	3.3	99*	294
S5	3.6	83*	341
S6	1.9**	72*	137**

*1–2 *SD*s below the mean,

**2 or more *SD*s below the mean,

^1–2 *SD*s above the mean.

Table V

Phonological development at age 3.

	Initial Cs	Final Cs	PCC	Processes
S1	10 (b, p, d, t, g, k, m, n, w, j)	8 (p, d, t, k, m, n, s, l)	77%	Cluster reduction (31%) Stopping (61%) Gliding (27%)
S2	15 (b, p, d, t, g, k, m, n, f, s, Σ, ð, w, j, l)	9 (p, d, t, k, n, z, s, r, l)	82%	Stopping (25%) Gliding (33%)
S3	13 (b, p, d, t, g, k, m, n, f, s, w, j, l)	8 (d, t, k, m, n, z, s, l)	86%	Gliding (56%)
S4	12 (b, p, d, t, g, k, m, n, f, s, w, j)	7 (p, d, t, k, n, z, s)	78%	Cluster reduction (20%) Stopping (22%) Gliding (56%)
S5	10 (b, p, d, t, k, m, n, s, w, j)	10 (p, d, t, k, m, n, f, z, s, l)	76%	Cluster reduction (20%) Gliding (60%)
S6	9 (b, p, d, t, m, n, w, j, l)	4 (d, t, n, z)	68%	Cluster reduction (40%) Stopping (47%)