Running Head: INTERNATIONAL ADOPTION AND LANGUAGE DEVELOPMENT

Starting Over:

International Adoption as a Natural Experiment in Language Development

Jesse Snedeker and Joy Geren

Harvard University

Address Correspondence to:

Jesse Snedeker

1136 WJH, 33 Kirkland St.

Cambridge MA, 02138

617-495-3873

snedeker@wjh.harvard.edu

Word Count: 4000 (main text, footnotes & author note)

Abstract

Language development is characterized by predictable shifts in the words children learn and the complexity of their utterances. Because acquisition typically occurs simultaneously with maturation and cognitive development, it is difficult to determine the causes of these shifts. We explored how acquisition precedes in the absence of possible cognitive or maturational roadblocks, by examining the acquisition of English in internationally-adopted preschoolers. Like infants, and unlike other second-language learners, these children acquire language from child-directed speech, without access to bilingual informants. Parental reports (CDI-2) and speech samples were collected from 14 preschoolers, 3 to 18 months after they were adopted from China. These children showed the same developmental patterns as monolingual infants (matched for vocabulary size). Early on, their vocabularies were dominated by nouns, their utterances were short, and grammatical morphemes were generally omitted. Children at later stages had more diverse vocabularies and produced longer utterances with more grammatical morphemes.

Keywords: language development, international adoption, word learning, syntax, language production, nouns, verbs

Language development is marked by a series a qualitative shifts. Infants speak in single-word utterances for several months before beginning to combine words. Young children learn a disproportionate number of nouns before acquiring a balanced complement of verbs, adjectives and prepositions. Young English speakers typically omit function morphemes from their early word combinations, and then gradually begin to add them in. A central question in language acquisition is what causes children to move through these phases (Lenneberg, 1967, Bloom, 1973, Gleitman & Newport, 1995, Ganger, Pinker, Chawla & Baker, 2004). Are the early stages reflections of cognitive immaturity or do they represent necessary steps in decoding the target language? Is the emergence of new linguistic abilities driven by maturation or by the child's growing knowledge of the language? These questions are difficult to answer because language acquisition is confounded with cognitive development and maturation in typically developing children.

However much of what we know about language development comes from studies of atypical populations. Research on aphasics suggested there might be a critical period for language acquisition (Lenneberg, 1967), a hypothesis confirmed by studying adults deprived of linguistic experience in childhood (Newport, 1990). Research on blind children (Landau & Gleitman, 1985), linguistic isolates (Goldin-Meadow & Feldman, 1977), and children with limited language models (Singleton & Newport, 2004) has been central in demonstrating the resilience of children's linguistic abilities. These natural experiments allow us to explore the effects of variables that are impossible or unethical to manipulate.

International adoption provides the opportunity for just such a natural experiment. Over 20,000 internationally-adopted children enter the U.S. each year (U.S. Department of State,

2005). While most are infants or toddlers, thousands of older children are also adopted. Typically these children rapidly lose their birth language (Glennen & Masters, 2002). By adulthood, they fail to distinguish speech in their birth language from an unknown language and show no cortical activations that distinguish them either (Pallier et al., 2003). Most of these children are adopted well within the sensitive period for language acquisition (Newport, 1990) and become fluent speakers of their new language (Pallier, et al., 2003). But we know almost nothing about how they get there. Recent studies show that internationally-adopted infants make rapid progress in acquiring English (Glennen & Masters, 2002). But there is no existing data on older adoptees.

The learning problem faced by these children is broadly similar to that of infants learning their first language: they are exposed to child-directed speech in the context of daily routines; they must learn the new language to communicate with their families; they have little access to text or bilingual informants; and they lack many of the metalinguistic abilities available to older children and adults (Gombert, 1992). However, these children are more cognitively and physically mature than their infant counterparts and have already started to learn one language.

The current study compares language acquisition in internationally-adopted preschoolers and monolingual infants. Our goal is to explore the role that cognitive development and maturation play in shaping the course of first-language acquisition by examining how acquisition proceeds when these road blocks have been removed. By doing this we hope to tease apart two very broad kinds of explanation for systematic changes during language acquisition:

1) **Developmental Hypotheses:** Theories of this kind attribute the order of acquisition or the emergence of new abilities to changes in the learner which are independent of the child's experience with a given language. Immaturity constrains language acquisition, limiting the kinds of words that a child can learn, the kinds of representations she can create or

the kinds of utterances she can produce. When these roadblocks are removed, either by biological maturation or cognitive development, children can acquire new linguistic abilities.

2) **Contingent-Acquisition Hypotheses:** These theories attribute the order of acquisition to the interdependence of different linguistic representations or processes. The emergence of new abilities is driven by the child's growing knowledge of the language. If knowledge of form A is necessary for acquiring form B, then the acquisition of B will have to await the acquisition of A.[1]

Critically, this distinction is orthogonal to the nativist/empiricist and domain-specific/domain-general dichotomies that organize theoretical discourse on language development. Thus there are developmental hypotheses which invoke the maturation of language-specific innate abilities, such as Wexler's optional infinitive hypothesis (1998), and others which invoke domain-general changes in memory and representational abilities (Shore, 1986). Likewise, there are contingent-acquisition hypotheses which are grounded in innate domain-specific knowledge of language (Snedeker & Gleitman, 2004) and others which rely on domain-general learning mechanisms (Bates & Goodman, 1997).

The popularity of theories linking language development to cognitive development has waned with the erosion of Piagetian dominance in developmental psychology. The failure to find robust correlations between linguistic milestones and Piagetian tasks led some observers to conclude that general cognitive factors are unlikely to account for broad changes in language development (for discussion see Gopnik & Meltzoff, 1997). However, we know of no conclusive evidence against developmental hypotheses. Patterns of association and disassociation do not bear directly on developmental accounts which are domain-specific and maturational. Furthermore, recent examinations of acquisition in children with developmental

disorders suggest that language and cognitive development may be closely associated during early childhood (for a review see Thomas & Karmiloff-Smith, 2005). The rise of domain-specific accounts of cognitive development merely increases the number of possible cognitive precursors to linguistic skills.

This paper explores two patterns in early language development that could be explained by either developmental hypotheses or contingent acquisition. We begin by describing these patterns, then we briefly examine why prior research on second-language acquisition has not resolved these issues.

Changes in Vocabulary Composition

Children's early vocabularies are dominated by nouns that refer to people, animals, and moveable objects. Although adults speak to children in full sentences, complete with verbs and function words, these elements are massively underrepresented in children's early vocabularies (Gentner, 1982, Bates, Dale & Thal, 1995) This is true not only in English but also in languages like Mandarin and Korean where verbs frequently occur in perceptually salient positions (for review see Gentner & Boroditsky, 2001). This input-output disparity can be plausibly attributed to the conceptual limitations of young children (Macnamara, 1972; Huttenlocher, Smiley & Ratner, 1983). Perhaps the relative dearth of verbs and adjectives is attributable to the infant's inability to conceive of relations, states or actions, while the overabundance of nouns is attributable to the conceptual primacy of object categories.

Alternately the changing composition of children's lexicons could reflect linguistic rather than conceptual growth (Gillette, Gleitman, Gleitman, & Lederer, 1999; Snedeker & Gleitman, 2004). An infant who is just breaking into language has to learn the meanings of words by observing the situational contexts in which they are used. Older children, who have already

acquired sizeable vocabularies, can also use the sentence in which the word appears. To simulate the effects of linguistic development in the absence of cognitive limitations, Gleitman and her colleagues have asked adults to identify words from different representations of the contexts in which they occurred in child-directed speech (Gillette et al., 1999; Snedeker, Li & Yuan, 2003; Snedeker & Gleitman, 2004). When the adults were limited to situational cues, they could only identify the concrete nouns. But when given information about the linguistic context, they were able to learn the verbs as well.

These human simulations demonstrate that changes in vocabulary composition are not necessarily attributable to changes in the learner's conceptual repertoire. But there are several differences between these studies and the experiences of young language learners which might limit the validity of the simulations. In contrast, the task and input of internationally-adopted children appear to closely parallel those of infant learners. Like infants, adopted children get prolonged exposure to their new language in the context of meaningful social interactions. Like infants they must simultaneously isolate the words and determine what they mean. However, like the adults in Gleitman's simulations, adopted children are more cognitively mature than infants. If shifts in vocabulary composition primarily reflect the changing cognitive capacities of the learner, then adopted children should acquire words from a variety of categories, much like their monolingual age mates. If vocabulary composition is largely a function of children's linguistic knowledge and its effects on their representation of the input, than adopted children should initially be restricted to the types of words learned by infants.

Early Grammatical Development

Similar questions have been raised about the role of maturation and cognitive development in children's early combinatorial speech. For months after they begin speaking, infants are

typically limited to one-word utterances. The appearance of word combinations has been attributed to motor and cognitive development and linguistic maturation, as well as the accumulation of linguistic knowledge (Bloom, 1973; Shore, 1986, Bates, et al., 1995). At around 24 to 30 months, children show a second burst of syntactic activity, adding determiners, auxiliaries and inflectional markers to their formerly sparse utterances (Brown, 1973).

Both of these shifts are strongly correlated with productive vocabulary size raising the intriguing possibility that lexical growth is causally related to syntactic development (Bates & Goodman, 1997). In support of this hypothesis, Bates and her colleagues demonstrated that these correlations hold up in atypical populations such as early-talkers, late-talkers and children with Williams Syndrome (Bates & Goodman, 1997). However, these studies cannot rule out the possibility that both lexical and syntactic acquisition depend upon the development of some other cognitive ability, one which is accelerated for early-talkers, delayed for late-talkers, and selectively spared in Williams Syndrome (e.g., auditory memory). We can test this hypothesis by examining the relation between lexical and grammatical development in adopted preschoolers. If they are causally linked, then the relationship should persist in maturationally-advanced learners. In contrast if the correlation is created by rate-limiting development in another domain, then it should be possible to find disassociations in older learners.

Comparing first and second language acquisition

Many other researchers have explored the parallels between first and second language acquisition, finding both similarities and discrepancies (see Clahsen, 1990; Ellis, 1994; Freeman & Freeman, 2001 for discussions). But none of this existing work addresses the questions that motivate this study. L2 researchers have typically focused on the development of specific syntactic constructions that appear somewhat later in first-language development (e.g., negation).

There is little work on the composition of the lexicon in L2 learners and no work that examines the relationship between early lexical and grammatical development. Furthermore, the most commonly studied populations, students receiving formal instruction or immigrants learning a language in the workplace or playground, are in language environments that are radically different from infants, making it unclear whether differences in acquisition are due to maturity or to differences in the learners' input and motivations.

Finally, most L2 studies have examined adults or children over six. Our goal is to find out whether cognitive changes occurring between 16 and 30 months of age shape early language acquisition. When we compare infants with adults we cannot isolate these effects from age-related changes that occur during middle childhood and adolescence. Since these later changes are known to alter acquisition (see e.g., Johnson & Newport, 1989), we have chosen to limit our study to children who begin acquiring English before 6.

Method

14 families with children adopted from China participated. The children were adopted between 2;7 and 5;1 (M = 4;2). Length of residence at the first session was 3 to 16 months (M = 8.1). Parents were invited to participate every 3 months until their child had been in the U.S. for 18 months. Thus each child participated in 1 to 5 sessions (M=2.4) and a total of 34 data points were collected. Children were excluded from participation if they had sensory, motor, or developmental disorders that might affect language.

Materials for the study were mailed to the parents who completed the MacArthur-Bates Communicative Development Inventory 2 (CDI-2) (Fenson, et al., 1993) and recorded a language sample in their home. The CDI-2 includes a 680-item vocabulary checklist and a 37-item forced-choice sentence-complexity measure, which asks about the child's use of inflectional

morphemes and closed-class words. The CDI-2 is normed for children 16-30 months (Fenson, et al., 1993), but has also been used with older children with limited English language skills (Berglund, Eriksson & Johansson, 2001). The language sample consisted of an hour-long recording of the parent and child playing with a standard toy set.

Parental reports for the adopted preschoolers were compared with those of monolingual infants who participated in earlier studies. Each session from an adopted child was matched to an infant with the same vocabulary size (±7%) on the parental report. The infant controls were 1;7 to 2;6 (M = 2;2).

Results

Children's Spontaneous Speech

The speech sample from the first session was transcribed, and the first 100 utterances were analyzed using the CLAN program (MacWhinney, 2000). These analyses validate the use of the CDI-2 with this population. The number of word types in the speech sample is highly correlated with CDI-2 vocabulary size (R^2=.54, F(1,12)=16.21, p <.005, R^2's are adjusted throughout). Parental reports also accurately reflect the kinds of words that the children use; the number of different nouns, verbs, and closed class items used by each participant correlates with the number that their parent endorsed on the CDI-2 (R^2=.22, F(1,12)=4.66, p=.052 for nouns; R^2=.38, F(1,12)=8.89, p <.05 for verbs; and R^2=.63, F(1,12)=25.52, p <.001 for closed-class words). Furthermore, the children's MLU is correlated with their score on the CDI-2 sentence-complexity metric, demonstrating that parents were sensitive to differences in the children's syntactic abilities (R^2=.32, F(1,12)=7.02, p < .05).

Rate of Acquisition

Since the number of sessions varied across participants, we conducted the CDI-2 analyses on the first data point contributed by each child, as well as on the entire data set. The results of the two analyses were quite similar and statistics for both are presented below.

Unsurprisingly, vocabulary size increased with the length of time that the child had spent in the U.S. As Figure 1 suggests, one participant was an outlier in this analysis, acquiring reliably fewer words than would be predicted at both observation sessions. With this participant removed, there is a robust logarithmic relation between time and vocabulary (R^2=.64, $F(1,11)=22.00$, $p < .001$ first session, R^2=.61, $F(1,30)=49.10$, $p <.0001$ all).[2] Age of arrival was not a significant predictor of vocabulary size (R^2's <.01, F's < 1.5, p's >.25) indicating that older adoptees did not learn words faster than young ones.

The logarithmic, or decelerating, growth curve contrasts sharply with the accelerating curve observed in infant learners (Fenson et al., 1994). We suspect that this reflects properties of the instrument rather than an actual deceleration in vocabulary growth. After 12 months many adoptees have developed beyond the point where the CDI provides an accurate estimate of their vocabulary size; in 54% of these sessions the children knew over 90% of the words and had presumably reached the instrument's ceiling. The secondary y-axis of Figure 1 allows us to compare vocabulary growth in the adopted children to the CDI-2 norms for infant learners (Fenson et al., 1993). After 3 months in the U.S., adopted preschoolers have vocabularies that rival 24-month-olds, who have been speaking for about a year. Thus, internationally-adopted preschoolers initially acquire words at roughly four times the rate of infants. This suggests that development or prior experience with a language can accelerate the initial pace of word learning. But we have no evidence that this advantage persists. Between month 3 and month 9, adopted

children make as much progress as the average infant does between 24 and 30 months, though ceiling effects in both groups make this finding difficult to interpret.

Vocabulary Composition

When children are near the ceiling of the CDI-2, vocabulary composition necessarily reflects the composition of the checklist. To ensure this did not unduly influence our findings, we removed observations where children had acquired over 90% of words from the analyses of all sessions. The remaining sample included 23 observations.

The adopted preschoolers show the same shifts in vocabulary composition as the infant learners (Figures 2-4). The proportion of nouns decreases linearly as the children's vocabularies grow (R^2=.49, $F(1,12) = 13.28$, p <.005 first, R^2=.54, $F(1,21) = 26.55$, $p < .001$ all). In contrast the proportion of verbs increases logarithmically with vocabulary size (R^2=.39, $F(1,12) = 9.27$, $p < .05$ first, R^2=.50, $F(1,21) = 22.89$, p <.001 all) and the proportion of closed-class items increases linearly (R^2=.72, $F(1,12) = 34.33$, p <.001 first, R^2=.69, $F(1,21) = 48.98$, p <.001 all). For each lexical class we compared the adoptees and controls with a paired t-test and a stepwise regression with vocabulary size, group and group * vocabulary as predictors. We found no reliable differences between the groups (t's< 1.1, p's >.25) and neither group nor group * vocabulary entered the regressions (F's < 1.3).

Grammatical Development

Infants typically begin combining words when they have a vocabulary of 50 to 200 words (Bates & Goodman, 1997). Since all of our participants had vocabularies over 150 words and were combining, we were unable to examine whether these events were linked. Instead, our analyses focused on the relation between vocabulary size and sentence-complexity scores, which are robustly correlated in infants when CDI-2 vocabulary is between 300 to 500 words (Bates &

Goodman, 1997). As Figure 5 illustrates, these two variables were also strongly correlated in the adopted children (R^2=.60, $F(1,12) = 20.52$, p <.001 first, R^2=.67, $F(1,32) = 67.20$, p <.001 all). There were no reliable differences between adoptees and infant controls (t's< 1.1, p's >.25). In the stepwise regressions, neither group nor group * vocabulary entered the analysis (F's < 1).

Discussion

The internationally-adopted preschoolers went through the same shifts in early language development as typically-developing infants. Like infants, they initially learned a disproportionate number of nouns, developing a more balanced lexicon over time. Like infants, their early utterances lacked inflectional morphemes and closed-class words, which were gradually added as vocabulary grew. In infants we might credit these shifts to general cognitive or maturational changes. However, these adoptees are substantially older, presumably they have acquired any possible cognitive and maturational pre-requisites for early language development.[3] Thus our results strongly suggest that these features of early language production are due to the nature of the learning problem rather than the limitations of infant learners.

Like any natural experiment this design has unavoidable confounds. Had we found qualitative differences between infants and adoptees, we would not have known whether they were attributable to maturation, experience with another language, or early deprivation. Because we found no qualitative differences, we can infer that none of these variables had a measurable effect or that two or more did so but tidily cancelled each other out. We consider the later possibility unlikely.

There is, however, one way in which the preschoolers differed from infant learners. While infants initially learn words quite slowly, the adoptees hit the ground running, going through the same stages as infants but more quickly. Thus while qualitative features of early acquisition are

not influenced by age or prior experience, the speed of acquisition is affected. Few existing proposals can account for the uniformity of this acceleration. Perhaps it reflects the development of domain-general processes affecting learning rate. Older children might require fewer exposures to link a word and a concept, or they might be more likely to encode the input or better able to retain it. Improvements in any of these processes during infancy could play a role in the acceleration of lexical development that typically occurs during the second and third year of life (Bates, Dale & Thal, 1995).

Research on early vocabulary composition has centered on Gentner's noun-dominance hypothesis (1982). The relation between our data and this hypothesis depends on how it is formulated. Many readers have interpreted it as a developmental hypothesis. For example, Hoff states (2001, p.157): "According to Gentner the relational meanings encoded in verbs are less available to young children through nonlinguistic experience. Thus, children acquire nouns before verbs because the concepts encoded by nouns are earlier cognitive developments than the concepts encoded by verbs." Our results clearly weigh against this interpretation of the hypothesis. If vocabulary shifts are driven by conceptual development then these shifts should not occur in the adopted preschoolers, since they presumably developed the relevant concepts as toddlers.

In subsequent writings, however, Gentner has rejected this developmental account arguing instead that the vocabulary shift is caused by the child's growing knowledge of how her language packages event components into words (Gentner & Boroditsky, 2001). For example, while English typically encodes manner of motion in the verb (*walk*) and path in the preposition (*up*), Spanish prefers to encode path in the verb (*ascender*, see Talmy, 1975). Although this is a contingent-acquisition hypothesis, it is not clear what predictions it makes for second-language

acquisition in childhood. If children simply attempt to map second-language labels onto the conceptual conflations provided in their first language, then we would expect precocious verb learning, to the degree that verb semantics in the two languages are aligned. We found no evidence of this in the adoptees, despite the fact that many common verbs in English and Chinese languages have similar meanings (Snedeker, Li & Yuan, 2003). On the other hand, if children attempt to map second-language labels directly to prelinguistic representations of event components, then the noun-dominance hypothesis would predict that second-language verb learning, like first-language verb learning, should initially be slow and effortful, accelerating as the child learns language-specific conflation patterns. Our data are consistent with this reading of the noun-dominance hypothesis as well as Gleitman's informational-change hypothesis.

Our claims are fairly modest and easily misconstrued. We are not suggesting that there are no maturational or cognitive prerequisites of early language development. To learn a language, a child must be able to perceive linguistic input, store it, analyze it, recall linguistic elements, and recombine them. Nor are we claiming that the time course of language acquisition is unaffected by maturation or cognitive development. For example, these data are consistent with theories where the onset of word production depends upon some prior maturational event.

We are merely arguing that two characteristic features of early language production—developmental shifts in vocabulary composition and the synchrony between vocabulary development and utterance complexity— need not be attributed to maturation or cognitive development. Maturation may explain why 15-month-olds produce words and 5-month-olds do not. But there is no need to invoke immaturity to explain why one-year-olds learn few verbs or fail to use grammatical morphemes. Older and wiser learners show similar lapses when they are placed in the same epistemic situation as the infant.

References

Bates, E., Dale, P.S., and Thal, D. (1995). Individual Differences and Their Implications for Theories of Language Development. In Fletcher, P. & MacWhinney, B. (Eds.), *The handbook of child language* (pp. 96-151), Oxford, England: Blackwell Publishers.

Bates, E. & Goodman, J. C. (1997). On the inseparability of grammar and the lexicon: Evidence from acquisition, aphasia, and real-time processing. *Language and Cognitive Processes. 12,* 507-584.

Berglund, E., Eriksson, M., & Johansson, I. (2001). Parental reports of spoken language skills in children with Down Syndrome. *Journal of Speech, Language and Hearing Research, 44,* 179–191.

Bloom, L. (1973) *One word at a time: the use of single-word utterances before syntax.* The Hague: Mouton.

Brown, R. (1973). *A first language: The early stages.* Cambridge, MA: Harvard University Press.

Clahsen, H. (1990). The comparative study of first and second language development. *Studies in Second Language Acquisition, 12,* 135-54.

Ellis, R. (1994). *The study of second language acquisition.* Oxford: Oxford University Press.

Fenson, L., Dale, P. S., Reznick, J. S., Thal, D., Bates, E., Hartung, J. P., et al. (1993). *MacArthur Communicative Development Inventories: User's guide and technical manual.* San Diego, CA: Singular.

Fenson, L., Dale, P.S., Reznick, J.S., Bates, E., Thal, D., & Pethick, S. (1994). Variability in early communicative development. *Monographs of the Society for Research in Child Development. 59(5),* v-173.

Freeman, D.E., & Freeman, Y.S. (2001). *Between worlds: Access to second language acquisition* (2nd ed.). Portsmouth, NH: Heinemann.

Ganger, J., Pinker, S., Chawla, S. & Baker, A. (2004). *The heritability of early milestones of vocabulary and grammar: A twin study*. Unpublished manuscript.

Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity versus natural partitioning. In S.A. Kuczaj, II (Ed.), *Language development: Vol 2. language, thought, and culture* (pp. 31-53). Hillsdale, NJ: Erlbaum.

Gentner, D., & Boroditsky, L. (2001). Individuation, relativity, and early word learning. In M. Bowerman & S. Levinson (Eds.), *Language acquisition and conceptual development*. Cambridge, England: Cambridge University Press.

Geren, J., Snedeker, J. & Ax, L. (2005). Starting over: A preliminary study of early

lexical and syntactic development in internationally adopted preschoolers. *Seminars in Speech and Language, 26(1),* 44-53.

Gillette, J., Gleitman, H., Gleitman, L., & Lederer, A. (1999). Human simulation of vocabulary learning. *Cognition, 73,* 135-176.

Gleitman, L.R. & E.L. Newport. 1995. The invention of language by children. In L.R. Gleitman & M. Liberman (Eds). *An invitation to cognitive science. Vol. 1: Language* (pp. 1-25). Cambridge, MA: MIT Press.

Glennen, S., & Masters, M. G. (2002). Typical and atypical language development in infants and toddlers adopted from Eastern Europe. *American Journal of Speech-Language Pathology, 11,* 417–433.

Goldin-Meadow, S. & Feldman, H. (1977). The development of language-like communication without a language model. *Science, 197,* 401-403.

Gombert, J.E. (1992). *Metalinguistic development.* Chicago: University of Chicago Press.

Gopnik & A. N. Meltzoff (1997). *Words, thoughts, and theories.* Cambridge, MA.: Bradford, MIT Press.

Hoff, E. (2001). *Language development*. Belmont, CA: Wadsworth Thomson Learning.

Huttenlocher, J., Smiley, P., & Ratner, H. (1983). What do word meanings reveal about conceptual development? In T. Wannamacher & W. Seiler (Eds.), *The development of word meanings and concepts* (pp. 210-233). Berlin: Springer-Verlag.

Johnson, J., and Newport, E. (1989). Critical period effects in second language learning. *Cognitive Psychology, 21*, 60-99.

Landau, B. & Gleitman, L.R. (1985). *Language and experience: Evidence from the blind child.* Cambridge, MA: Harvard University Press.

Lenneberg, E. (1967). *Biological foundations of language.* New York: Wiley.

Macnamara, J. (1972). Cognitive basis of language learning in infants. *Psychological Review, 79*, 1-13.

MacWhinney, B. (2000). *The CHILDES project: Tools for analyzing talk.* Mahwah, NJ: Erlbaum.

Newport, E. (1990). Maturational constraints on language learning. *Cognitive Science, 14*, 11–28.

Pallier, C., Dehaene, S., Poline, J., LeBihan, D., Argenti, A., Dupoux, E. & Mehler, J. (2003). Brain imaging of language plasticity in adopted adults. *Cerebral Cortex, 13,* 155-161.

Shore, C.M. (1986). Conceptual development and early multiword speech. *Development Psychology, 22,* 184-190.

Singleton, J.L., & Newport, E.L. (2004). When learners surpass their models: The acquisition of ASL from inconsistent input. *Cognitive Psychology, 49,* 370-407.

Snedeker, J., Li, P. & Yuan, S. (2003). Cross-Cultural Differences in the Input to Early Word Learning. *Proceedings of the 25th Annual Cognitive Science Conference.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Snedeker, J. & Gleitman, L. (2004). Why it is hard to label our concepts. In Hall, G. & Waxman, S. (Eds), *Weaving a Lexicon* (pp. 257-294). Cambridge, MA: MIT Press.

Talmy, L. (1975). Semantics and syntax of motion. In J. Kimball (Ed.), *Syntax and semantics* (Vol 4., pp 181-238). New York: Academic Press.

Thomas, M. S. C., & Karmiloff-Smith, A. (2005). Can developmental disorders reveal the component parts of the human language faculty? *Language Learning and Development, 1(1),* 65-92.

U.S. Department of State (2005). Immigrant visas issued to orphans coming to the U.S. Retrieved December 5, 2005, from http://travel.state.gov/family/adoption/stats/stats_451.html

Wexler, K. (1998). Maturation and growth of grammar. In W.C. Ritchie & T.K. Bhatia (Eds.), *Handbook of Child Language Acquisition* (pp. 55-110). San Diego: Academic Press.

Author Note

We thank Carissa Kemp, Laura Ax and Isabel Martin for assistance in recruitment and data collection; Caroline Whiting and Nicole Gavel for help with transcription and data entry; Lila Gleitman for inspiration and conversation; and the families who participated for their altruism. Data collection was supported by the Roger Brown Fund. Preparation of this paper was funded by National Science Foundation (BCS-0418423). This work was presented at CogSci 2005 and BUCLD 2004. The clinical implications of this research are discussed in Geren, Snedeker and Ax (2005).

Footnotes

[1] The contingent acquisition hypotheses under consideration make the weaker claim that one type of knowledge is needed for efficient acquisition or utilization of another type. This is desirable since the phenomena under consideration are strong but violable. For example, children do learn some verbs early on (Bates, Dale & Thal, 1995).

[1] When this participant is included, her observations have standardized residuals less than -2 and the logarithmic relation between time and vocabulary is considerably weaker (R^2=.21, F(1,12) = 4.36, p=.059 first session, R^2=.24, F(1,12) = 11.60, p <.005 all). This child had no obvious perceptual limitations, cognitive delays or background characteristics that might explain her relatively slow language acquisition.

[1] In our ongoing work we have confirmed this by having parents assess children's performance on developmental milestones that typically coincide with early language acquisition. The internationally-adopted preschoolers (n=20) passed 89% of these milestones, while the vocabulary-matched infants (n=20) passed only 53%.

Figure Captions

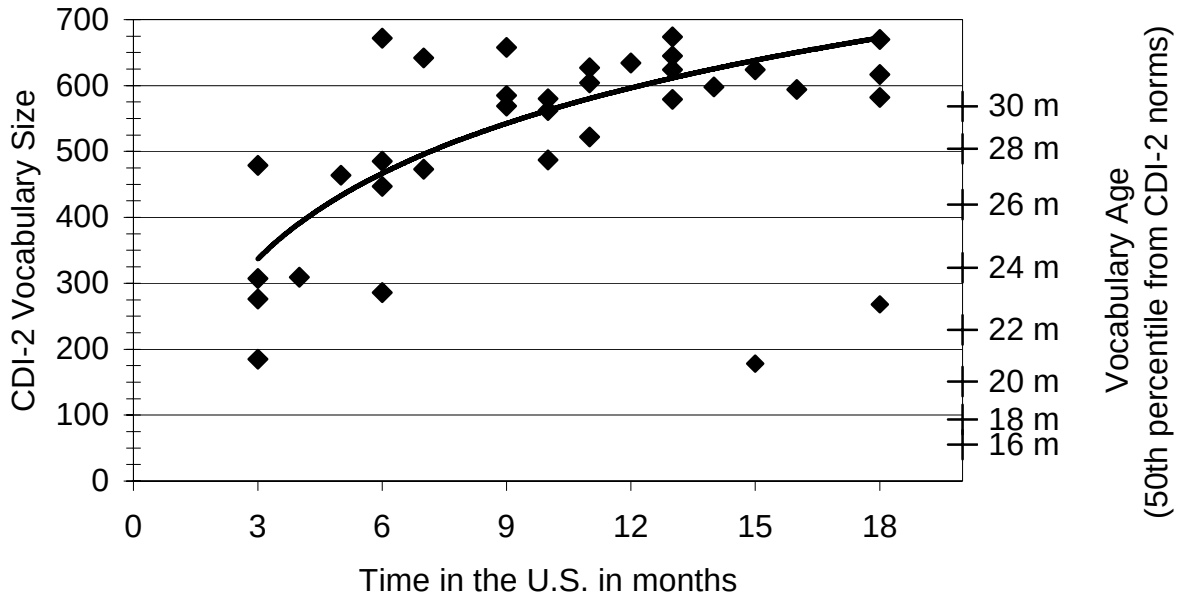
Figure 1: Vocabulary Growth in Internationally-Adopted Preschoolers

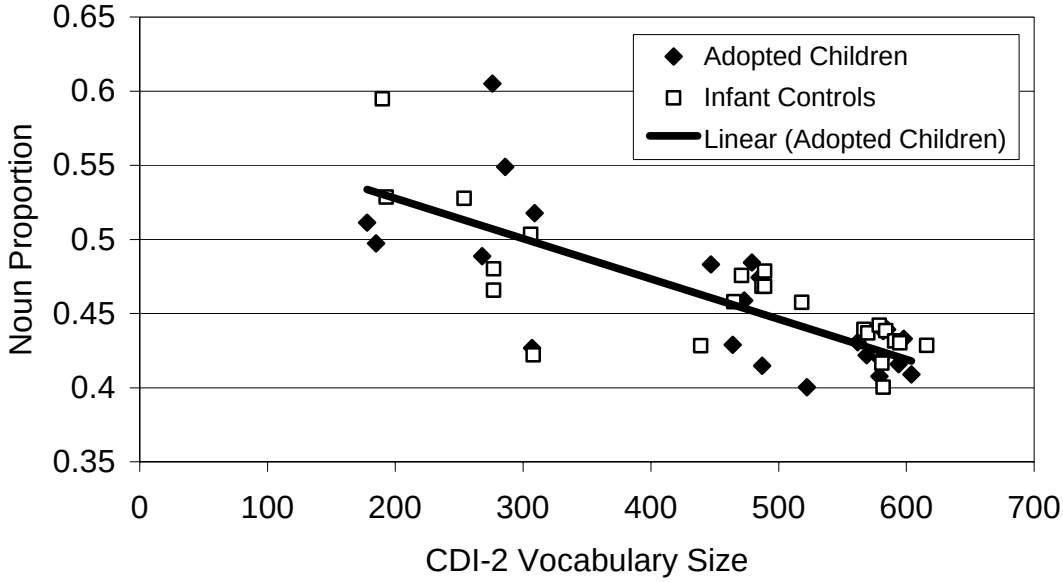
Figure 2: Nouns as a Proportion of the Child's Total Vocabulary on the Parental Report

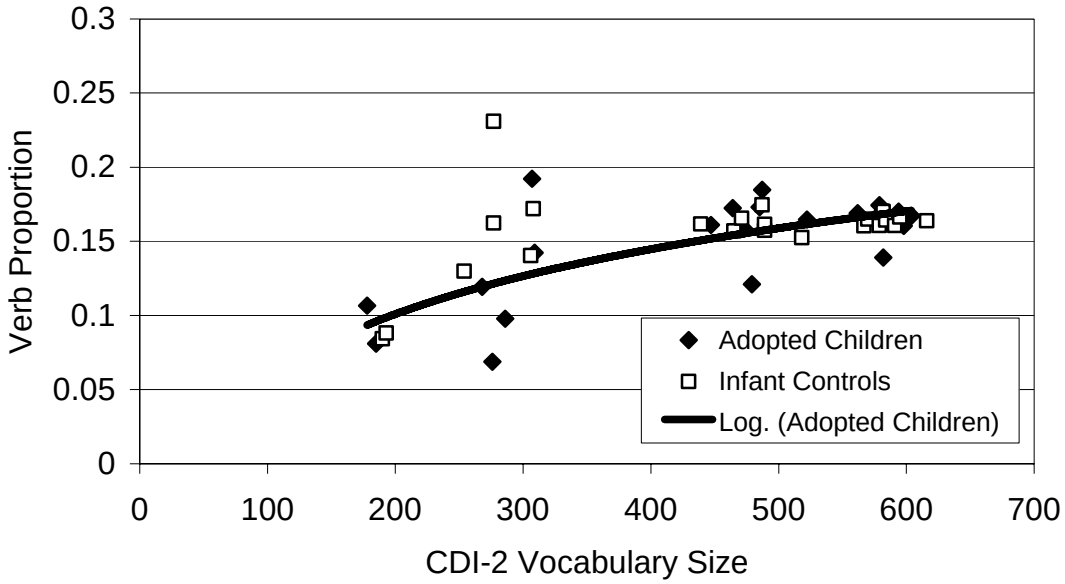
Figure 3: Verbs as a Proportion of the Child's Total Vocabulary on the Parental Report

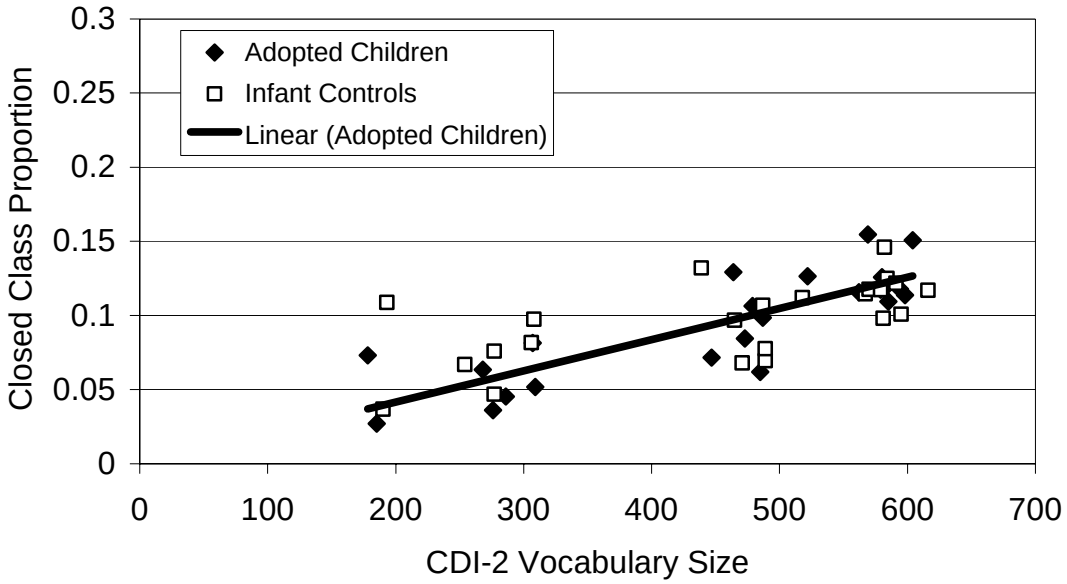
Figure 4: Closed Class Words as a Proportion of the Child's Total Vocabulary on the Parental Report

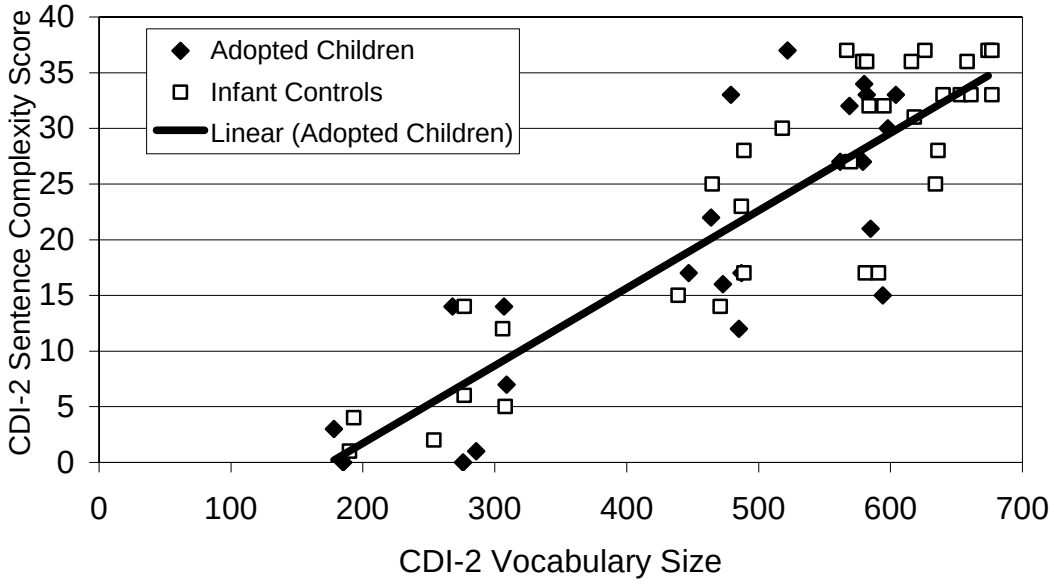
Figure 5: Total Score on Sentence Complexity Measure as a Function of Vocabulary Size


CDI-2 Vocabulary Size
700
600
500
400
300
200
100
0
0
3
6
9
12
15
18
Time in the U.S. in months
30 m
28 m
26 m
24 m
22 m
20 m
18 m
16 m
Vocabulary Age
(50th percentile from CDI-2 norms)


0.65
0.6
0.55
0.5
0.45
0.4
0.35
Noun Proportion
0
100
200
300
400
500
600
700
CDI-2 Vocabulary Size
Adopted Children
Infant Controls
Linear (Adopted Children)


0.3
0.25
0.2
0.15
0.1
0.05
0
Verb Proportion
0
100
200
300
400
500
600
700
CDI-2 Vocabulary Size
Adopted Children
Infant Controls
Log. (Adopted Children)


Adopted Children
Infant Controls
Linear (Adopted Children)
Closed Class Proportion
0.3
0.25
0.2
0.15
0.1
0.05
0
0
100
200
300
400
500
600
700
CDI-2 Vocabulary Size


CDI-2 Sentence Complexity Score
0
5
10
15
20
25
30
35
40
0
100
200
300
400
500
600
700
CDI-2 Vocabulary Size
Adopted Children
Infant Controls
Linear (Adopted Children)