

## LANGUAGE AND ENVIRONMENT

### A Cross-Cultural Study of the Gestural Communication Systems of Chinese and American Deaf Children

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#### 0. INTRODUCTION<sup>1</sup>

Sign languages of the deaf are autonomous languages which are not based on the spoken languages of hearing cultures (Bellugi & Studdert-Kennedy 1980; Klima & Bellugi 1980; Lane & Grosjean 1980). A sign language such as American Sign Language (ASL) is a primary linguistic system passed down from one generation of deaf people to the next and is a language in the full sense of the word. Like spoken languages, ASL is structured at syntactic (Liddell 1980; Padden 1983), morphological (Klima & Bellugi 1979; Supalla 1982) and "phonological" (Liddell & Johnson 1986; Padden & Perlmutter 1987) levels.

Deaf children born to deaf parents and exposed from birth to a conventional sign language such as ASL have been found to acquire that language naturally; that is, these children progress through stages in acquiring sign language similar to those of hearing children acquiring a spoken language (Caselli 1983; Hoffmeister 1978; Hoffmeister & Wilbur 1980; Kantor 1982; Newport & Ashbrook 1977; Newport & Meier 1985). Thus, in a conventional signing environment, deaf children are not at all handicapped with respect to language learning.

However, 90% of deaf children are *not* born to deaf parents who could provide early exposure to a conventional sign language. Rather, they are born to hearing parents who, quite naturally, tend to expose their

children to speech (Hoffmeister & Wilbur 1980). Unfortunately, it is extremely uncommon for deaf children with severe to profound hearing losses to acquire the spoken language of their hearing parents naturally, that is, without intensive and specialized instruction. Even with instruction, deaf children's acquisition of speech is markedly delayed when compared either to the acquisition of speech by hearing children of hearing parents, or to the acquisition of sign by deaf children of deaf parents. By age 5 or 6, and despite intensive early training programs, the average profoundly deaf child has only a very reduced oral linguistic capacity (Conrad 1979).

In addition, unless hearing parents send their deaf children to a school in which sign language is used, these deaf children are not likely to receive conventional sign language input. Under such inopportune circumstances, these deaf children might be expected to fail to communicate at all, or perhaps to communicate only in non-symbolic ways. This turns out not to be the case.

Previous studies of deaf children of hearing parents have shown that these children spontaneously use gestures (referred to as "home sign") to communicate even if they are not exposed to a conventional sign language model (Fant 1972; Lenneberg 1964; Moores 1974; Tervoort 1961). Given a home environment in which family members communicate with each other through many different channels, one might expect that the deaf child would exploit the accessible modality (the manual modality) for the purposes of communication. However, given that no conventional model in the manual modality is available for the child, one might *not* expect that the child's communication would be structured in language-like ways.

Longitudinal studies by Goldin-Meadow and Mylander (e.g., 1983; 1984; 1990a,b) have shown that, despite lacking conventional linguistic input (either signed or spoken), deaf children of hearing parents in the United States are able to structure their gestural communication systems at the lexical, syntactic and morphological levels. Moreover, the communication systems developed by these deaf children share many of the structural properties of the early linguistic systems developed by hearing children learning English and deaf children learning American Sign Language. These findings suggest that combinatorial structure at more than one level is fundamental to human language – so fundamental that it can be developed by children who do not have access to a conventional language model and therefore may themselves be shaping their communication systems.

Nevertheless, it is possible that the structure in the American deaf children's communication systems came not from the children but from

some other non-linguistic factors in their environment. For example, Bruner (1975) and Shatz (1981) have suggested that mother-child interaction patterns may aid a child in developing insight into certain linguistic structures. In order to determine the extent to which structure in the deaf children's gestures is a product of the way in which mothers and children jointly interact in their culture – and in so doing, develop a more stringent test of the effects and non-effects of environmental factors on the deaf children's gestural systems – we have studied deaf children in a second culture, Chinese culture.

We have chosen Chinese culture as a second culture in which to explore the spontaneous communication systems of deaf children because literature on socialization (Miller, Fung & Mintz 1991; Young 1972), on task-oriented activities (Smith & Freedman 1982) and on academic achievement (Chen & Uttal 1988; Stevenson, Lee, Chen, Stigler, Hsu & Kitamura 1990) suggests that patterns of mother-child interaction in Chinese culture differ greatly from those in American culture, particularly those in white, middle-class American culture. In addition, our own studies of mother-child interaction between *hearing mothers* and their *deaf children* in Chinese and American families replicate these differences (Wang 1992; Wang, Mylander & Goldin-Meadow, in press). In particular, we have found, first, that Chinese mothers are very active in *initiating* interactions with their deaf children, whereas American mothers tend to wait for their children to initiate interactions. Second, Chinese mothers tend to offer *directives* to their deaf children before they have the opportunity to try out the task. In contrast, American mothers tend to offer directives to their deaf children only after their children fail to accomplish the task or after their children request help. Third, Chinese mothers tend to *evaluate* their children's abilities in accomplishing the tasks. For example, a Chinese mother might say to her child "you are smart" if the child performed the task correctly or "you are stupid" if the child failed the task. American mothers, on the other hand, tend to evaluate task outcomes. For example, an American mother might give her child feedback such as "yes, that's right" if the child performed the task correctly or "no, turn it this way" if the child failed the task. Finally, when *commenting on pictures or toys*, Chinese mothers tend not only to label the pictures or toys but also to supply additional information. For example, in reaction to a picture of a house, a Chinese mother might say "house, the house is very high; the roof is pointed; there are houses over there." In contrast, the American mothers tend merely to label pictures or toys, supplying no extra information. For example, in response to the same picture, an American mother might say only "house, that's a house."

The salient differences in Chinese and American maternal interaction patterns have provided us with an excellent opportunity to examine

the role that mother-child interaction plays in the development of the gestural communication systems of deaf children. If we find similarities between the spontaneous gestural systems developed by deaf children in Chinese culture and deaf children in American culture, an increasingly powerful argument can be made for the non-effects of mother-child interaction patterns on the development of these gestural systems – that is, we will have increasingly compelling evidence for the resilience of the linguistic properties found in the deaf children's gestural systems. Conversely, to the extent that the gestural systems of the Chinese deaf children are consistently different from the American deaf children's gestural systems, an equally compelling argument can be made for the effects of cultural variation – as instantiated in mother-child interaction patterns – on the spontaneous gestural systems of deaf children.

## 1. METHODS AND PROCEDURES

**Chinese sample.** We have thus far analyzed data from a single developmental point for four deaf children and their hearing mothers. In work currently in progress, we are examining a larger group of children and their mothers, each observed over a year-long period. Such longitudinal data are necessary if we are to determine whether there are long-term effects of maternal gesturing. Nevertheless, the data presented here represent a preliminary step in assessing whether maternal gesture plays a role in shaping the child's gesture system. The four children were observed, each for several hours, at ages 2;9 (Jie-jie, girl), 4;1 (Bao-bao, boy), 4;4 (Qing-qing, girl), and 5;0 (Wen-wen, boy).<sup>2</sup> All four children were from Taiwanese middle-class families. At the time of videotaping, Jie-jie had no siblings, Bao-bao had one older hearing brother, Qing-qing had one younger hearing sister, and Wen-wen had one younger hearing brother. The mother was the primary caretaker in each family. All four children were congenitally deaf with no other reported cognitive or physical disabilities. The cause of deafness was unknown for three children. Qing-qing's deafness was believed to be caused by a drug taken by her mother during pregnancy. All four children had severe to profound hearing losses: Jie-jie had a 106-108 db loss in both ears; Bao-bao had a 70-90 db loss in both ears; Qing-qing had a 105-110 db loss in both ears; and Wen-wen had a 100 db loss in his right ear and a 110 db loss in his left ear.

At the time of videotaping, none of the four children had been exposed to either Taiwanese Sign Language (TSL) or Chinese Sign Language (CSL). All four children attended oral schools in Taipei. Jie-jie attended preschool in the Taipei Qi Cong Municipal School, Bao-bao and Qing-qing attended the Taipei Zheng Yin Oral School for the Deaf, and Wen-wen attended the Ai Er Oral School for the Deaf part-

time and a hearing school affiliated with Taipei Teachers University part-time. All three of the schools for the deaf that the children attended were committed to training the children to speak and did not allow the use of TSL or CSL.<sup>3</sup>

**American sample.** Four American deaf children and their hearing mothers were selected for comparative purposes from our American sample (Goldin-Meadow & Mylander 1984). The American children were matched to the Chinese as much as possible by gender, age, and family background: Mildred (2;9, girl), David (3;10, boy), Karen (4;2, girl), and Marvin (4;2, boy). All four children were from white, middle-class families. At the time of videotaping, Mildred had three older hearing sisters, David had one older brother and sister, Karen had one younger sister, and Marvin had no siblings. The mother was the primary caretaker in each family. All four children were congenitally deaf with no other reported cognitive or physical disabilities. The cause of deafness was unknown for all four children. Each child had a profound hearing loss: Mildred had a 90 db loss, David had a >90 db loss, Karen had a 100 db loss, and Marvin had a 95 db loss. At the time of videotaping, Mildred, Karen and Marvin all attended the same oral preschool for the deaf in the Chicago area. David attended an oral preschool for the deaf in the Philadelphia area. None of the children had been exposed to ASL or MCE (Manually Coded English) at the time of testing.

**Data collection and coding.** Both the Chinese data and the American data were collected by native members of their respective cultures. Each child was videotaped at home during natural play settings with a set of toys, books, and puzzles (described in Goldin-Meadow 1979) designed to facilitate interaction. Each session lasted from 1 to 2 hours. The gestures that the deaf children and their hearing mothers produced were coded according to a system described in Goldin-Meadow and Mylander (1984) by native speakers from the cultural communities. Reliability was established between two trained coders in each cultural community. Overall, there was 90% agreement between the coders; reliability for individual coding categories ranged between 88% and 93%. It is important to note that the system developed to transcribe the gestures of the American deaf children was easily used without modification to transcribe the gestures of the Chinese subjects.<sup>4</sup>

## 2. RESULTS

**Rate of gesturing.** A common assumption in many studies of language acquisition is that the frequency with which a particular construction is used in a child's input will affect whether that construction is found in

the child's output (that is, studies tend to correlate frequency in maternal input with child output, cf. Brown & Hanlon 1970). However, in the typical language-learning situation, a child hears many constructions so frequently that, if there were a minimal threshold input needed to acquire a construction, the threshold would likely be exceeded many times over (see Newport, Gleitman & Gleitman 1977, for discussion). Thus, under typical language-learning circumstances, it is difficult to explore the role of frequency of input in the child's acquisition of language. However, degraded input conditions, such as the ones experienced by our deaf subjects, may facilitate exploration of this issue.

We therefore begin by examining how frequently the Chinese and American mothers gestured – a measure of how much gestural input the children received. We found that the Chinese mothers produced many more gestures per hour on average (374 gestures per hour) than did the American mothers (84 gestures per hour). We then examined the children's rate of gesturing and found that the asymmetry in the mothers' rate of gesturing was mirrored in the children: The Chinese children produced 364 gestures per hour on average, while the American children produced only 197. These data suggest that the maternal rate of gesturing did have an impact on the child rate. However, note that while the Chinese children gestured more frequently than the American children, they produced only two times as many gestures per hour as the American children – rather than four-fold disparity found in the mothers' rates. In other words, the American children gestured more often than might be expected on the basis of their mothers' rates, suggesting that there may be a minimal level of communication that a child will produce even if the child does not have a particularly active communication partner.

Although both the Chinese and American deaf children in our studies were lacking conventional language models and received only "unconventional" gestural input from their hearing parents, the fact that the Chinese mothers gestured so much more than the American mothers means that the Chinese deaf children received much more of this unconventional input than did the American deaf children. Thus, we ask whether the frequency of input (albeit unconventional input) plays a role in determining whether a child acquires a particular structural pattern. Consider a hypothetical situation in which the Chinese and American mothers both produce a consistent pattern in their gestures but the American mothers produce the pattern far less frequently than the Chinese mothers. If the frequency with which a pattern is produced in the input determines the likelihood of its production in the output, the pattern will more likely be acquired by the Chinese deaf children than the American deaf children. If, on the other hand, repeated exposure to a pattern is not necessary for acquisition to proceed

(i.e., if what is essential is that the pattern be consistently produced the few times it appears), the pattern will be equally likely acquired by both the Chinese and American deaf children.

In the remainder of this paper, we will examine some of the properties in the deaf children's gestural systems, focusing on whether the frequency and type of maternal gestural input is related to the child's gestural output.

**Types of gestures.** All of the mothers in both groups produced the three types of gestures that have been previously found in Goldin-Meadow's American subjects: deictic gestures, marker gestures and characterizing gestures. The three gesture types are distinguished from one another on the basis of form and function (see Goldin-Meadow & Mylander 1984, and Feldman, Goldin-Meadow & Gleitman 1978, for discussion). Deictic gestures are static handshapes, usually (but not always) involving an extended index finger, that are used to indicate objects, persons, or places in the surrounds. Marker gestures are head or hand movements typically borrowed from the hearing culture and used to modulate meanings, e.g., to affirm (typically with a nod), to negate (with a headshake), or to question (with a shrug and hand-flip). Deictic and marker gestures vary little in form both within and across cultures, thus providing little opportunity to explore the relationship between the forms the mothers used and those used by their children. In contrast, characterizing gestures do assume a variety of forms and, as a result, we focus in this paper primarily on this type of gesture.

**Characterizing gestures.** Characterizing gestures typically portray the actions and attributes of objects and people and can be divided into two types:<sup>5</sup> *pantomimic* gestures in which the form of the gesture mimics its referent (e.g., moving an O-hand in a short arc toward the mouth to convey "eating"), and *conventional* gestures in which forms tend to be less transparently related to their referents. Conventional gestures or emblems (Ekman & Friesen 1969) are gestures that are recognized within the hearing culture as particular symbols for a given meaning (e.g., a flat hand held with the palm facing up means "give-it-to-me" in American culture, and an index finger brushing against the cheek means "shame" in Chinese culture).

Given the fact that conventional gestures (emblems) show a fair amount of cultural specificity (McNeill 1992), we expect to find differences in the conventional gestures used by the mothers in our two cultural groups. Figure 1 shows that the Chinese and American mothers indeed used different types of conventional gestures with their children. For the most part, the American mothers used conventional gestures to make requests (e.g., extending a palm to request an object). In contrast, the Chinese mothers, in addition to using some of the same request gestures, also used a variety of

other conventional gestures that were used far less frequently by the American mothers; for example, gestures conveying evaluation (an extended pinky finger meaning "bad"), and gestures conveying shame (an index finger brushing against the cheek). Thus, the Chinese and American mothers exposed their deaf children to different types of conventional gestures.

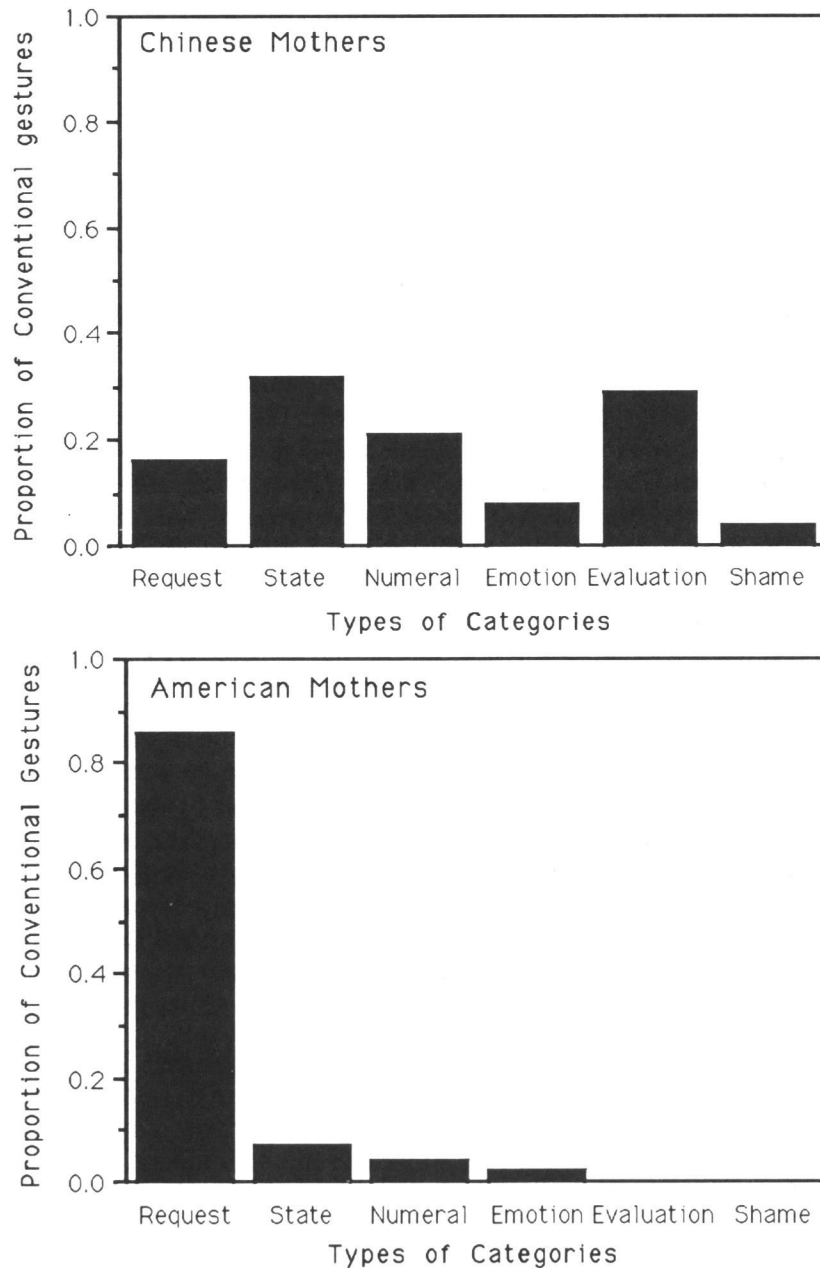


Figure 1. Conventional Gestures in Chinese and American Mothers

Moreover, given that conventional gestures have forms that are arbitrarily related to their referents and are culturally constituted, we expect that the deaf children would not be able to invent such gestures but would instead learn the conventional gestures they saw their mothers use. Figure 2 supports this prediction. In both groups, the deaf children used essentially the same types of conventional gestures in the same proportions as their hearing mothers. In fact, the proportion of a particular child's conventional gestures that could be found in that child's mother's gestures as well as very high in both cultural groups (.88 for the Chinese children and .73 for the American children). Parenthetically, it is worth noting that shaming and evaluation, both prominent in the socialization practices of Chinese mothers of *hearing* children (cf. Miller, et al. 1991), are so central to the Chinese culture that they have been translated into the manual modality, thus allowing the Chinese *deaf* children to be socialized into this important aspect of their culture.

Recall that the mothers and the children in both cultures also used a second type of characterizing gesture – the pantomimic gesture whose form is transparently related to its referent. These gestures can be created "on the spot" and thus need not be modeled for the child. Indeed, we found that, in contrast to conventional gestures, the proportion of a particular child's *pantomimic* gestures that could be found in that child's mother's gestures was relatively low in each cultural group (.34 for the Chinese children and .25 for the American children). Thus, the majority of the pantomimic gestures the children produced were *not* modeled after their mothers' gestures.

**Distribution of gestural types.** We next examined the distribution of deictic, characterizing, and marker gestures in conversation in both mother and child. We found that the Chinese and American mothers differed in the relative frequency with which they produced these three types of gestures. As Figure 3 reveals, the Chinese mothers produced deictic gestures more frequently than characterizing gestures, and characterizing gestures either more frequently than, or as often as, marker gestures. The American mothers also produced deictic gestures frequently, but they produced far more marker gestures than characterizing gestures. In other words, the American mothers used very few gestures portraying actions and attributes in their communications; instead they used gesture primarily to indicate objects and to modulate their meanings.

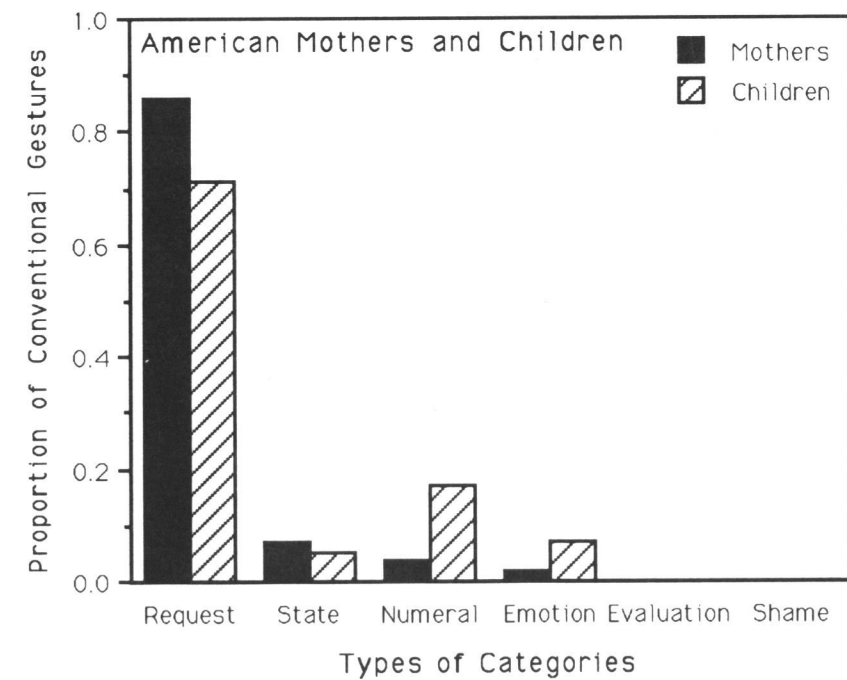
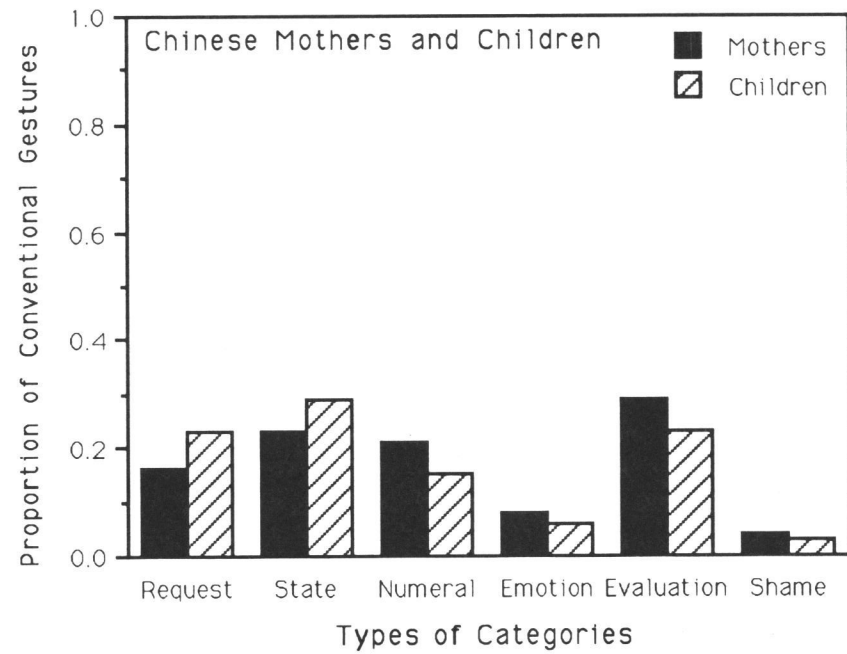


Figure 2. Conventional Gestures in Chinese and American Mothers and Children

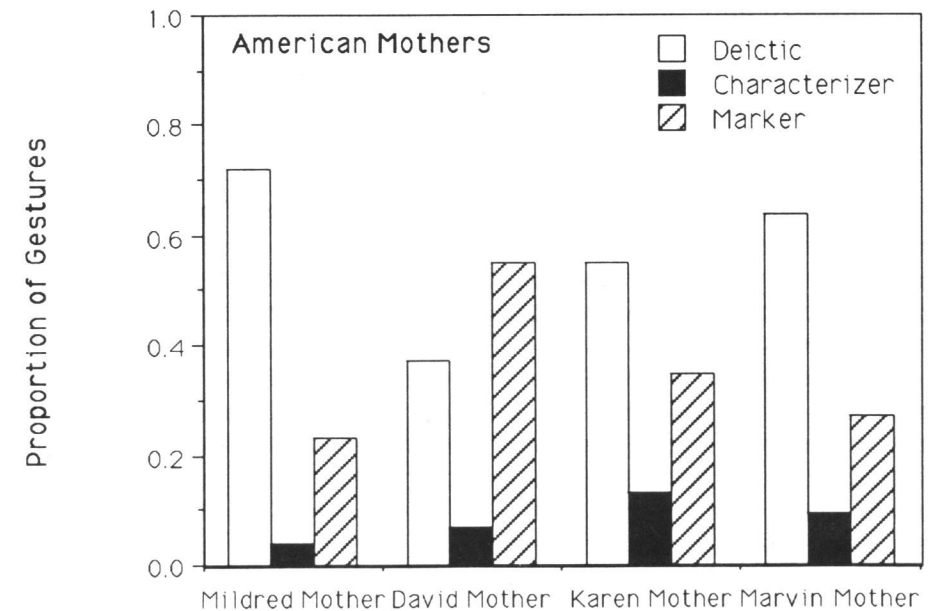
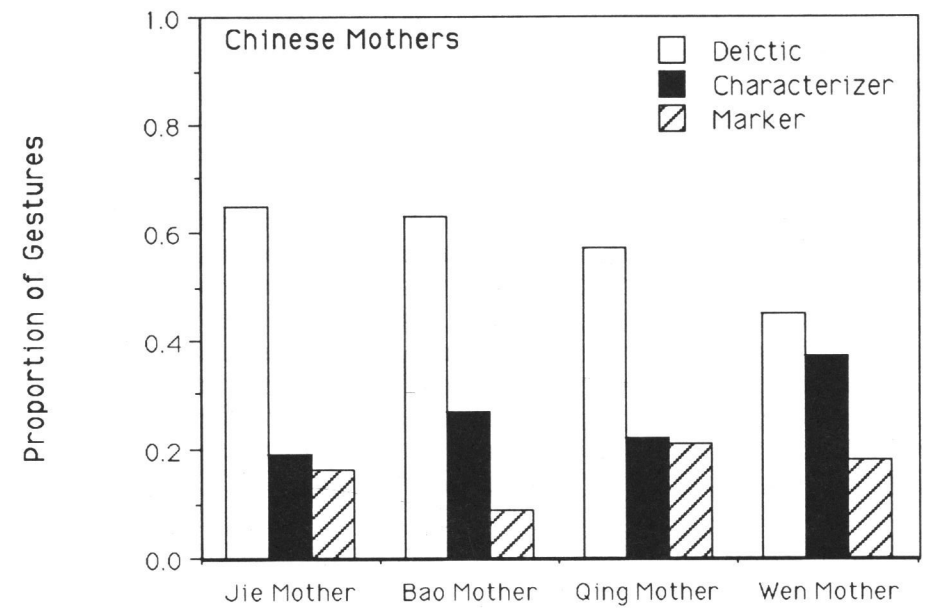


Figure 3. Distribution of Deictic, Characterizing, and Marker Gestures in the Communications of Chinese and American Mothers

Despite the fact that the Chinese and American mothers used the three types of gestures differently, no differences were found in the two groups of children. As seen in Figure 4, the children in both cultures produced deictic gestures more frequently than, or as often as, characterizing gestures, and characterizing gestures more frequently than marker gestures. Thus, although the differences between the Chinese and American mothers' conventional gestures were mirrored in their children's gestures, the differences between the Chinese and American mothers' distribution of gestures in conversation were *not* mirrored in their children's gestures. Despite wide differences in the input they received, the children in the two cultures used their gestures in communication in precisely the same way. This pattern – that differences in mothers' gestural input are not reflected in the children's gestural output – will be seen again when we examine the frequency with which gestures are combined into strings.

**Mean length of gestural utterances.** We examined the average length of the mothers' gestural strings (MLGU, the mean length of gestural utterances) and found that the Chinese and American mothers differed in their average length of strings. The average MLGU was 1.41 for the Chinese mothers but only 1.10 for the American mothers (note that 1.00 is the lowest possible mean; essentially, the American mothers produced only single gesture utterances). Despite the differences in the extent to which the mothers combined their gestures into strings, the deaf children showed no such differences. The average MLGU was 1.41 for the Chinese children and 1.44 for the American children. Thus, the children combined their gestures into strings whether or not their mothers did.

**Recursion.** Finally, we examined the property of recursion in the gestures of both mother and child. Each of the Chinese and American deaf children were found to produce complex gesture sentences, that is, gesture sentences containing more than one proposition. Thus, each of the children's gestural systems allowed propositions to be recursive units – the children could derive from one unit (the proposition) a string that again contained the unit, permitting the generation of new strings from old. Most importantly, the four American children were found to combine their gestures into complex gesture sentences several months before their mothers did (Goldin-Meadow & Mylander 1984), suggesting that the onset of complex sentences in the children's gestures was not precipitated by their mothers' gestures in the American group.<sup>6</sup> At this point, we do not have the longitudinal data necessary to determine whether the Chinese children also combined their gestures into complex sentences before their mothers. Nevertheless, both the Chinese and American children were found to produce proportionately more complex gesture sentences than did their mothers (see Figure 5).

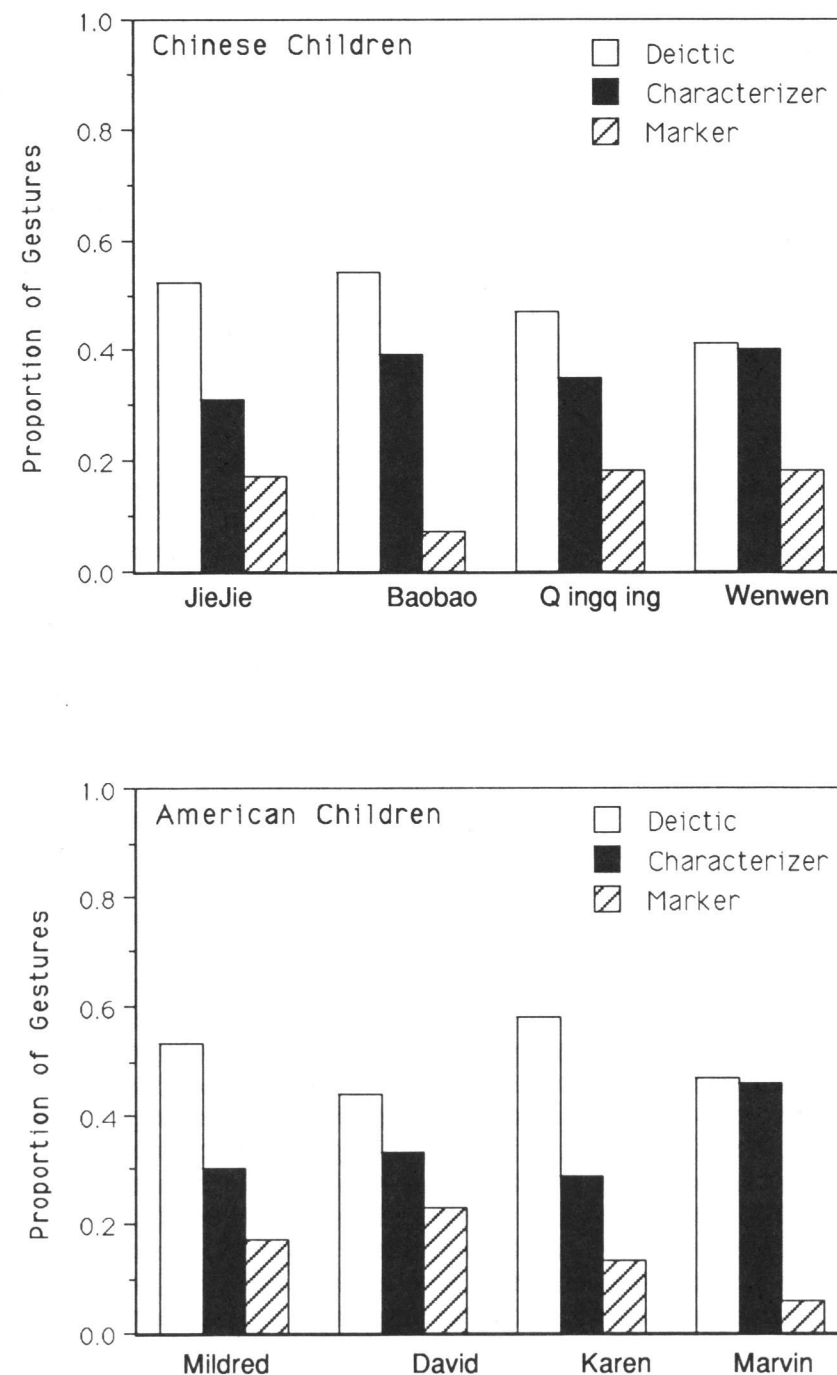


Figure 4. Distribution of Deictic, Characterizing, and Marker Gestures in the Communications of Chinese and American Children

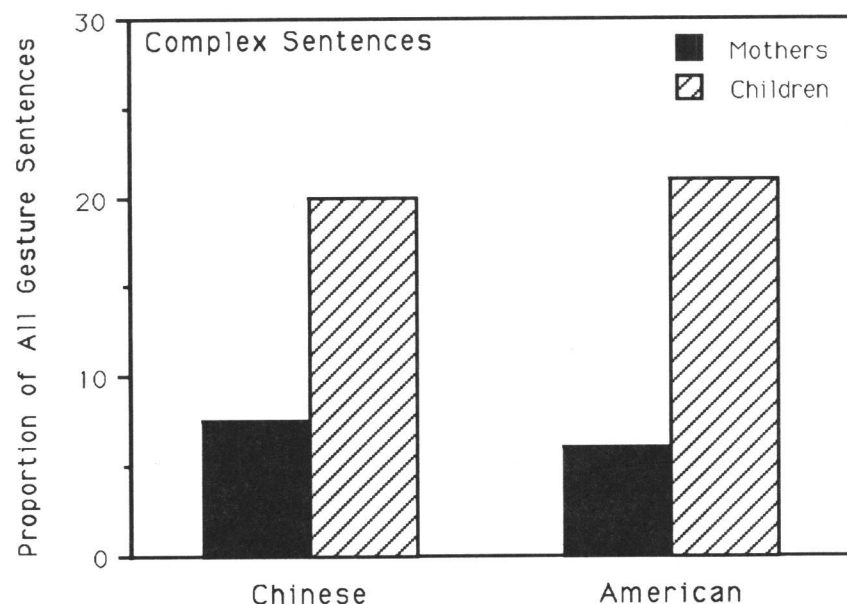


Figure 5. Proportion of Gesture Sentences that were Complex Produced by the Chinese and American Mothers and Children

### 3. CONCLUSION

The language properties found in the gesture systems developed by the deaf children in our studies are, by definition, properties whose development is “resilient” to one atypical language-learning environment – an environment in which the child lacks an accessible conventional language model. Our previous work has shown that deaf children of hearing parents in the United States can develop gesture systems that possess many of the same structures as the early systems developed by young children learning conventional languages. This is true whether the comparison is made to young hearing children learning a conventional spoken language or young deaf children learning a conventional sign language. The question arises, however, to what extent is the structure developed by our American deaf children shaped by cultural, although non-linguistic, factors (e.g., the play routines mothers establish with their children may exert an influence on the structure of their communication, cf. Bruner 1975)? Thus, we ask what aspects of structure in the deaf children’s gesture systems are “resilient” across cultural variation.

We have investigated whether deaf children lacking an accessible conventional language model in a second culture, a Chinese culture, develop gesture systems that are structured similarly to the American

deaf children’s gesture systems. Our data suggest that, despite the differences in the gestural models they received from their hearing mothers, the Chinese and American deaf children produced gestures that were comparable in many aspects of language – particularly in the distribution and arrangement of word-like units – differing primarily in their use of culturally-bound emblematic gestures. Moreover, our data suggest that a large amount of input is not essential to the development of many properties of language. For example, even though the gestural input received by the Chinese children in our sample was greater than that received by the American children, the Chinese and American children showed no differences in the types and distributional arrangements of their gestures.

We began our study by noting that the Chinese mothers interacted differently with their deaf children than the American mothers did with theirs (Wang 1992; Wang et al., in press). Given the differences in the worlds that the deaf children in these two cultures experienced, the similarities found in the spontaneous gesture systems developed by these children provide an increasingly powerful argument for the non-effects of mother-child interaction patterns on the development of these linguistic properties; that is, we have increasingly compelling evidence for the resilience of these aspects of language in the face of cultural variation. On the other hand, the differences we have found in the conventional emblems used by the Chinese and American deaf children provide evidence for the impact of cultural variation on the development of certain aspects of the deaf children’s gesture systems (particularly in portions of their gestural lexicons).

The properties of the deaf child’s gesture system that are resilient across cultural variation appear, in a sense, to be buffered against the environment. The fact that these properties can develop in very different environments suggests that children themselves may be constrained to interpret the environment in particular ways. Constraints of this sort serve to narrow the range of possible outcomes in language development simply because they guide the child’s search through the environment for relevant data. Although this sort of narrowing, or canalization, is often attributed to genetic causes (cf. Waddington 1957), canalization can be caused by the environment as well (Gottlieb 1991; Goldin-Meadow 1991). Indeed, the strength of our studies lies in the fact that they do not assume a particular cause for the constraints on language-learning. Rather, our studies provide an empirical process by which the constraints on language-learning can be identified; these findings can then serve as a framework within which causes can be explored. In this way, our findings inform the search for the biological and cultural foundations of the language-learning process.



## NOTES

- (1) This work was supported by Grant No. BNS 8810769 from the National Science Foundation and Grant No. RO1 DC00491 from NIH to S. Goldin-Meadow, and by a Pacific Cultural Foundation subsidy. Address correspondence to Xiao-lei Wang, Carolyn Mylander, and Susan Goldin-Meadow at the University of Chicago, Department of Psychology, 5730 South Woodlawn Avenue, Chicago, IL 60637, USA.
- (2) All the names of the subjects have been changed to protect the children's identities.
- (3) One of the schools, the Taipei Zheng Yin Oral School for the Deaf, did use what can be called "sound gestures," gestures used to highlight for a deaf child the manner in which certain sounds are generated (a system somewhat comparable to the cued speech system used in certain schools for the deaf in the United States). For example, the first consonant for the Chinese word *niao* 'bird' is a nasal sound. To make the nasalization salient, the index finger is pressed against the side of the nose, and this sound gesture is produced whenever the word *niao* is said. Both Bao-bao and Qing-qing were exposed to sound gestures; however, sound gestures accounted for only 2% of the total gestures that each child produced. We have therefore eliminated sound gestures from our analyses in this paper.
- (4) It is possible that the reason our coding system was so easily adapted to a second culture was that the system is too general to capture whatever differences exist in the way individuals or groups gesture. However, it is worth noting that this system, devised on the basis of the American deaf children's gestures, when applied to the gestures produced by the American hearing mothers, resulted in very different profiles of gesture abilities in mother and in child (Goldin-Meadow & Mylander 1983; 1984).
- (5) These action and attribute gestures are either used to indicate the actions or attributes they portray (in a predicate-like fashion), or they are used to identify the object typically associated with the action or attribute (in a noun-like fashion). For example, a twisting gesture could be used either to refer to the act of twisting open a jar or to the jar itself; see Goldin-Meadow, Butcher, Mylander & Dodge 1993 for a description of how one of the American deaf children distinguished these various uses of characterizing gestures in his system.
- (6) Indeed, the data suggest that the *mothers* might have altered their gestures as a result of interacting with their deaf children over time; although see Goldin-Meadow & Mylander 1990b, for evidence that, over a two-year period, there was little adaptation occurring in either direction – that is, the mother did not adapt the morphology of her gestures to her child's, nor did the child adapt the morphology of his gestures to his mother's.

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