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UNDERLYING REDUNDANCY AND ITS REDUCTION IN A LANGUAGE DEVELOPED WITHOUT A LANGUAGE MODEL: CONSTRAINTS IMPOSED BY CONVENTIONAL LINGUISTIC INPUT*

1. INTRODUCTION

1.1 *Constraints on Surface and Underlying Redundancy in Child Language: The Role of a Language Model*

Early child languages, like adult languages, make use of complex sentences with redundant elements. In addition, both adult and child languages possess systematic devices for reducing redundancy in those complex sentences. However, child languages, unlike adult languages, appear to have constraints on the site in their complex sentences at which redundancy is expressed and reduced.

For example, Lust and Mervis (1980) studied the spontaneous speech of 32 young English-learning children and found that the children produced many complex sentences with expressed redundancy in the subject (e.g., "And *duckies* run and *duckies* quack") but few with expressed redundancy in the predicate (e.g., "Debbie *fall on the horsie* and me *fall on the horsie*"). Moreover, Lust and Mervis found that the children produced many complex sentences in which redundant elements were reduced in the subject (e.g., "*They* didn't open up and Ø spill"), but few with redundant elements reduced in the predicate (e.g., "And my mommy Ø and my daddy *will be in New York*").

Similarly, in a study of spontaneously produced complex sentences in three young English-learning children, Tager-Flusberg, deVilliers and Hakuta (1982) found that two of the three children produced more sentences in which the site of expressed redundancy was the subject than the predicate, and all three children produced more sentences in which the site of reduced redundancy was the subject than the predicate. Apparently, despite the fact that in adult English both expressed redundancy and reduced redundancy are allowed in either the subject or the predicate, young English-learning children are biased

B. Lust (ed.), Studies in the Acquisition of Anaphora, Vol. II, 105—133.

against incorporating and/or reducing redundancy in the predicates of their own sentences.

Lust has hypothesized that this systematic bias against redundant predicates and toward redundant subjects results from the English-learning child's aversion to reducing redundancy in a leftward direction and his predilection toward reducing redundancy in a rightward direction. Lust has pointed out that, in sentences of spoken English with normal unmarked SVO order, predicate redundancy can only be reduced by leftward reduction (e.g., "frogs Ø and kangaroos *jump*" where the null anaphor Ø *precedes* "jump" and the surface redundancy is therefore reduced in a leftward direction from the expressed referent). Reduction of predicate redundancy in a rightward direction creates a sentence which is unacceptable in English (e.g., *"frogs *jump* and kangaroos Ø"). In contrast, subject redundancy in sentences of spoken English with normal unmarked SVO order can only be reduced by rightward reduction (e.g., "*frogs* jump and Ø catch flies," where the null anaphor Ø *follows* "frogs"). Reduction of subject redundancy in a leftward direction creates an unacceptable English sentence (e.g., *"Ø jump and *frogs* catch flies"). Under this hypothesis, it is the young child's prejudice against leftward reduction which precludes his use of redundant predicates and his predilection toward rightward reduction which leads to his use of redundant subjects.

In a test of this hypothesis, Lust (1977) asked English-learning children to imitate sentences with redundancy at a number of different sentential sites. As Lust predicted, the children were found to have more difficulty imitating sentences with redundancy patterns which allow only leftward reduction (sentences with redundancy either in the verb of the predicate, e.g., "the kitties Ø and the dogs *hide*," or in the object of the predicate, e.g., "push Ø and hug the *kitty-cat*"), than they did imitating sentences with redundancy patterns which allow only rightward reduction (sentences with redundancy either in the subject alone, e.g., "the *teddy bear* walks and Ø sleeps" or in both the implied subject and the verb, e.g., "*eat* the crackers and Ø the cake").

Lust and Wakayama (1979) used the same paradigm of elicited imitation in a study of Japanese children, and found that Japanese-learning children, like English-learning children, tended to imitate preferentially sentences with particular sites of redundancy. However, unlike the English-learning children, the Japanese-learning children were more successful at imitating sentences with redundancy patterns which allow *leftward* reduction (e.g., "sumire-to Ø tanpopo-ga *saku*" = "violet Ø and dandelion *bloom*") than they were at imitating sentences with redundancy patterns which allow *rightward* reduction (e.g., "*inu-wa* hoeru-shi Ø kamitsuku" = "dog *bark* and Ø bite"). In addition, and consonant with the results from the imitation study, Lust, Wakayama, Snyder and Bergmann (in preparation) studied the natural speech of young Japanese children and found that Japanese-learning children (unlike English-learning children) were more likely to produce coordinate complex sentences with redundancy patterns which allow *leftward* reduction than they were to produce sentences with rendundancy patterns which allow *rightward* reduction.

Thus, although there appear to be constraints on redundancy in the early child languages of both English-learning and Japanese-learning children, the nature of the constraints in these two child languages appears to differ: English-learning children have a bias toward sentences with redundancy patterns which allow rightward reduction, while Japanese-learning children have a bias toward sentences with redundancy patterns which allow leftward reduction.[1]

In an attempt to provide theoretical underpinning to her cross-cultural observations, Lust (1981) attributed the different redundancy patterns found in English child language (rightward reduction patterns) and Japanese child language (leftward reduction patterns) to the fact that adult English is principally a right-branching language while adult Japanese is principally a left-branching language. The principal branching direction of a language refers to the direction in which major recursive devices such as relative clauses and other forms of sentence complementation are positioned (Lust, 1981, 1983). Lust pointed out that the generation of recursive terms in English tends to occur to the right of a non-null site (e.g., "the friend *who came from Tokyo*") while in Japanese the generation of recursive terms tends to occur to the left of a non-null site (e.g., "*Tokyo kara kita* tomodachi" [= *Tokyo from came* the friend]; see Smith, 1978). Lust has hypothesized that a child comes to the language-learning situation with a bias to attend to the principal branching direction of the language he is learning and to associate that branching direction with preferred forms of expressed and reduced redundancy. Lust's hypothesis suggests that input from the language model is necessary to determine the specific direction of the child's redundancy preferences: right-branching complex sentences in the input produce the English-learning child's predilection for rightward redundancy reduction, while left-branching complex sentences in the input produce the Japanese-learning child's predilection for leftward redundancy reduction.

This formulation leads quite naturally to an additional question about input: What would be the redundancy biases (if any) of a child whose language model is neither principally right-branching nor principally left-branching? One approach to this question is to study children learning languages which have no consistent principal branching directions (e.g., Hindi, cf., Lust, deAbrew and Sharma, 1982). Another approach, the one I take in this chapter, is to study a child who is developing a language with no language model whatsoever. For such a child, there would be no structural constraints from a language model affecting redundancy in the child's complex sentences. As a result, one might expect to observe "natural" biases with respect to redundancy in the child's complex sentences, or perhaps to observe no biases at all. I have attempted to determine the preferences the child himself brings to the language-learning situation by describing the nature of redundancy in a gestural communication system developed by a deaf child without the benefit of a conventional language model.

1.2 *Language Development Without a Language Model: Previous Findings*

For several years my colleagues and I have been studying the gestural communication systems of a number of deaf children of hearing parents. These children have hearing losses so severe that they can make no natural use of the oral language that surrounds them. Moreover, these particular deaf children have not been exposed to conventional manual languages (e.g., Signed English, American Sign Language), and instead are being trained orally (i.e., trained to lipread and to produce sounds through kinesthetic cues). At the time of our observations, the children had made little, if any, significant progress in their oral training. Thus, for all intents and purposes these children were lacking conventional linguistic input in both oral and manual modalities.

Despite the lack of a conventional language model, each of the ten deaf children we have studied has developed a gestural system that has many, but obviously not all, of the properties of human natural languages (Goldin-Meadow and Feldman, 1975, 1977; Feldman, Goldin-Meadow and Gleitman, 1978; Goldin-Meadow, 1979, 1982, 1985; Goldin-Meadow and Morford, 1985). Moreover, the gestural systems developed by these deaf children have been shown to be structurally more complex than the gestures produced by the childen's hearing parents (Goldin-Meadow and Mylander, 1983, 1984).

All ten deaf children were found to develop gestural lexical items of two types. First was the noun-like *deictic sign* used to refer to people, places, and things (e.g., a pointing gesture that relies heavily on context for interpretation, analogous to "that" or "there" in the speech of a comparably aged hearing child). Deictic signs interpreted in context were assumed to convey semantic case roles such as patient, actor, and recipient. The second type of lexical item developed by the deaf children was the verb/adjective-like *characterizing sign* used to refer to actions and attributes (e.g., a pantomimed action or trait such as a fist held at the mouth, accompanied by chewing, to signify "eat," or the index finger and thumb forming a circle in the air to mean "round"). Characterizing signs were assumed to convey predicate functions, both action and attribute.

All ten deaf children were found to concatenate their lexical items into sign sentences expressing the typical semantic relations found in child speech. For example, one child pointed at a block tower and then signed HIT (fist swat in air) to indicate that he had just hit the tower. In another example, the same child signed HIT, then pointed at his mother to request her to perform the hitting. The sign sentences produced by each of the deaf children were found to conform to rule-governed regularities of two types: (1) Construction-order regularities which described the location in the surface structure of a simple sentence where a particular semantic element (case or predicate) tended to appear (for example, signs for the patient tended to precede signs for the act; point at an apple, followed by the act sign EAT). (2) Production probability regularities which described the likelihood of a particular case or predicate to be signed in the surface structure of a simple sentence (patients were most likely to be signed, actors were least likely; for instance, the patient "apple" would be more likely to be explicitly produced in a sentence about eating than would the actor "boy").

Finally, each of the deaf children exhibited rules of recursion in their gesture systems. Each child was able to generate novel complex sentences (containing at least two propositions or semantic relations) from combinations of simple, one-proposition sentences. For example, the child might point at a tower, produce the HIT sign and then (without breaking the flow of movement of his arm) produce the FALL sign [flat palm flops over in air] to comment on the fact that he had hit [act_1] the tower and that the tower had fallen [act_2].

In sum, we have found that deaf children, even without the benefit of a conventional language model, can develop a gestural communication system which displays some of the observed properties characteristic of early child language (constructional ordering of elements, differential probabilities of production of elements, and recursive concatenation of semantic relations).

1.3 *A Study of Redundancy in the Deaf Child's Complex Sentences*

In the present study, I will focus on the deaf child's complex sentences, in particular, on redundancy in those complex sentences. At the outset, it is important to point out that my analysis of redundancy in the deaf child's complex sentences will differ from analyses of redundancy in English-learning children's complex sentences simply because ellipsis is so frequent in the deaf child's sentences. It is extremely uncommon to find surface redundancy (i.e., 2 occurrences of an element in surface structure, e.g., "you *jump* and mommy *jump*") in the deaf child's complex sentences. As a result, we cannot easily talk of reducing surface redundancy (in the sense of reducing 2 surface occurrences of an element to 1) in the deaf child's complex sentences, nor is it then possible to consider the direction of redundancy reduction in the deaf child's complex sentences.

Nevertheless, the deaf child's complex sentences can be said to have redundancy at underlying levels. In particular, we have found that many of the deaf child's complex sentences contain shared elements in propositional structure, i.e., elements that a play a role in each of the propositions of a complex sentence. My analysis of the deaf child's complex sentences consequently will focus on shared elements in the propositional structure of those sentences.

To understand how my analysis of redundancy in the deaf child's complex sentences can be compared to analyses of redundancy in English-learning children's complex sentences, it is important to realize that, for English-learning children, the structural constraints on redundancy and redundancy reduction in complex sentences (i.e., the bias toward rightward redundancy reduction) have an indirect effect on

propositional structure. Since unmarked word order in English is SVO, redundancy patterns which allow rightward reduction tend to result in sentences with the subject as the site of expressed redundancy ($SV_1O_1 + SV_2O_2$) or the site of reduced redundancy ($S[V_1O_1 + V_2O_2]$). Moreover, since the subject in young English-learning children's sentences often represents an actor, the children's sentences tend to have propositional structures in which the actor (as subject) is redundant at an underlying level, i.e., plays a role in both propositions (e.g., "And *duckies* run and *duckies* quack"). Conversely, the English-learning child's bias against patterns which allow leftward reduction tends to result in *few* sentences with the predicate as the site of expressed redundancy (e.g., $S_1VO + S_2VO$) or the site of reduced redundancy (e.g., $[S_1 + S_2]VO$). Since the predicate in English-learning children's sentences tends to represent actions and objects, the children express few sentences with propositional structures in which the action and/or object play a role in both propositions (e.g., "Debbie *fall on the horsie* and me *fall on the horsie*").

This line of reasoning suggests that the language model to which a child is exposed, by providing structural (branching) information which sets a bias toward either rightward or leftward redundancy reduction, indirectly affects the propositional structure of the child's complex sentences, i.e., affects which elements are shared across propositions. But what if a child were not exposed to any conventional language model whatsoever? What biases would develop in the propositional structures of the complex sentences of such a child?

I have attempted to address this question by describing the nature of shared elements in one deaf child's complex sentences. In particular, I first ask (in section 3) whether there are any shared elements at all in the propositional structure of the complex sentences of a deaf child developing a gestural language without a conventional language model. If, as turns out to be the case, shared elements can be found at the propositional level, I next ask whether there are any constraints on which elements in a sentence will tend to be shared (as there appear to be constraints for English-learning children).

Finally, in section 4, I ask how the deaf child deals with underlying redundancy in the surface structure of his complex sentences. Is there a systematic device for treating shared elements differently from unshared elements in the surface structure of the deaf child's complex sentences and, if so, are there constraints on the way that device treats particular shared elements and not others (as there seem to be for the redundancy reduction devices in the surface structures of English-learning children's complex sentences)?

2. DATA BASE

The data for this report come from our most prolific deaf subject, David, who over the course of our studies produced complex sentences (i.e., sentences which contained two or more propositions) in approximately 30% of the 1700 sign sentences observed. The boundaries of a deaf child's sign sentences were determined by tension and relaxation of the hands: If the child produced two or more signs without breaking the flow of movement and without relaxing his hand or arm, we coded those signs as part of one sentence. If the signs in that sentence conveyed two or more propositions (even if those propositions were conveyed incompletely), that sentence was then classified as complex.

The data were gathered over 13 sessions, beginning when David was 2 years, 10 months old and ending when he was 4 years, 10 months old. Informal play with a standard set of toys was videotaped approximately every two months in his home. The videotapes were transcribed and coded according to the system described in detail in Feldman et al. (1978) and Goldin-Meadow (1979; see these reports and Goldin-Meadow and Mylander, 1984, as well for information on criteria and reliability for each of the coding categories and also for further details on procedure).

We reviewed the videotapes first to extract those motor acts which appeared to be used symbolically for communicative purposes, and then described those acts borrowing from the system developed by Stokoe (1960) to describe American Sign Language. We next segmented these gestures into word units and sentence units. Finally, we assigned semantic meanings to each of the sign words and sign sentences, using as guides Bloom's (1970) method of rich interpretation and Fillmore's (1968) case descriptions.

In assigning semantic descriptions to sentences, we classified each sentence according to the number of propositions contained within that sentence. Most of David's productions were simple sentences, containing only one proposition. For example,

(1) a. HIT mother [David IVa 81][2]
b. you/mother hit (blocks)

Line (a) of the example should be read from left to right; the sign that occurs first in the temporal sequence is the first entry on the left. Deictic signs are represented in lower case letters (e.g., a point at mother is represented as "mother"), and characterizing signs are represented in capital letters (e.g., a fist swatting in the air is represented as "HIT"). Line (b) of the example includes explicitly signed elements (hit, mother) as well as elements that were not signed but were inferred from context (blocks). The implicit elements are enclosed in parentheses in line (b).

David also produced complex sentences containing more than one proposition. For example,

(2) a. knife$_1$ David knife$_2$ sister [David IVa 135]
b. (she/mother) (gave) knife$_1$ (to) me/David (and) (she/mother) (gave) knife$_2$ (to) you/sister
c. *she gave* knife$_1$ to me and knife$_2$ to you

In examples of complex sentences, line (a) of the example should again be read from left to right, and contains translations of the signs actually produced in the sentence. Line (b) includes glosses of semantic elements that were not explicitly signed but were inferred from context (again, represented in parentheses). Note that for complex sentences, shared elements (i.e., elements that played a role in both propositions) are mentioned twice in line (b), once in each proposition regardless of whether the element was signed twice, once, or not at all. In addition, for complex sentences we have included a third line, line (c), in which shared elements are italicized but are represented only once in the gloss, again regardless of how often the elements were signed in the actual sentence. Line (c) approximates an English gloss of the sentence. We followed English rules of redundancy reduction in formulating the glosses in line (c).

When coding complex sentences, we noted explicitly the relationship that linked the two propositions in each complex sentence. David produced complex sentences containing propositions linked coordinately (sentences in which an "and," "but" or "or" conjunction would be appropriate; see example 3), as well as sentences containing propositions linked temporally, causally, or subordinately (sentences in which a "then" [or "and then"], "cause" or "which" conjunction would be appropriate; see example 4). Although David did not ever produce explicit signs for any of the connectives, connectives could be reliably inferred on the basis of context using semantic rather than structural criteria (i.e., the connective was determined on the basis of the relationship the two propositions held to one another and not, for example, on the basis of the actual order of the signs in the sentence).

(3) a. guitar$_1$ STRUM guitar$_2$ STRUM [David VIIIb 4]
b. (Santa$_1$) strums guitar$_1$ (and) (Santa$_2$) strums guitar$_2$
c. Santa$_1$ *strums* guitar$_1$ and Santa$_2$ guitar$_2$

(4) a. TAKE-OUT glasses DON [David VIIIa 177]
b. (you/Heidi) take-out glasses (then) (I/David) don glasses
c. you take-out then I don *glasses*

We further classified David's complex sentences according to the number and types of elements that played a role in both propositions of the complex sentence (i.e., according to the number and types of shared elements in a complex sentence). Sentence 5 is an example of a complex sentence with no shared elements, sentence 6 is an example of a sentence with one shared element (the actor, "horse"), and sentence 7 is an example of a sentence with three shared elements (the actor, "Heidi," the act, "put," and the recipient, "village"). The shared elements are italicized in line (c) of each example. It is important to note that an element was considered shared if it played a role in both of the inferred propositions of a complex sentence, *whether or not* a sign for that element appeared explicitly in the surface structure of the sentence.

(5) a. THROW SPREAD-APART [David Vb 45]
b. (you/Susan) spread-apart (then) (I/David) throw (toy-fruit)
c. you spread-apart then I throw toy-fruit

(6) a. CLIMB SLEEP horse [David Va 212]
b. horse climbs (house) (then) horse sleeps
c. *horse* climbs house then sleeps

(7) a. [headshake] toy$_1$ village toy$_2$ village [David VIIa 51]
b. No, (you/Heidi) (put) toy$_1$ (in) village (and) (you/Heidi) (put) toy$_2$ (in) village
c. No. *you put* toy$_1$ and toy$_2$ in *village*

The data base for this report includes only those complex sentences which contained two action propositions (with actions either explicitly conveyed by characterizing signs or implicit and inferred from context) produced by David during sessions I through XIII (149 in *toto*).[3] In the analysis of the site of shared elements in the propositional structures of David's complex sentences (section 3), only those complex sentences which were coordinately linked (73 sentences) are considered (see below). In section 4, analysis of the marking of shared elements in the surface structures of David's complex sentences, all 149 of David's complex sentences are considered.

3. THE SITE OF SHARED ELEMENTS IN THE PROPOSITIONAL STRUCTURE OF THE DEAF CHILD'S COMPLEX SENTENCES

I have limited my analysis of the site of shared elements in the propositional structure of the deaf child's complex sentences to the subset of David's complex sentences which were coordinately linked (73 in toto) in order that this data base be as comparable as possible to the data base in studies of spontaneously produced complex sentences in English-learning children (cf., Lust and Mervis, 1980; Tager-Flusberg et al., 1982). For this analysis, I have defined a shared element as any semantic element which was involved in both propositions of a two-proposition sentence, independent of whether that element was explicitly signed in the surface of the sentence. For example, in David's sentence "CLIMB SLEEP horse" (glossed as 'horse climbs house then sleeps'), the horse is the actor in both propositions (i.e., he is both climber and sleeper) and is therefore considered a shared element, even though the sign "horse" appears only once in the sentence actually produced. Thus, this analysis is focused on shared elements in the propositions which *underlie* the child's complex sentences.

3.1 *Shared Elements in David's Coordinate Complex Sentences*

Of David's 73 coordinately linked complex sign sentences analyzed in this study, 59 or 81% contained shared elements (i.e., contained an element which was redundantly represented in line (b) and italicized in line (c) of our glosses). These 59 sentences form the corpus of the analysis which follows in this section.

I first attempted to determine whether David preferred to coordinately link complex sentences containing particular types of shared elements. To this end, I classified each of David's 59 sentences according to the site in propositional structure of the sentence where a shared element was noted. David produced coordinately linked complex sign sentences with four types of patterns of shared elements. Each of these patterns is exemplified below.

The Actor as the Shared Element. 39% of David's 59 coordinately linked complex sentences with shared elements had propositional structures with shared actors. In 13 of these sentences, the actor alone was the shared element, exemplified in sentence 8 where only "cowboy" is shared across the two underlying propositions.

(8) a. cowboy RIDE TWIRL [David XIIb 51]
b. cowboy rides (horse) (and) cowboy twirls (rope)
c. *cowboy* rides horse and twirls rope

In addition, David produced 10 sentences (all of which were sentences with objects) in which not only the actor but also the action was shared. These sentences are exemplified in sentence 9 where "soldier" and "beats" are the shared elements in the two underlying propositions.

(9) a. [headshake] guitar drum soldier [David IXa 193]
b. soldier (beat) drum (but) soldier not (beat) guitar
c. *soldier beats* drum but not guitar

The Action and Object as the Shared Elements. 42% of David's 59 sentences had propositional structures which shared the action alone in sentences with no objects, or which shared both the action and the object in sentences with objects (either direct objects, i.e., patients, or indirect objects, i.e., recipients). Sentence 10 illustrates a conjunction of propositions in which both "eat" and "lunch" are shared elements.

(10) a. Lisa [headshake] EAT David EAT [nod] David [David Vb 73]
b. you/Lisa not eat (lunch) (but) I/David eat (lunch)
c. not you but I *eat lunch*

The Actor and Object as Shared Elements. 15% of David's 59 sentences had propositional structures with shared elements in the actor as well as in the object, usually the direct object (the patient) but occasionally the indirect object (the recipient). For example, in sentence 11 "Heidi" appears in both propositions as an actor and "bus" appears in both as an object (patient).

(11) a. Heidi STOP CAPTURE [David VIIIa 316]
b. you/Heidi stop (bus) (and) you/Heidi capture (bus)
c. *you* stop and capture *bus*

The Action Alone as the Shared Element. Finally, 3% of David's 59 sentences were sentences which contained actors, actions, and objects in propositional structure, but which had shared elements in the action and not the actor or the object. Sentence 12 is an example, where "strum" is the shared element in the two propositions and an English gloss of the sentence would be "$Santa_1$ *strums* $guitar_1$ and $Santa_2$ Ø $guitar_2$."

(12) a. $guitar_1$ STRUM $guitar_2$ STRUM [David VIIIb 4]
b. ($Santa_1$) strums $guitar_1$ (and) ($Santa_2$) strums $guitar_2$
c. $Santa_1$ *strums* $guitar_1$ and $Santa_2$ $guitar_2$

3.2 *A Comparison to Shared Elements in the Coordinate Complex Sentences of English-Learning Children*

As reported above, 81% of David's 73 coordinate complex sentences contained some sort of shared element in propositional structure. In comparison, 92% of the 63 coordinate complex sentences produced by the 32 English-learning children (ages 2—0 to 3—1) in Lust and Mervis' (1980) study contained some sort of shared element in propositional structure. Similarly, in their study of three English-learning children (ages 1—5 to 1—8), Tager-Flusberg et al. (1982) found that 86% of Adam's 187 coordinate complex sentences, 94% of Sarah's 82 sentences, and 95% of Eve's 91 sentences contained shared elements in propositional structure. Thus, David's signed coordinate complex sentences were similar to the young English-learning child's spoken coordinate complex sentences with respect to the percentage of shared elements in propositional structure.

However, David's sentences did differ from the English-learning child's in terms of which semantic elements in propositional structure tended to be shared. Recall that 39% of David's coordinate complex sentences had propositional structures with shared actors and 42% had propositional structures with shared actions and objects.[4] In contrast, both Lust and Mervis' and Tager-Flusberg et al.'s subjects produced many more sentences which had propositional structures with shared actors than with shared actions and/or objects.[5] In the Lust and Mervis study, 76% of the children's 51 coordinate complex sentences with shared elements had propositional structures with shared actors, while only 14% had propositional structures with shared actions and/or objects. In the Tager-Flusberg et al. study, 87% of Adam's 161 coordinate complex sentences with shared elements, 89% of Sarah's 77 sentences, and 62% of Eve's 86 sentences had propositional structures with shared actors, while only 13%, 11% and 38% of each child's sentences, respectively, had propositional structures with shared actions and/or objects. Thus, while the English-learning children in the Lust and Mervis and Tager-Flusberg et al. studies showed a bias toward producing coordinate complex sentences which describe a single actor performing two different actions or the same action on two different objects, David showed no such bias.

As described earlier, Lust (1981) suggests that the bias toward shared actors displayed in the propositional structure of the English-learning child's early complex sentences is an indirect effect of the language model to which the child is exposed. In particular, it is an outgrowth of the right-branching structure of the English language model. We have found that a child who lacks a conventional language model can develop a gestural communication system with frequent use of shared elements in the propositional structure of his complex sentences, but with no preference for shared actors as opposed to other shared elements in his propositional structures. The fact that a child developing language without input from a language model shows no bias toward shared actors suggests that this bias may indeed reflect the effects of structural information in the language model, and not a semantic bias which the child brings to the language-learning situation.

4. MARKING SHARED ELEMENTS IN THE SURFACE STRUCTURE OF THE DEAF CHILD'S COMPLEX SENTENCES

We turn now to the level of surface structure, and ask whether the deaf child has developed a technique for explicitly distinguishing shared elements from unshared elements in the surface forms of his sign sentences.

4.1 *Distinguishing Shared from Unshared Elements in David's Complex Sentences: Reduction*

4.1.1 *Production Probability as a Marking Device*

To begin, it is important to note that ellipsis was extremely common in David's sign sentences. Few of his two-proposition sentences contained more than four signs in surface structure but many had five or six elements in underlying structure. Thus, many elements in the propositional structures of David's complex sentences were not explicitly signed in the surface forms of those sentences. In fact, shared elements (elements which played a role in both propositions and therefore could, in principle, have appeared twice in surface structure) were actually signed twice in only 16 (13%) of David's 120 complex sentences which contained shared elements in propositional structure.

In our previous work, we have found that deletion is not random in the deaf child's sign sentences, but rather follows a systematic pattern and serves to distinguish (or mark) semantic elements in the child's simple sign sentences. In particular, we have found that semantic elements in the deaf child's simple sentences differed in terms of the probability with which each element was signed in the surface forms of the sentences (Feldman et al., 1978; Goldin-Meadow, 1979). For example, patients were found to have a high production probability (were relatively likely to be explicitly signed in the deaf child's simple sentences) while actors were found to have a low production probability (were relatively unlikely to be signed). Thus, in simple sentences, probability of production or deletion serves the function of distinguishing or marking particular cases.

I consider here the possibility that production probability in complex sentences also serves a marking function; that of distinguishing shared elements from unshared elements. I am, in effect, suggesting that the probability of producing a particular semantic element when it is involved in *both* propositions of a complex sentence (the shared element) might differ systematically from the production probability of the same semantic element when it is involved in only one proposition of a complex sentence (the unshared element).

I look first at David's complex sentences taken as a whole. Overall, David was more likely to produce a sign for a semantic element when it was unshared than when it was shared in his complex sentences. 52% of the 111 unshared patients in the propositional structures of David's complex sentences were signed, while only 32% of the 65 shared patients in the propositional structures of his complex sentences were signed. Similarly, 47% of David's 178 unshared actors were signed, while only 31% of his 105 shared actors were signed. Thus, ignoring for the moment the differences across sentences in underlying and surface structure, there appears to be a systematic distinction between shared and unshared elements in David's complex sentences.

It is important to note, however, that the likelihood with which an element is signed in a sentence is *not* independent of the number of elements in both the underlying and surface structures of that sentence. As a result, it is necessary to determine the production probabilities of shared and unshared elements taking both underlying structure and surface structure into account. Since the relationship between production probability and underlying structure is relatively complex, it is necessary to discuss underlying structure and its effect on production probability in some detail before looking at the question of production probability as a device for marking shared and unshared elements in the deaf child's complex sentences.

4.1.2 *The Effect of Underlying Structure on Production Probability*

We have found previously in simple sentences that production probability of a given semantic element is affected by the number of elements in underlying structure. For simple sentences of a given length (i.e., holding the number of elements constant in surface structure), the *fewer* the number of elements in underlying structure, the *more* likely a particular element was to be signed explicitly in surface structure (Goldin-Meadow, 1979, 1985). For example, the actor case in a two-sign sentence with a 3-element underlying structure (1 predicate and 2 cases, e.g., "frogs eat flies") was less likely to be signed than was the actor case in a two-sign sentence with a 2-element underlying structure (1 predicate and 1 case, e.g., "frogs jump"). We have interpreted this phenomenon to reflect more "competition" for the two surface slots among the elements in a 3-element underlying structure than among the elements in a 2-element underlying structure.

In complex sentences, we have similarly found that production probability decreased as the number of elements in underlying structure increased. For example, the likelihood of an actor being signed explicitly in a three-sign sentence with 6 elements in underlying structure (e.g., "John beats the drum and Mary strums the guitar") is less than its likelihood of being signed in a three-sign sentence with 5 elements in underlying structure (e.g., "John beats the drum and Mary dances"). However, in complex sentences, production probability was found to decrease systematically as the number of elements in underlying structure increased *only if* we calculated the number of elements in underlying structure on the basis of phrasal and not sentential conjunction (Goldin-Meadow, 1982). Phrasal conjunction is a coordination of noun phrases, verb phrases, or other nonsentential constituents, as opposed to sentential conjunction which is a coordination of sentences (see Dik, 1968; Dougherty, 1970, 1971; Gleitman, 1965; Lakoff and Peters, 1969; for discussions of sentential and phrasal conjunction). The question for the deaf child's system (and for linguistic theory as well) is whether only one or both types of conjunction can occur in underlying structure.

As an example of conjunction in the deaf child's system, consider David's two requests of Heidi: "OPEN BLOW wand" (glossed as 'you/Heidi open the jar and then blow the wand'). If we assume that only sentential conjunction can occur in underlying structure, then the underlying structure of this complex sentence would contain two complete sentences (i.e., 'you/Heidi open jar and you/Heidi blow wand'), and the shared element (Heidi) would be represented two times in underlying structure. In contrast, if we assume that phrasal conjunction (in this instance, conjunction of two verb phrases) can occur in underlying structure, the underlying structure of this sentence would be 'you/Heidi open the jar and blow the wand,' and the shared element (Heidi) would be represented only once in underlying structure.

We have shown previously that if we assume that only sentential conjunction can occur in the underlying structure of the deaf child's complex sentences (accounting for an underlying structure of 6 elements in the above example), we find no systematic relationship whatsoever between production probability and underlying structure (Goldin-Meadow, 1982). If, however, we assume that phrasal conjunction can also occur in the underlying structure of the deaf child's complex sentences (accounting for an underlying structure of 5 elements in the above example) and alter our calculations of production probability accordingly, we find that production probability systematically decreases as the number of elements in underlying structure increases (Goldin-Meadow, 1982).

As noted previously, this systematic relationship between production probability and underlying structure (i.e., systematic decrease in production probability as the number of elements in underlying structure increases) is found robustly in the simple sentences of each of the ten deaf children in our studies (Goldin-Meadow, 1979, 1985), as well as in the simple sentences of hearing children (Goldin-Meadow and Mylander, 1984). Following the bootstrap approach we have used previously to determine structural regularities in the deaf child's gesture system, I take the systematic relationship between production probability and underlying structure in David's complex sentences as evidence that phrasal conjunction can occur in the underlying structure of those complex sentences.

4.1.3 *Calculating Production Probability in Complex Sentences*

In the present analysis, I have calculated the number of elements in the underlying structure of David's complex sentences assuming that phrasal conjunction occurs in underlying structure, i.e., assuming that shared elements are represented only once in underlying structure.[6] Further, I have held the number of elements in *underlying structure* constant when comparing calculated production probabilities in David's complex sentences. In addition, because the number of signs actually produced in a sentence affects production probability (the more signs produced in a sentence, the greater the likelihood that the elements in the propositional structure of that sentence will be signed in surface structure, i.e., the higher the production probability of the elements in the sentence), I have also held constant the number of elements in *surface structure* when comparing calculated production probabilities in David's complex sentences.

As an example, when calculating production probability for the shared actor, I first classified each sentence produced by David according to the number of elements it contained at both underlying and surface levels. The sentence, "OPEN BLOW wand," glossed as 'you/Heidi open the jar and blow the wand,' was classified as having an underlying structure of 5 elements (1 shared actor [Heidi], 2 acts [open and blow] and 2 patients [jar and wand]), and a surface structure of 3 elements (open, blow, and wand). Production probability for the shared actor was then derived by taking the number of times a sign for the shared actor actually appeared in surface structure (0 in this example), divided by the number of times the shared actor appeared in underlying structure (once in this example), and in this case was 0/1 (0.00). Production probability was calculated for sets of sentences having the same number of elements in underlying structure and surface structure.

Production probability for a set of sentences was taken to be the average of production probabilities for the individual sentences in that set. Thus, production probability for the shared actor in the sentence in the above example would be averaged in with production probabilities for the shared actors in all of David's sentences with shared actors and with underlying structures of 5 and surface structures of 3.

Examples of the complex sentences that formed the data base for the production probability calculations are listed in Table I. All of the sentences in the table have 5 elements in underlying structure and are classified according to the target semantic element (patient or actor), whether or not the target element was shared or unshared, and the number of elements in surface structure (two or three).

4.1.4 *Production Probability of Shared and Unshared Elements*

Table II presents production probabilities for the shared and unshared patients in David's complex action sentences (including coordinately, temporally, causally, and subordinately linked two-action complex sentences), classified according to the number of elements in underlying structure and in surface structure. As we would expect, production probability for both the shared and unshared patients tended to decrease systematically as the number of elements in underlying structure increased, for sentences containing either 2, 3, or 4 elements in surface structure. Note, however, that independent of number of items in surface structure, production probability for the *shared* patient tended to be *lower* than production probability for the *unshared* patient. This pattern is particularly evident in two- and three-sign complex sentences and less marked in complex sentences with four elements in surface structure. Thus, holding underlying structure and surface structure constant, shared patients appear to be distinguished from unshared patients by their relatively lower production probability.

Table III presents comparable production probability data for shared and unshared *actors*, again classified according to the number of elements in underlying structure and surface structure. Again we find that production probability for both the shared and unshared actors tended to systematically decrease as the number of elements in underlying structure increased, for sentences containing either 2, 3, or 4 elements in surface structure. Further, we find that where comparison

TABLE I
Examples of David's Complex Sentences with 5 Elements in Underlying Structure[a]

Patients in Complex Sentences

UNSHARED PATIENTS

(1) *Two* Elements in Surface Structure
- (a) POW-WOW head [David IXa 81]
- (b) (Indian) pow-wows; (Indian) (puts) (feather) (on) head
- (c) Indian who pow-wows puts *feather* on head

(2) *Three* Elements in Surface Structure
- (a) [headshake] SWING mouse OPEN/CLOSE [David IXa 208]
- (b) No, (duck) swings (but) mouse opens/closes (scissors)
- (c) No, duck swings but mouse opens/closes *scissors*

SHARED PATIENTS

(1) *Two* Elements in Surface Structure
- (a) PUSHDOWN GIVE [David Xa 173]
- (b) (you/Heidi) give (bus) (to me/David) (by way of) (you/Heidi) pushing-down (bus)
- (c) you give *bus* to-me by pushing-down

(2) *Three* Elements in Surface Structure
- (a) TAKE-OUT glasses DON [David VIa 151]
- (b) (you/Heidi) take-out glasses (then) (I/David) don glasses
- (c) you take-out then I don *glasses*

Actors in Complex Sentences

UNSHARED ACTORS

(1) *Two* Elements in Surface Structure
- (a) THROW SPREAD-APART [David Vb 45]
- (b) (you/Susan) spread-apart (then) (I/David) throw (toy-fruit)
- (c) *you* spread-apart then *I* throw toy-fruit

(2) *Three* Elements in Surface Structure
- (a) me/David you/Heidi she/sister [David Xb 48]
- (b) you/Heidi (give) (penny) (to) me/David (or) she/sister (give) (penny) (to) me/David
- (c) *you* or *she* give penny to-me

SHARED ACTORS

(1) *Two* Elements in Surface Structure
- (a) BACK-UP GO-FORWARD [David XIIb 6]
- (b) (firetruck) backs-up (off book) (then) (firetruck) goes-forward (down street)
- (c) *firetruck* backs-up off-book then goes-forward down-street

(2) *Three* Elements in Surface Structure
- (a) cowboy RIDE TWIRL [David XIIb 51]
- (b) cowboy rides (horse) (and) twirls (rope)
- (c) *cowboy* rides horse and twirls rope

[a] The italicized word in line (c) represents the target element (i.e., the shared or unshared actor or patient) in each example.

TABLE II
Patient Production Probability in David's Complex Sentences

Number of Elements in Surface Structure	Number of Elements in Underlying Structure		
	Four	Five	Six
UNSHARED PATIENT			
Two	0.38 (8)[a]	0.00 (9)	0.00 (10)
Three	0.91 (11)	0.69 (13)	0.33 (6)
Four	1.00 (3)	0.93 (15)	0.67 (12)
SHARED PATIENT			
Two	0.00 (7)	0.00 (8)	0.00 (6)
Three	0.33 (6)	0.13 (8)	0.00 (3)
Four	1.00 (3)	0.75 (8)	

[a] The number in parentheses represents the total number of sentences in that category produced by David during the study. The blank cell indicates that David produced only 1 sentence of that particular type.

TABLE III
Actor Production Probability in David's Complex Sentences

Number of Elements in Surface Structure	Number of Elements in Underlying Structure		
	Four	Five	Six
UNSHARED ACTOR			
Two	1.00 (6)[a]	0.00 (6)	0.04 (23)
Three	1.00 (14)	0.36 (22)	0.25 (16)
Four	1.00 (4)	0.80 (15)	0.53 (15)
SHARED ACTOR			
Two	0.00 (19)	0.00 (16)	0.00 (3)
Three	0.42 (12)	0.36 (11)	
Four	1.00 (3)	0.62 (13)	0.33 (3)

[a] The number in parentheses represents the total number of sentences in that category produced by David during the study. The blank cell indicates that David produce no sentences of that particular type.

was possible, production probability for the *shared* actor tended to be *lower* than production probability for the *unshared* actor, although the pattern was not as striking as for the patient.

In sum, it appears that David did indeed have a systematic way of dealing with shared elements in his complex sentences: shared semantic elements were less likely to be signed (i.e., tended to have a lower production probability) than were unshared semantic elements (which tended to have a higher production probability).

4.2 *A Comparison to Surface-Marking Devices in the Complex Sentences of English-Learning Children*

We have found that David had a systematic procedure for dealing with underlying redundancy in the surface forms of his complex sign sentences. In particular, David distinguished semantic elements which were shared in propositional structure from semantic elements which were not shared by reducing the probability with which shared elements were signed in surface structure. Note that David's tendency to sign shared semantic elements *less* often than unshared semantic elements is not unlike the strategy of reducing redundancy found in the complex sentences of English-learning children.[7] In fact, David's reduction phenomena seem most often to involve complete ellipsis of shared elements (much like reduction in Japanese or Sinhalese, e.g., "Ø came and Ø stayed," Lust, pc). Thus, the basic principle of using some form of reduction to deal with shared elements appears to be characteristic of both David's gesture language and the spoken language of young English-learning children.

However, while English-learning children appear to show a bias in the way they treat shared elements in the surface structures of their complex sentences, David showed no such bias. Recall that the English-learning children in Lust's (1977) study, when asked to imitate coordinate complex sentences with elements redundantly represented in surface structure, tended to reduce redundant elements in the *subject* (typically a shared actor) more often than they reduced redundant elements in the *predicate* (typically shared actions and/or patients). For example, the children might imitate sentences like "babies laugh and babies cry" by changing the sentence (i.e., reducing the redundantly represented shared actor 'babies') to "babies laugh and cry," but would rarely change sentences like "mommies jump and babies jump" to "mommies and babies jump" (i.e., they would rarely reduce the redundantly represented shared action 'jump').

In contrast, David showed no bias in the way he treated shared elements in the surface structures of his complex sentences. Comparing Tables 2 and 3, we find that David did not tend to treat shared patients any differently from shared actors with respect to production probability. In particular, for sentences with the same number of elements in underlying and surface structure, the difference between production probability for the shared patient and the unshared patient (i.e., the amount of reduction for shared patients vis a vis unshared patients) tended to be no greater than the difference between production probability for the shared actor and the unshared actor (the amount of reduction for shared actors vis a vis unshared actors).[8] Thus, unlike English-learning children who reduced redundancy in the subject (shared actor) but not the predicate (including shared patients), David was as likely to omit shared patients as he was to omit shared actors.[9] David therefore did appear to systematically reduce underlying redundancy in the surface forms of his sentences (as do children learning English), but (unlike English-learning children) David did not appear to preferentially reduce redundancy in surface structure, perhaps because he had no model to bias him to do so.

5. CONCLUSION

This study has explored shared elements in the propositional structures of complex sentences in a language developed by a deaf child without the benefit of a conventional language model.[10] We have found that, even lacking linguistic input, a child can develop a gesture system with complex sentences which have propositional structures with shared elements, and can develop a systematic device (deletion) for distinguishing shared from unshared elements in those complex sentences. We have concluded that the young child appears to have the ability to deal with shared elements in propositional structure in a systematic and rule-governed fashion, even without the guidance of a conventional language model.

However, we have also found that the deaf child developing his gesture system without a language model *fails* to show certain *biases* in dealing with underlying redundancy, biases that the hearing child developing a spoken language with a language model appears to show.

In particular, children learning English are biased towards producing complex sentences which have propositional structures with shared actors rather than shared actions and/or objects. Moreover, when imitating sentences with shared elements redundantly represented in surface structure, English-learning children are biased towards reducing redundancy in sentences with shared actors rather than shared actions and/or objects. The deaf child in this study showed no such biases. In particular, the child studied here showed no preferences with respect to the site in propositional structure in which shared elements were likely to appear. He produced sentences which had propositional structures with shared actors approximately as often as sentences which had propositional structures with shared actions and/or objects. Moreover, the child displayed no preferences with respect to which shared element he was likely to delete from surface structure. He reduced production probability for shared actors approximately as much as he reduced production probability for shared objects (patients).

Lust (1981) has suggested that the bias toward shared actors and against shared actions and objects in the English-learning child's complex sentences is an indirect outgrowth of the language model to which the child is exposed; in particular, an outgrowth of the child's attention to the principle branching direction of the language he is learning. Under this hypothesis, it is the language model (more precisely, the child's interpretation of the language model) which is responsible for the biases seen in underlying and surface redundancy in the English-learning child's complex sentences.

But what of the child with no conventional language model? It is possible that a child without a conventional language model might not generate any systematic procedures for dealing with underlying redundancy in complex sentences. That is, all regularities for dealing with underlying redundancy might be "fragile," and unlikely to develop without a finely-tuned linguistic input. Alternatively, a child without a conventional language model might still generate systematic procedures for dealing with underlying redundancy, and might even generate procedures similar to those found in children learning conventional languages. In other words, the regularities for dealing with underlying redundancy might be "resilient," and likely to appear even under impoverished conditions of language input. To a degree, the results of this study support the "resilience" hypothesis — certain systematic procedures for dealing with underlying redundancy (in particular, systematic deletion procedures) appeared in David's language despite degraded linguistic input.

Recall, however, that although systematic deletion procedures were characteristic of David's complex sentences, *biases* in the application of deletion procedures (biases found in the early language of English-learning children — e.g., biases toward reducing redundancy in the actor) were *not* evident in the deaf child's complex sentences. The data from this study consequently suggest that while the tendency to reduce underlying redundancy is itself relatively resilient, biases in reducing underlying redundancy for some semantic elements but not for others are relatively fragile, and depend upon input from a conventional language model.[11]

In conclusion, the results of this study (necessarily tentative since the data come from a single child) provide indirect support for one hypothesized effect of a language model on propositional structure in the earliest complex sentences of child language. With the guidance of adult language models, children learning English develop biases with respect to shared elements in the propositional structures of their early complex sentences. Without the guidance of a conventional language model, the child in this study did *not*. A child appears able to develop many of the more resilient aspects of language (including aspects such as complex sentences with shared elements in propositional structure, and systematic reduction devices for dealing with those shared elements in surface structure) even without explicit structuring from a conventional language model. However, biases with respect to which elements are preferentially shared in underlying structure and are preferentially reduced in surface structure appear to be characteristics of language so fragile as to require the guidance of a conventional model to appear at all.

NOTES

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[1] Note that instances of both rightward and leftward reduction can be found in the adult forms of both English and Japanese. Thus, the particular constraints on redundancy described by Lust and her colleagues appear to be a feature of child and not adult languages.

[2] The information in brackets indicates the name of the child who produced the sentence (David), the session in which he produced the sentence (e.g., IVa), and the transcription number of the sentence (e.g., 81).

[3] For the analyses in this report, I leave aside those complex sentences containing more than two propositions (150), as well as those two-proposition sentences containing attribute propositions (162).

[4] It is interesting to note that David does show a bias against shared actions and/or objects in his non-coordinately linked complex sentences (i.e., his sentences linked temporally, causally, or subordinately). In particular, only 15% of David's 61 non-coordinate complex sentences with shared elements had propositional structures with shared actions/or objects. 41% of these 61 sentences had propositional structures with shared actors, 15% had propositional structures with shared actors and objects, and 9% had propositional structures with shared elements that switched roles (e.g., the shared element played a role as actor in one proposition and as patient in the other proposition).

[5] David produced one type of sentence with shared elements in which sentential conjunction rather than phrasal conjunction was assumed to occur in underlying structure. If a shared element was signed *twice* in the surface structure of a sentence (a relatively rare event — 16 of 120 sentences with shared elements, 13%), that shared element was considered to have two slots in the underlying structure of the sentence. If the shared element was signed once or not at all, that shared element was considered to have one slot in underlying structure as described in the text.

For example, sentence 8 "cowboy RIDE TWIRL" has only one occurrence of the shared actor (cowboy) in surface structure, and thus is considered to have phrasal conjunction in underlying structure. Under phrasal conjunction, the sentence is assumed to have 5 elements in underlying structure (1 shared actor [cowboy], 2 acts [ride, twirl], and 2 patients [horse, rope]) and 3 in surface structure (cowboy, ride, twirl). Production probability for the shared actor in the sentence is then 1.00, 1 (the number of times a sign for the actor appeared in surface structure) divided by 1 (the number of times the shared actor appeared in underlying structure). The sentence is compared with other sentences having 5 elements in underlying structure and 3 elements in surface structure.

If, however, sentence 8 were to have a second occurrence of the sign for cowboy in surface structure. e.g., "cowboy RIDE TWIRL cowboy," the sentence would then be considered to be an instance of sentential conjunction and would be assumed to have 6 slots in underlying structure (2 for the shared actor, 2 acts, and 2 patients) and 4 elements in surface structure (2 cowboys, ride, twirl). Production probability for the shared actor in this sentence would again be 1.00, 2 (the number of times a sign for the shared actor appeared in surface structure) divided by 2 (the number of times the actor appeared in underlying structure), but the sentence would be compared with other sentences having 6 elements in underlying structure and 4 in surface structure.

The decision to assign two slots in underlying structure to shared elements when they were represented twice in surface structure is admittedly an arbitrary one. However, a reanalysis of the data assigning one rather than two slots in underlying structure

to these twice-repeated elements yields a pattern of results identical to that displayed in Tables 2 and 3.

[6] The data on expressed and reduced redundancy in the Lust and Mervis (1980) study are reported in terms of subjects, verbs, and objects. The data in the Tager-Flusberg et al. (1982) study are reported in terms of redundancy patterns allowing forward (rightward) and backward (leftward) reduction. In order to compare these data to David's which are formulated in terms of semantic categories (actor, action, etc.), I translated the Lust and Mervis and the Tager-Flusberg et al. findings into semantic terms using the following two assumptions: (1) Since unmarked word order in English is SVO, I assumed that redundancy patterns that allow forward reduction primarily involve redundancy in the subject (S) and that redundancy patterns that allow backward reduction primarily involve predicate (VO) reduction. (2) Since in young children's early sentences, the subject often represents an actor and the predicate often represents an action (or an action on an object), I assumed that sentences with subject redundancy (expressed or reduced) tend to be sentences which have propositional structures with shared actors (i.e., sentences about a single actor performing two different actions or performing one action on two different objects) and that sentences with predicate redundancy (expressed or reduced) tend to be sentences which have propositional structures with shared actions and objects (i.e., sentences about two different actors performing the same action).

[7] I thank Lila Gleitman for pointing out to me the similarity between David's reduction strategy and the redundancy reduction strategies found in conventional languages.

[8] Note that while patients were far more likely to be signed than actors in the deaf child's simple sentences, patients (either shared or unshared) in complex sentences were just as likely to be signed as actors (shared or unshared) in complex sentences. Thus, the patient/actor case-marking rule (i.e., the rule that patients are marked by high production probability and actors marked by low production probability) seems to be applicable only in single proposition simple sentences in the deaf child's system.

[9] Systematic reduction of shared elements *vis à vis* unshared elements remains evident even when David's coordinately linked complex sentences are analyzed separately from his other types of complex sentences. Moreover, as in David's complex sentences overall, shared patients are no more likely to be reduced than are shared actors in the subset of David's complex sentences that are coordinately linked.

[10] Although David was receiving no *conventional* linguistic input, it is possible that his hearing mother spontaneously produced gestures which served as a model for David's gestured sentences. However, David's mother produced only 8 complex sentences (out of 68 total sign sentences, 12%) on the videotapes during a time period when David produced 88 complex sentences (out of 338 sign sentences, 26%) [X^2 (1) = 5.62, $p < 0.02$]. It is important to note that this difference in complex sign sentence production between mother and child did *not* appear to be attributable to a reluctance on the part of the mother to gesture on the videotapes. In fact, despite the fact that David's mother produced complex sign sentences less frequently than did her child (1.8 complex sign sentences per hour for mother vs. 8.6 for child), David's mother produced *single signs* almost twice as often as did her child (62.5 single signs per hour for mother vs. 39.5 for child). See Goldin-Meadow and Mylander, 1983, 1984, for further discussion.

[11] It is possible that the deaf child in this study failed to show biases with respect to

shared elements in the propositional structures of his complex sentences not because he lacked a conventional language model, but because he was developing his language in the manual modality. To determine whether the absence of bias in the deaf child's system stems from his lack of input or from the manual modality, it is necessary to determine whether the biases Lust and her colleagues observe in spoken language acquisition are also found in the acquisition of a conventional manual language. Studies of this sort have not yet been done on the acquisition of sign.

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