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What the Hands Reveal About the Brain.  
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## Chapter 3

### Signers with Strokes: Left-hemisphere Lesions

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#### 3.1 Gail D.: *The Agrammatic Signer*

When we first met Gail D., she was with her three deaf children, ages 9 to 14, all of them fluent in ASL, their “mother tongue.” The children were holding a lively conversation in ASL, describing the events that led up to and followed their mother’s left-hemisphere stroke some eight months before.

Our studies began with videotaping the children’s signing, which we later submitted to linguistic analysis. We assumed that the family’s signing would enable us to characterize Gail D.’s own prestroke signing and that the difference between her present signing and her children’s would make clear the linguistic nature of her impairment. The children’s ASL appeared to be rich and displayed all the appropriate inflectional and derivational morphology, including all the characteristic syntactic mechanisms of ASL, making full use of spatial contrasts to specify functions such as grammatical subject and object. In short, their colloquial ASL was perfectly full and correct. We felt assured that Gail D.’s prestroke language had been the same, a conclusion in which her brother, also a deaf signer, concurred.

At the time of the interview, Gail D., when compared to her children, presented us with a striking contrast. The difference between the mother and her children would have impressed even an uninformed outsider. The three bright-faced children were engaged in high-spirited, effortless interchange; their hands moved rapidly, smoothly, rhythmically. The commentary “changed hands” as each vied to take the conversational lead. Sitting between them, their mother looked from one to another as they took their turns. She, however, made almost no signs. She appeared to follow the conversation with eager attention, but even though she was its subject, she did not join in. An occasional nod, even an isolated sign came from her, but it was effortful, halting, and out of synchrony with the cadence of her children’s free-flowing interchanges and completed after a false start or two. To us her signs seemed appropriate but limited,

an indication that she was following the conversation—agreeing or disagreeing with what the children were telling us about her. Her frequent changes of facial expression registered her affective responses, but she seemed quite unable to initiate any communications about herself. We had the general impression that Gail D. was a vibrant, enthusiastic young woman, well tuned-in to the conversation, but her expression often turned into a grimace in the struggle to produce even an isolated sign—a pained reflection of her frustration.

Gail D. is a congenitally deaf woman, born of hearing parents. The etiology of her deafness, however, is hereditary; she has a deaf brother and a deaf sister. As a child she learned ASL from her deaf elder sister. She attended a school for deaf students and later worked as a postal employee and as a photograph retoucher. She was 38 at the time of testing, having experienced a left-hemisphere stroke some eight months before. Although initially her entire right side was affected, she had regained the use of her leg and face; her right arm, however, remained paralyzed. She had no apparent sensory deficit.

A CT scan performed eleven months after her stroke (figure 3.1) showed a left-hemisphere lesion:

#### *CT Findings*

There was a left-hemisphere lesion that involved most of the convexity of the frontal lobe, including Broca's area and the anterior portions of the superior and middle temporal gyri. The parietal lobe was spared, with the exception of the bottom of the postcentral gyrus and of small patchy lucencies in the white matter underlying the angular gyrus. The left internal capsule, putamen, and claustrum were also involved.

Gail D.'s children told us that her prestroke signing had been rich and effortless and much like their own but that after her stroke she suddenly became unable to communicate her thoughts through her language and certainly unable to formulate anything like a full statement. Even when she managed to bring forth a signed yes or no to signal agreement or disagreement, the ASL sign she produced occasionally seemed at variance with her intention, as when, in apparent agreement with someone else's claim about her, she nodded yes but signed no. Thus the lexical substitutions (so-called verbal paraphasias) that adversely affected her linguistic output did not always similarly affect her use of symbolic gestures in general.

By the time we began our testing, eight months after Gail D.'s stroke, the initial disabilities caused by the stroke had in many ways abated. Gail D. could now eat properly and could hold and manipulate objects, such as forks and pens, appropriately. She was also able to care for herself and for her family. Despite these recoveries in her

Gail D.

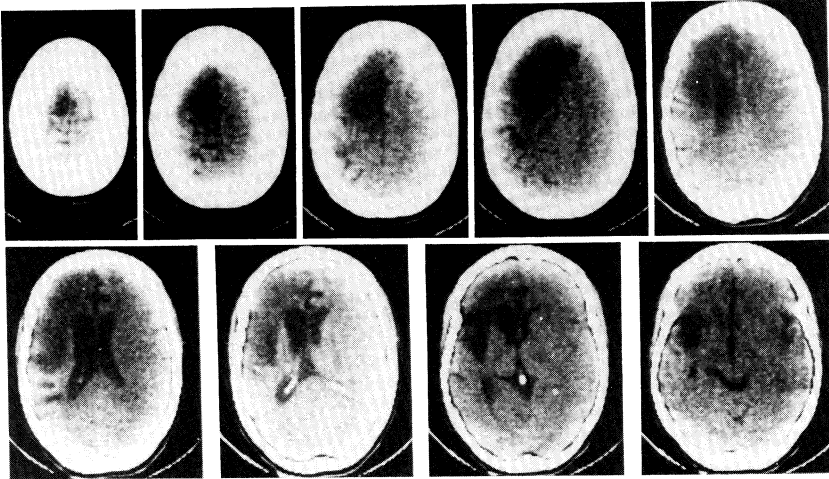
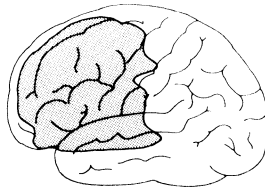


Figure 3.1  
Lateral reconstruction of lesion and CT scan of left-lesioned patient Gail D.

physical condition, however, Gail D. was still virtually unable to express herself in sign (although her family reported that she understood them when they were signing).

We now present a translation from ASL of part of an interchange between one of the examiners and two of Gail D.'s children:

EXAMINER: When did the stroke happen?

DAUGHTER: The first time it happened, I saw her. No, that time, both of us happened to see her standing, and then fall. It was hot, and it was in the summertime. She was standing in the kitchen, and she staggered and fell by the corner of the door. She lost her balance and fell on the floor. She was really dizzy. First I told her to go to bed; and I pleaded with her, and told her that she couldn't stand, and that I could cook for the family. "Go to bed," I said to her, "I know how to cook." But she stood near the corner, and then she just lost her balance and fell on the floor. I ran and tried to catch her, but I failed. I was holding her, and she was dizzy—it was terrible! We dragged her to the bed and tried



to pull her up on it. Her whole right side had become weak, and she had lost her ability to sign.

EXAMINER: What was her signing like after she returned from the hospital?

SON: It was hard to understand her language at first. I tried to catch what she meant. She seemed to know what she wanted to say, but it was hard for us to understand her. Sometimes her mind was confused at first. She could only answer yes or no, and even so we could not always be sure what she meant. She learned again, little by little, and now it is easier to make out what she is trying to sign. After her stroke, we had to take it step by step, and even to teach her the ABCs again.

Gail D. was 37 years old when she suffered this incapacitating stroke. From an interview with a close friend who was with the family throughout their problems, we learned more about the onset of the difficulties. Gail D. was in the hospital for three weeks after her stroke. At first, as the children indicated, she would not sign at all; communication for her was limited mostly to nodding her head to affirm or agree and to shaking her head to negate or disagree. Gail D. also had difficulty eating at first, not remembering how to hold a fork and trying to put the wrong end of it in her mouth. She would sometimes miss her mouth and try to direct her hand to her mouth. This lasted three to four weeks after the stroke. The children reported that the first sign Gail D. regained was CIGARETTE. Before the stroke she had been an inveterate smoker, which apparently provided enough motivation for this initial sign. Slowly she began to regain signs, one by one. Overall incapacitation and confusion such as this is not unusual during the initial recovery stage following a massive stroke.

Gail D. was born and raised in the West, the youngest in a family of five. Like her elder sister and brother, she has been deaf since birth. She went to the same residential school for deaf children as they did. Gail D.'s older siblings provided a sign language environment for her before she went to school. Her sign language environment was maintained during both elementary and high school, where the primary language used was ASL. She graduated from a residential high school with a vocational degree. During all those years her major form of communication was ASL—with classmates, dormitory counselors, friends, and other deaf adults. Gail D. married a deaf classmate and had three children, all of whom are deaf. These were the children we met during the first interview with Gail D. From childhood on, ASL

has been Gail D.'s primary form of communication. Before her stroke Gail D. had been active in the local association for the deaf and had many deaf friends.

### 3.1.1 *Agrammatic Language in Gail D.*

As has been indicated, Gail D.'s spontaneous output was extremely sparse after her stroke. In order to elicit a richer sample that might reveal more clearly the nature of her language impairment, we asked Gail D. to describe the Cookie Theft picture. By allowing her to describe a picture, we provided her with a reference point from which she could formulate her description in sign as carefully and slowly as she desired. The examiner also presented her with prompts when necessary. The picture, taken from the BDAE, is reproduced in figure 2.1. The picture is a standard in studies of agrammatism across many different languages. In later chapters we examine all six patients' descriptions of the Cookie Theft picture.

#### *Language Sample*

The following is a sample of Gail D.'s interchanges with the examiner, all in ASL. The examiner's probes are given in English translation; Gail D.'s signing is in English gloss for signs. Figure 3.2 shows Gail D.'s awkward rendition and effortful articulation of the sign BROTHER, taken from her description of the picture.

EXAMINER: What's that? [Pointing to the picture.]

GAIL D.: THREE.

EXAMINER: Who is that? [Pointing to the woman in the picture.]

GAIL D.: MOTHER.

EXAMINER: Who is that? [Pointing to the boy.]

GAIL D.: BROTHER . . . BROTHER . . . .

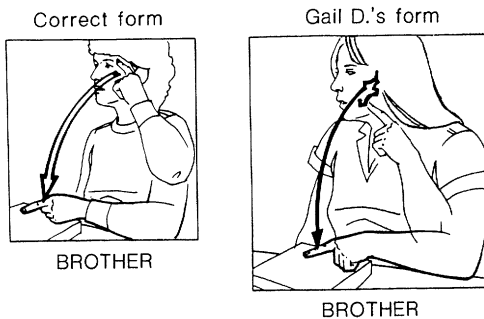


Figure 3.2  
Effortful production typical of Gail D.'s signing.

EXAMINER: What's happening there? [Pointing to the water spilling on the floor.]

GAIL D.: WHAT? [Points, gestures, mouths "oh."]

EXAMINER: What is that? [Pointing to the water again.]

GAIL D.: F- . . . E- . . . F- . . . A- . . . L- . . . L. [Fingerspells "fall" laboriously.]

EXAMINER: What is the woman doing there?

GAIL D.: [Fumbles and gestures, then signs] PLATE T- . . . E- . . . O- . . . W- . . . L. [Attempts to fingerspell "towel."]

EXAMINER: What is the woman doing?

GAIL D.: TURN-OFF. TURN-OFF.

EXAMINER: What does the girl want?

GAIL D.: [Mouths "cookie" but puts finger to lips as does girl in picture.]

EXAMINER: What does the boy want?

GAIL D.: C- . . . A- . . . O- . . . O- . . . K- . . . E. [Attempts to fingerspell "cookie."]

EXAMINER: The boy wants what?

GAIL D.: [Points to boy, then to girl, then fingerspells] G- . . . A- . . . V- . . . E.

EXAMINER: The boy gave her a cookie?

GAIL D.: YES.

EXAMINER: What happened there? [Pointing to the stool about to fall.]

GAIL D.: [Mouths "off" and "fall" fumbles.]

EXAMINER: It is falling?

GAIL D.: YES.

EXAMINER: Okay. The boy is falling?

GAIL D.: YES.

EXAMINER: What about the girl?

GAIL D.: [Puts finger to lips.]

EXAMINER: She wants a cookie? [Prompting.]

GAIL D.: YES.

EXAMINER: What about the mother here?

GAIL D.: [Mouths "off" and pantomimes turning the faucet off, then attempts to fingerspell.] F- . . . D- . . . A- . . . S.

EXAMINER: [Guessing.] Dish?

GAIL D.: YES.

EXAMINER: Okay, fine. That's a funny picture. [Both smile.]

As the transcription shows, even with the picture before her and the prompting, Gail D.'s signing is exceedingly sparse. She tries to form ASL signs and to fingerspell English words, but even these

simple words show transpositions and perseverations of the letters, for example, T-E-O-W-L for T-O-W-E-L. There are certain characteristics of Gail D.'s choice of means of communication that make her signing unusual, aside from the sparseness. First, there is an inordinate proportion of fingerspelled words. But more than that, for some of the items that she fingerspells, there are familiar and simple ASL signs that correspond to them. In such a passage the signs would be expected to occur rather than the fingerspelled words. These include the signs GIVE, COOKIE, and FALL, all of which Gail D. fingerspelled rather than signed. In other passages, though, Gail D. used these signs. In addition, she resorts to a variety of other methods of communication—the mouthing of English words, pantomime, and other nonsign gesturing. It is unusual that a combination of diverse communicative devices would occur in such an intermingled fashion within one description. Gail D. appears to be trying every device at her disposal to communicate, and after effortful attempts she appears blocked and continues to be so after switching from one mode of communication to another. This switching might well reflect a strategy that she adopted to bypass the blocking that rapidly develops within one mode of communication.

Gail D.'s signing consists largely of isolated open-class signs, without any of the grammatical apparatus of ASL. There are no grammatical inflections, no instances of derivational morphology, no compounding, no spatial indexing of nominals, and no verb agreement. Note, for example, that instead of signing the appropriate ASL verb GIVE, with its spatial inflections for verb agreement, Gail D. fingerspells instead. Her signed output is essentially a limited set of nouns and a few verbs, all in uninflected, simple citation form.

In fact, Gail D.'s signing of the Cookie Theft picture (figure 2.1) is similar to that of hearing patients who are classified as having Broca's aphasia. Goodglass and Kaplan (1972) present the following transcript for a case of an English-speaking Broca's aphasic describing the same picture.

EXAMINER: What happened?

PATIENT: Cookie jar . . . fall over . . . chair . . . water . . . empty  
. . . . OV . . . OV . . . .

EXAMINER: Overflow?

PATIENT: Yeah.

### *The Contrast between Broca-like Signing and Autistic Signing*

Deficits in language can take many forms. To sharpen our understanding of Gail D.'s language capacities, we found it instructive to compare her signing with the signing of another language-impaired

deaf woman whose signing bears some surface resemblance to that of Gail D. This young woman, Judith M., is a deaf autistic signer, also from a deaf family. She has deaf parents and two deaf elder brothers. The family communicates in ASL only, and the young woman has been surrounded all her life by ASL as a major form of communication. Her two elder brothers are native signers and college educated.

Judith M.'s first eleven months of life were, according to family reports, normal, with no traumatic events. Then, at the age of 11 months, she began to exhibit autisticlike behavior; she no longer made eye contact with the people around her. Instead of watching or responding to facial expressions, she stared listlessly at inanimate objects. She was diagnosed as autistic. Judith M. did not begin signing until the age of 5, when she produced the sign ICE-CREAM. We interviewed her at home with her family when she was 21. Like Gail D., Judith M. had a rich signing environment, in which her family signed all the time.

In what follows we give a sample interchange between Judith M. and her father (the father's ASL has been translated into English):

FATHER: Do you want to see a train?

JUDITH M.: SEE TRAIN. [An imitation of sign just produced by her father.]

FATHER: First, we will . . . ?

JUDITH M.: FIRST. [Imitation.]

FATHER: Second, we will . . . ?

JUDITH M.: SECOND . . . STORE.

FATHER: Yes, we will go to the store. Third, we will . . . ?

JUDITH M.: THIRD. [Imitation.]

FATHER: Yes, we will be home soon.

JUDITH M.: HOME, SOON. [Imitation.]

FATHER: What will we do on Wednesday?

JUDITH M.: STORE . . . TRAIN.

FATHER: That again?

JUDITH M.: AGAIN. [Imitation.]

FATHER: Father and Judith M. will go to a store.

JUDITH M.: STORE . . . FIRST . . . SECOND.

FATHER: In the morning, we first go to the store.

JUDITH M.: FIRST. [Imitation.]

### *Similarities in Signing of Gail D. and Judith M.*

There are certain similarities in the surface output of the two young deaf women communicating in ASL; the output of both is highly restricted. The signed utterances of each consist of only one or two

signs, without syntactic relationships expressed. Both signers are from rich signing environments in which ASL is the primary form of communication among family and friends; yet in contrast to the grammatically rich and motorically facile signing evident around them in the home, the two of them exhibit marked signing deficits. Like Gail D., Judith M. shows not a shred of the complex grammar of ASL (no sentences, no inflections, no derivational processes, no compounding, no embeddings, and no spatial organization). The sign output of both is dysfluent, halting, effortful, and awkward, but in somewhat different fashions. Both emit signs somewhat effortfully, even stiffly. Both have highly restrictive vocabularies in their spontaneous signing, so their output is extremely sparse and limited. Despite these similarities, however, there are also differences between the two women that highlight the particular nature of Gail D.'s deficit in sign language.

#### *Differences in Categorization*

Some important differences between the language of the two young women were revealed by their responses to pictures. Almost all of Gail D.'s signed responses were the appropriate names for the objects in the pictures. In fact, in giving names for objects presented in pictures, Gail D. not only was accurate but even emitted responses relatively easily on many occasions. In contrast, Judith M.'s responses were often bizarre and limited to the same few signs given again and again as a response to a variety of different objects. For example, we showed her fifteen pictures of animals—dogs, cats, rats, snakes, monkeys, lobsters, insects, horses, and birds, and asked her to name each. To rat, monkey, insect, and bird, she responded BIRD; to all the others, she responded DOG. Her responses to pictures of people were even more bizarre. She misidentified all the pictures of people in her first response, focusing on some nonessential or irrelevant feature or activity: To a picture of a man running, for example, she responded HAIR. (It is revealing that Judith M. does not refer to any of her three brothers by name, but rather calls each of them BOY.) In contrast, her responses to inanimate objects were far more varied and often correct (she correctly named a helicopter, train, chair, book, church, airplane, spoon, store, iron, house, ring, hanger, and bicycle). Sometimes she responded with an item in a semantically related category (to a picture of a wreath, she responded TREE; to a picture of a car, she responded BICYCLE). These unusual naming responses reveal a curious distribution in Judith M.'s vocabulary, which appears to map to her interests. Autistic persons often show more involvement with things than with people. In contrast, virtually all of Gail D.'s re-

sponses, though short and discontinuous, were correct and appropriate, no matter what category of item she named (persons, places, things, colors, numbers, letters, activities, and so on).

#### *Differences in Communicative Intent*

When we consider Judith M.'s conversation, we note that much of her contribution is a kind of echolalia, imitating signs just made to her. In discourse with her family she rarely initiated topics of conversation. On the few occasions when she did initiate some conversational topic, a limited set of functions was involved; all the functions were situation bound and self-centered. Sometimes Judith M. initiated a topic to excuse herself from uncomfortable situations or to satisfy needs, such as eating, drinking, sleeping, and bathing. Furthermore, she interspersed all kinds of mannerism in her discourse. She rarely made eye contact and tended to avoid social interaction. The examiner had to make a gentle attempt to get her attention for each situation and each picture elicitation. As one family member wrote us, she "initiates communication only to serve basic wants and needs of her own." She shows no variation in facial expression or gesturing, nor does she attempt to mime or to communicate in other ways. The family member wrote us also that Judith M. "appears generally incapable of abstract thought, and shows no indication that she responds to the feelings of others, but only exhibits limited, largely echolalic signing." This echolalic signing is interspersed with meaningless repetitive movements that appear empty of communicative intent. Despite her rich signing environment, her own signing—and the cognitive capacities that underlie her language—is highly limited.

In summary, Judith M. is echolalic and avoids eye contact or any other contact with people. She rarely signs spontaneously except for the minimum necessary to satisfy basic needs; she appears to have little or no cognitive communicative intent. These are characteristics that Judith M. has displayed since infancy. She is "in a world of her own," as her parents put it. As is typical of autistic people, she is strikingly deficient in linguistic and cognitive functions. But unlike Gail D., she gives no indication that she is aware of her language shortcomings or of the feelings, intentions, or language of those around her.

#### *3.1.2 A Broca-like Sign Profile*

Although the surface form of Gail D.'s signing has some similarities to Judith M.'s, Gail D. tries every means at her disposal to communicate. She makes eye contact; she tries urgently to communicate, to

indicate her ideas, and to engage in conversation with those around her. In her attempts to communicate, Gail D. not only struggles to express herself in signs but also attempts to mime, gesture, and even mouth or fingerspell English words. She is acutely aware of her difficulty in communicating and is constantly monitoring the responses of others, nodding vigorously when she is understood and indicating clearly when the addressee has misinterpreted her attempts to express herself. With a few signs and gestures Gail D. persists and often succeeds in communicating information about her past, family, childhood, and current experiences.

Gail D.'s signing output is limited to the expression of unadorned referential nouns and verbs, without any of the grammatical apparatus of ASL. It is clear that she has suffered a breakdown in specific aspects of linguistic functions that she once commanded. Despite her linguistic difficulties, she shows a zealous desire to communicate. Also, she shows the preservation of other cognitive functions, as the following results attest.

#### *Lexical Retrieval*

One important language function is the ability to access lexical items and associate them with their appropriate referents, that is, to bring up from memory the words that name specific things or actions or qualities. Gail D.'s spontaneous signing was extremely sparse, and what she did produce was almost exclusively uninflected nouns and verbs. In various tasks that we gave her, including some that required her to name pictures of objects, Gail D. showed that she could come up with the correct sign for the item presented. It is interesting that Gail D. often did not seem to have the same kind of effortful articulation on many of the naming tasks that she showed in spontaneous signing. She was rapid and, more important, accurate in naming objects. Figure 3.3 illustrates the kinds of effortful, awkward production Gail D. showed in her spontaneous signing of GIRL.

Because Gail D. was occasionally able to give a single sign response smoothly and rapidly, her deficit was clearly not a peripheral motor one but something more central. Furthermore, certain irregularities in Gail D.'s signing appear to depend on the linguistic function and structure of the unit she was attempting to produce, rather than on the form of the gesture itself. For example, a given gestural component, such as path movement directed toward her body, was preserved when that direction was a simple sublexical component of a sign, as when she signed ACCEPT. However, when that same path movement functioned as an inflectional morpheme (for example, indicating first person, as in BLAME-ME), she failed to produce it,



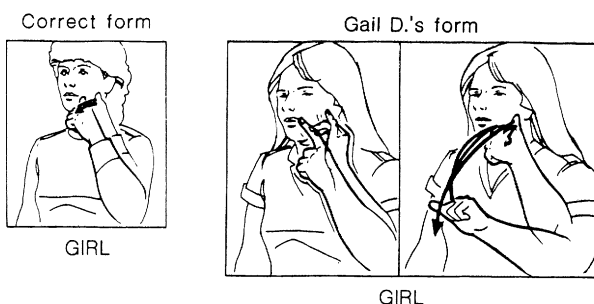


Figure 3.3

Articulatory difficulty characteristic of Gail D.'s signing. In the example Gail D. searches for the Hand Configuration and Movement of the sign, although on occasion she produces the sign smoothly.

signing instead the uninflected form. Thus her sign impairment cannot be simply a result of an inability to control and produce a given movement; it must be linguistically based.

As noted, Gail D. could produce many isolated signs if all that was required were morphologically simple, unmodulated open-class items. Her comprehension and memory for lexical items was good; she obtained a near-perfect score on a test of the comprehension of single signs. She was even readily able to give prompt and accurate answers to questions in ASL, such as "What do you do with a book?" and "What color is grass?" Likewise, on a test that requires comprehension and memory of two and three signs and their associated spatial loci, Gail D. performed similarly to controls. She was also able to follow many complex commands. In certain areas of ASL morphology, however, both her comprehension and her production were clearly deficient.

### *Morphology*

Gail D.'s signing reflects none of the grammatical apparatus of ASL—none of the morphological inflections, for example, that are the markers for grammatical distinctions in the language. Recall that signs of ASL are related by a wide variety of inflectional and derivational processes. As discussed in chapter 1, a base lexical item often has a family of associated forms that are interrelated by formal patterning based on modifications of the movement of the signs in space. These different forms mark grammatical categories, such as person, number, reciprocity, temporal aspect, distributional aspect, and derivational processes. Gail D. not only consistently omitted these required inflectional morphemes in her spontaneous signing but also was unable to produce such morphologically complex forms in an elicitation

task. Her difficulty appears to come in assembling meaningful elements into a composite unit. Her primary problem is not in selecting the correct lexical morpheme but in combining the lexical morpheme with inflectional morphemes.

Gail D.'s morphological deficits extend beyond her inability to produce morphologically complex forms. One productive derivational process in ASL relates semantically associated noun-verb pairs, such as BROOM and SWEEP. On a comprehension test of the morphological distinction between these formally related nouns and verbs, Gail D. performed poorly compared to control subjects. She scored only 60 percent correct, below the range of scores of control subjects (the lowest score among sixteen young adult signers was 80 percent correct, and that among three elderly control subjects was 85 percent correct). Similarly, her performance was poor on a test of production of noun/verb distinction. In the testing we found that at times Gail D. made the appropriate formal distinction in specific individual noun-verb pairs (as in DOOR and OPEN-DOOR or BRACELET and PUT-ON-BRACELET); nevertheless, she did not appear to have control of this morphological distinction. The fact that her performance was poor in comprehension and production tasks makes it clear that her problems are at a morphological level, not at a motoric one.

#### *Spatialized Syntax*

As we have seen, Gail D. emitted only single signs without any of the inflectional apparatus of ASL or any of the other spatial-grammatical devices in the language, including those involving the manipulation of space. Even when we tried to elicit the production of relatively simple inflectional forms (such as that expressed by the change in direction of motion that signals a difference in subject-object relations), Gail D. was grossly impaired. The situation was different for comprehension of spatial syntax, however. Here, on many of our tests, she performed well. We note parenthetically that even her memory for nonlanguage spatial location was good. She was given two short-term memory tests; one required remembering the spatial locations of a series of randomly arranged blocks. In this test, the Corsi blocks test, there is an array of blocks before the patient. Patterns of an increasing number of blocks are formed by the examiner tapping out, on the blocks, the different spatial patterns. The patient taps out the same patterns until she reaches her spatial span. The second test, digit span, involves memory for sequences, not spatial memory. In this test the examiner signs series of numbers of increasing length, which the patient repeats until she reaches her digit span. Gail D. performed well on the Corsi blocks, with a spatial span of 5.

This score for spatial memory is well within the range of normal control signers. Her digit span, however, was 3, a sequence that is shorter than that of control subjects. Returning now to her language, we note that, although Gail D. could not produce a multisign utterance and although her signs were generally monomorphemic, she appeared to understand and grasp the gist of conversations, to understand instructions, to cope well with directives, and to correct the addressee's interpretations of her limited signs. Under these circumstances, however, one cannot be certain how much of Gail D.'s understanding is based on contextual cues, how much on the comprehension of selected words in the sentence, and how much on the comprehension of specific syntactic properties of a sentence.

To resolve this question, we administered a variety of comprehension tests. Among them were items from the standard BDAE, such as the ASL equivalent of "Put the watch next to the pencil and then turn the card over"—signed with an array of the objects in front of her. Gail D. performed all the tasks correctly. Thus we conclude that her comprehension is syntactically based.

To isolate aspects of her processing of ASL syntax, we used the two Verb Agreement Tests. These tests require the decoding of certain syntactic structures in ASL, namely, the spatial marking for verb agreement. In both tests we used reversible situations, such as a cat biting a dog and a dog biting a cat. Contrasts such as these are used to test for the processing of subject and object of active sentences in spoken English. In English it is the order of the items that signals subject-object relations. In ASL such grammatical relations may also be signaled by the manipulation of spatial relations, in which case the nominals are associated with specific points in the plane of signing space and the direction of the movement of the verb between spatial endpoints indicates subject-object relations. Gail D. had no difficulty comprehending these spatial relations in either test. When asked to point to the picture reflecting the relationship expressed in a signed sentence (Verb Agreement with Fixed Framework), she scored 80 percent correct. Furthermore, on the Verb Agreement Test with Shifting Reference, she had a flawless performance, comprehending all items correctly. These results stand in sharp contrast to her performance on the noun-verb comprehension test. Furthermore, the difference between the two performances is stable. A year and a half after our first testing of Gail D. (two years poststroke), we retested her on her comprehension of these two grammatical processes. At this later testing, the discrepancy was just as pronounced: superior performance (100 percent correct) on the verb agreement with fixed framework test but impaired performance (60 percent) on the compre-

hension of noun/verb distinction test. In the second testing, as in the first, Gail D. gave every indication that she could discriminate the characteristic movement of the verb from that of the related noun; her problem seemed to be one of associating each of the movement patterns with the appropriate grammatical category. Because there was no evidence at all of syntactic relations in her signing, this good comprehension of spatial verb agreement without reliance on contextual or semantic cues is striking.

### 3.1.3 *Agrammatic English and Agrammatic ASL*

#### *Agrammatic English Writing*

We have some samples of Gail D.'s prestroke written English, primarily from brief notes that she kept to indicate daily activities. As is common, deaf adults misspell many English words based on a lack of knowledge of their grapheme-phoneme correspondence. Spelling, of course, requires the ability to make productive use of English orthography. Hearing people tend to spell according to the pronunciation of words, as the frequency of phonetic misspellings testifies. Deaf people, of course, are less likely to rely on word pronunciation. Hoemann et al. (1976) tested deaf children in a recognition paradigm for the spelling of names for common objects. He found that only 19 percent of the errors for any age group were phonetically based, in contrast to up to 83 percent for hearing children on the same task. Hanson (1982) has studied the kinds of spelling error made by deaf adults and deaf children; she also found a predominance of errors that are not phonetically based. One type of error involved letter deletions in writing, as in "pinic" for *picnic*; "vehile" for *vehicle*. Another type of frequent and striking error was the transposition of letters within a word in ways that are not at all phonetically based. For example, "bapitze" for *baptize*, "hemipshere" for *hemisphere*, "sur-grey" for *surgery*, "umberlla" for *umbrella*, and "agrue" for *argue*. Gail D.'s prestroke writing has misspellings of this kind; nevertheless the grammatical structure, even in these brief written reminders to herself, is intact. Here are some examples of her prestroke writing:

I went to the hospital for blood trements.

I went to the clinic for medince but it is all wrong.

My husband buy medince for me. I don't have money.

The sentences have some complexity. There are pronouns, prepositions, some articles, and generally adequate grammatical structure, although the sentences are not without error, especially in the spelling; but the spelling errors, in general, cluster around the same few words (for example, "medince").

After her stroke Gail D. was able to write with her left hand, but her written English was radically different. Describing the Cookie Theft picture (figure 2.1) from the BDAE, Gail D. wrote the following:

Boy fell.  
Girl want a cooker.  
Mother turn off.

Her poststroke writing is extremely abbreviated, with little sentence structure. Her spelling deteriorated dramatically: She cannot spell her own name correctly or that of the city she lives in. The errors not only involve omissions or transpositions but also include radical and irrelevant intrusions ("Aution" for *Austin*, "Trex" for *Texas*, "firht" for *first*). The fact that Gail D.'s written English is impaired in a way similar to her signing points to a general loss of language capacities.

#### *Agrammatic Signing*

We present another sample of Gail D.'s poststroke signing:

GAIL D.: BROTHER . . . [Mouths "stove."] . . . C-O-A-T-T . . .  
[Mimes "flame burning."] . . . MANY C-A-A-T . . . FIRE . . .  
[Face expresses surprise, gestures.]  
[Examiner guesses that she means that her brother burned her on the stove.]  
GAIL D.: YES.  
EXAMINER: What did the brother burn?  
GAIL D.: YES . . . C-O-A . . .  
EXAMINER: You mean the cat?  
GAIL D.: YES. [Nods emphatically.]

This sample comes from our extended examination eight months after her stroke and typifies the extreme poverty of the output. Virtually all signs are either expletives (YES, NO) or open-class referential items, largely confined to nouns and to a limited number of them. The examiner guesses about the intent of the communication and in fact bears the brunt of the conversational interaction. Yet Gail D. clearly has a story about her childhood that she wants to convey and is able to indicate whether the examiner's guesses are correct or not. Although the communication is halting and effortful, with many interjections by the examiner, much information seems to have been exchanged.

#### *3.1.4 Modality and Language*

Indeed, Gail D.'s particular pattern of language impairment strongly resembles the pattern that is called Broca's aphasia in hearing pa-

tients. The characteristics of this syndrome include production that is awkward and dysfluent, lacks grammatical formatives, and is syntactically impoverished; comprehension, however, is relatively spared (see figure 3.4 for rating-scale profile). Although the modality is different, Gail D.'s signing fits the description of a Broca's aphasic remarkably well, and tests of her comprehension (the BDAE and her responses to the examiner in conversation) show that it is good; her scores on the BDAE comprehension test fall in the range typical of hearing Broca's aphasics. Closer examination with sensitive tests does reveal that Gail D. has some comprehension impairment for closed-class morphology. This is also consistent with the pattern of language deficits claimed for hearing Broca's aphasics (Zurif 1980).

There is one way in which Gail D.'s behavior appears to diverge from that of the conglomerate of impairments in language, including agrammatism, that has classically been referred to as Broca's aphasia. As indicated, Gail D.'s appreciation of one significant aspect of ASL syntax (conveyed through verb agreement) is not only good but in fact superior: her comprehension of syntactic relations conveyed spatially. For example, Gail D. obtained a perfect score on a test of verb agreement with shifting reference. This result differs from her performance on noun-verb and other morphology tests, in which she was impaired; verb agreement, however, is spatial. This difference may have to do with the site and extent of Gail D.'s left-hemisphere lesion. The CT scan shows that, although her lesion is massive, affecting the entire convexity of the left frontal lobe and parts of the anterior temporal lobe, the left parietal lobe is spared. Just this sort of lesion would cause typical Broca's aphasia in a hearing patient, with comprehension of closed-class morphology disrupted. This appears to be true across several different spoken languages (Kean 1985). It is important to note that Gail D. did not show intact comprehension of all grammatical processes. As described, she showed impaired comprehension on a morphological test of noun/verb distinction. Also, Gail D. showed severe impairment on a test to elicit production of morphological inflections. This pattern of impairment is similar to the kind of deficit seen across hearing agrammatic patients. Yet Gail D. has no trouble comprehending (although she could not produce) syntactic relations conveyed spatially. In fact, her performance on these tests was better than that of many non-brain-damaged young control subjects. This difference between Gail D.'s capacity to process morphology and syntax conveyed through spatial verb agreement in ASL, both of which are absent from her signing, may be a consequence of the modality through which these linguistic structures are conveyed.

Patient's Name Gail D. Date of rating \_\_\_\_\_  
 Rated by \_\_\_\_\_

### APHASIA SEVERITY RATING SCALE

0. No usable sign or sign comprehension.
- ①. All communication is through fragmentary expression; great need for inference, questioning and guessing by the listener. The range of information which can be exchanged is limited, and the listener carries the burden of communication.
2. Conversation about familiar subjects is possible with help from the listener. There are frequent failures to convey the idea, but patient shares the burden of communication with the examiner.
3. The patient can discuss almost all everyday problems with little or no assistance. However, reduction of sign and/or comprehension make conversation about certain material difficult or impossible.
4. Some obvious loss of fluency in sign or facility of comprehension, without significant limitation on ideas expressed or form of expression.
5. Minimal discernible sign handicaps; patient may have subjective difficulties which are not apparent to listener.

### RATING SCALE PROFILE OF SIGN CHARACTERISTICS

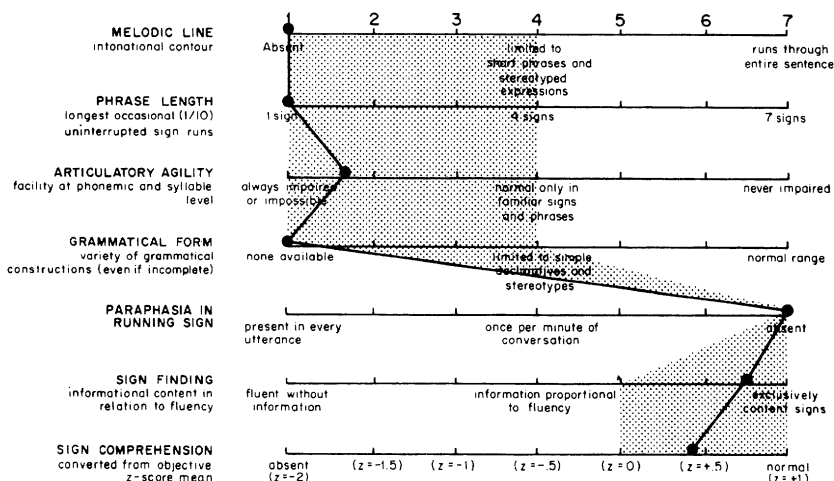


Figure 3.4

Standardized assessment of aphasia: rating-scale profile from Boston Diagnostic Aphasia Examination for Gail D. The shaded region represents the range of profiles of hearing subjects who are classified as having Broca's aphasia. Gail D.'s sign profile falls well within this range.

Indeed, it is precisely in syntax that ASL makes the most dramatic use of space, and this is where Gail D.'s performance is unexpectedly good. Our interpretation is that syntactic function is nonetheless subserved by left-hemisphere structures. However, this case leads us to raise an interesting possibility: Will it turn out that the areas within the left hemisphere that are crucial for spatialized syntactic processing are more intimately connected to higher-order spatial processing in general? We examine this hypothesis in the light of the additional cases we present.

### 3.2 Karen L.: *The Grammatical Signer*

When we entered the room, Karen L. greeted us warmly and profusely, all smiles of recognition and pleasure. She began signing immediately, a tirade of talk, gossip, personal accounts of her experiences, complaints and praises about her surroundings. Her sign language flowed, hand moving freely and rapidly, in marked contrast to the halting, effortful, limited communication of Gail D. Karen L. told us stories about her background, her school days, and her personal history when we visited. Karen L. became deaf at the age of 6 months during an attack of scarlet fever. She attended a residential school for deaf children, and it was there that she learned ASL, which then served as her preferred way of communicating with others. ASL was her primary means of communication throughout her life with family and friends. She left high school at age 16, before graduating, and supported herself by working in manufacturing jobs. She worked throughout her adult life in relatively arduous surroundings. Karen L. married a man who, like herself, is deaf; thus in the family the communication was in ASL. Her close friends were deaf people, and sign language was their common mode of communication as well. In her most recent position Karen L. worked as a maid for a deaf couple, both of whom are professional educators; she had also been a baby-sitter and companion for deaf children. Karen L. regularly attended a church that had a deaf congregation and a signing minister. Her physician was one who knew deaf people and sign language. He conducted his examinations in sign language, and when he arranged to put Karen L. in a nursing home temporarily, he sought to find other deaf people for that home as well, so that she would have someone to communicate with.

During our test sessions Karen L. was happy to see the deaf examiners who visited with her, was eager to communicate with them in sign language, and was generally loquacious and gregarious. On five different occasions, we visited Karen L. and tested her; thus we had



the opportunity to study the course of recovery of her abilities after her stroke. The results reported here are primarily from testing a year and eight months after her stroke, when Karen L. was 67 years old. Karen L.'s right side was paralyzed when we tested her; she had to walk with a cane or walker, and she had only limited use of her right arm. During testing and regularly after her stroke, Karen L. signed with her left hand, using the less functioning right hand as a base. Nonetheless, she had no problem producing signs.

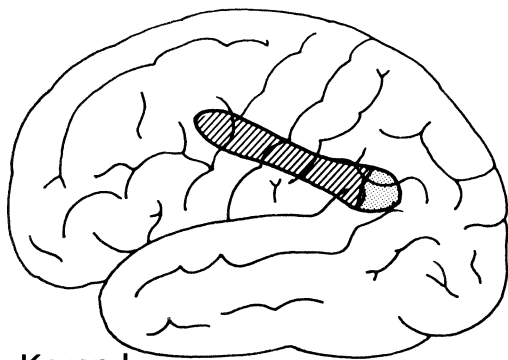
Ten weeks after her stroke Karen L. had a CT scan (figure 3.5), which showed damage to the left hemisphere:

### *CT Findings*

The scan showed primary impairment in the left parietal region. There was a left slit-like lucency in the region of the supramarginal and angular gyri that extended anteriorly and subcortically into the postcentral and precentral gyri, as well as into the posterior portion of the middle frontal gyrus.

Karen L. was described by deaf friends who knew her before her stroke as "warm, talkative [even garrulous in sign], and friendly." She exhibited the same characteristics after her stroke with the researchers who came to visit her at the hospital, the nursing home, and in the home of friends. She narrated events that occurred in the nursing home, in the hospital, and from her life before her stroke. She communicated well and freely, and for the most part, during our testing her memory seemed good; her signing was motorically fluent and in considerable part understandable (as we will explain).

We were able to interview a number of Karen L.'s deaf friends who had been in close communication with her both before and after her stroke, and thus we had a basis for evaluating her poststroke signing. A videotape filmed a few days after her stroke showed that Karen L. was nearly globally aphasic at first, using primarily gestures that were largely uninterpretable. There were hardly any recognizable signs at the time, only primarily vague gestures. To a series of questions she could indicate only that she did not know. We interviewed Karen L. six months after her stroke; she showed considerable improvement. By the time of our formal testing, Karen L.'s signing was once again effortless, grammatical, and interpretable; indeed, she was gregarious and even voluble. Her early symptomatology is reported in Chiarello, Knight, and Mandel (1982) and in Bellugi (1983). During our testing Karen L. appeared to be the least impaired of the three left-lesioned patients in her signing output; however, she often failed to understand instructions and showed some sign comprehension loss. Although she was ready and eager to communicate and al-



Karen L.

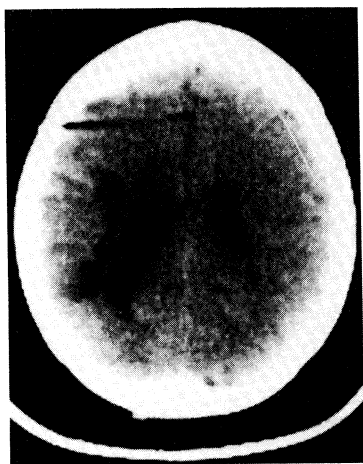


Figure 3.5  
Lateral reconstruction of lesion and CT scan of left-lesioned patient Karen L.

though her signing was interpretable and for the most part understandable, Karen L.'s signing contained numerous errors, which we analyze here. On testing she would often persevere and sometimes fail to find the sign that she was searching for, but in contrast to her immediate poststroke signing, which was largely gestural, Karen L. was able to sign freely. Sampling from our numerous videotapes of Karen L.'s spontaneous signing, we examine her signing errors in two specific domains.

### 3.2.1 *Sublexical Errors in Signing*

Recall that Gail D. produced largely referential signs without any of the rich grammatical apparatus of ASL—the wide array of inflections that marks verbs and nouns for distinctions of person; the distinctions of number, temporal aspect, and distributional aspect; the rich assortment of derivational processes that elaborate the lexicon of ASL; or the spatially organized syntax that forms the framework for sentences and discourse in the language. On the other hand, Karen L.'s signing exhibited a range of grammatical markers, and she made use of the spatial organization provided by the language freely and correctly. We did, however, find an interesting array of errors that occurred in her signing, not at the grammatical level but primarily at the level of substitutions of sublexical parameters of signs—Handshapes, Movements, and Locations. Karen L. sometimes used an incorrect Handshape or an incorrect Movement for an intended sign; sometimes the Place of Articulation was incorrectly selected. Such sublexical errors are in some ways reminiscent of slips of the hand, which we have studied in the spontaneous signing of normal non-brain-damaged deaf people. Slips of the hand are analogous to slips of the tongue in spoken language (Newkirk et al. 1980). However, these normal slips of the hand are inadvertent misorderings between intended signs within a given string, whereas Karen L.'s substitutions did not appear to have their source in other signs in the signing stream.

From analyzing videotapes of Karen L.'s free conversation, we found that virtually all her sublexical errors, which were numerous, produced well-formed nonsense signs in ASL, that is, sign forms that make use of the appropriate parameter values of ASL in allowable combinations but with the substitution of one parameter value for another. Table 3.1 presents examples of Karen L.'s sublexical substitutions. These include selection errors within each of the major formational parameters of ASL: Hand Configuration, Movement, and Place of Articulation. Figure 3.6 illustrates three of these errors. As the figure shows, in signing CAREFUL, which has a /K/ Handshape,

Table 3.1  
Sublexical substitutions of Karen L.

Sign	Parameter	Substitutions
CAREFUL	Hand Configuration	/W/ for /K/
FEEL	Hand Configuration	/B/ for /8/
BATHROOM	Hand Configuration	/A/ for /T/
ENJOY	Movement	/up-and-down/ for /circular/
GIRL	Movement	/contact/ for /downward brushing/
NAME	Movement	/back-and-forth/ for /downward/
SEE	Place of Articulation	/chin/ for /cheek/

Karen L. incorrectly used a /W/ Handshape. The resulting form is still recognizable from the context as the intended sign CAREFUL but is a nonexistent form in ASL, rather like saying *tareful* instead of *careful* in English. The ASL sign ENJOY has a flat /B/ Handshape and a circular Movement on the torso; Karen L. instead once produced it with correct Handshape and Place of Articulation but with an up-and-down Movement. The ASL sign FEEL has an open /8/ Handshape and a brushing Movement on the torso; Karen L. produced the sign with an incorrect Handshape, again producing a nonsense form in ASL (see figure 3.6). These were occasional errors, not consistent ways of forming a sign; at times Karen L. produced the same signs correctly, and at different times she made different sublexical substitutions.

One might well ask whether Karen L.'s sublexical errors might be attributable to motor difficulties. Like Gail D., she was right-handed before her stroke, and like Gail D., she relied on her nondominant hand for signing after her stroke. Because signing often involves the two hands as articulators in an intricately patterned fashion, this might raise some interesting questions. In ASL the two hands play important but differing roles; for most uninflected signs one hand is active or dominant. It has been noted that signers often use only one hand when the other hand is occupied with, for example, carrying packages. We investigated the capacity for signing under different experimental conditions in right- and left-handed deaf signers using only one hand in preparation for evaluating brain-damaged signers who may have paralysis of one arm. We found that deaf signers are perfectly able to convey linguistic information fully and without error using only one hand, even when that hand is their nondominant hand (Vaid, Bellugi, and Poizner 1985). We also tested control subjects matched with the left- and right-lesioned subjects in age and background, requiring them to use only one hand throughout our tests and conversational sessions, in order to evaluate linguistic per-



Karen L.'s Sublexical errors



Karen L.'s Handshape error  
(/W/ for /K/)



Karen L.'s Movement error  
(/N/ for /@/)



Karen L.'s Handshape error  
(/B/ for /@/)

Figure 3.6  
Sublexical errors typical of Karen L.'s signing. Note selection errors within major formational parameters of ASL. These are the equivalent of phonemic paraphasias of spoken language.

formance using the nondominant hand, and found no linguistic deficits. This gives us confidence that Karen L.'s linguistically motivated sublexical errors are not traceable to signing with her non-dominant hand. Karen L.'s errors occurred within the context of unfaltering signing and involved substitutions of ASL formational parameters. The rule-governed nature of Karen L.'s errors and their occurrence in the context of fluent signing clearly confirm an aphasic disturbance.

### 3.2.2 *Underspecified but Grammatical Signing*

It is interesting that we found no instances of signing errors at other levels of Karen L.'s language: no substitutions of inflectional markers, no errors in grammatical construction, and no discernible errors in either sign order or verb markers, which serve as part of the spatial underpinnings of syntax in ASL. In great contrast to Gail D., Karen L. made full use of the grammatical properties of ASL and did so appropriately, without errors. Thus Karen L.'s signing is fully grammatical but shows primary impairment at the *sublexical* level of structure (the equivalent to phonemic errors in spoken language). Her grammar remains relatively well preserved.

Karen L. did, however, have two other sources of difficulty in signing and in conveying her intentions clearly. One source came from her occasional problems with accessing signs during our testing (for example, confrontation naming). When attempting to recall a sign, Karen L. would on occasion grope for the sign or use some circumlocution. Another source of difficulty in Karen L.'s signing gives rise to an impression of vagueness. In free conversation Karen L. uses all the spatial syntactic mechanisms (the means by which signs are related to one another in sentences, such as verb indexing, pronominal indexing, index shifting, and coreferentiality). She uses pronominal indexes freely and frequently. What she often *fails* to do is indicate the nominals associated with these indexes; that is, she fails to identify pronominal referents. Thus Karen L. would often have to be asked who or what was the topic of the syntactically correct description. The analogue in a spoken language such as English might be the use of pronouns when their antecedent is unclear or the overuse of indefinites (for example, "something" or "someone"). In ASL this is represented by frequent occurrence of spatial indexes—either on the verb or as spatially realized pronominals—without the prerequisite specification of prior referents. The passage that follows illustrates Karen L.'s failure to specify the nominals associated with her frequent indexes.

Karen L. is signing to the examiner about an event. Her signing is given in notation, followed by an English translation equivalent:

KAREN L.: LOOK-FOR FIND WITH ME, LIKE, ME. WITH ME DOG. ME MONEY, ALL-TOGETHER HOME. INDEX<sub>a</sub> WITH TWO-OF-US<sub>a</sub>, EASY. WELL INDEX<sub>b-c</sub><sup>neg</sup>['they'] LEAVE<sub>b</sub> LEAVE<sub>c</sub> LEAVE<sup>[Exhaustive]</sup>. AND LOOK-FOR<sup>[Durational]</sup>. INDEX<sub>b</sub> PUNISH INDEX<sub>b</sub>. WELL, ME WRONG. LOOK-FOR<sub>b</sub><sup>[Durational]</sup> NOW LOOK-FOR<sub>b</sub><sup>[Durational]</sup> INDEX<sub>b</sub>. ME OTHER GIRL HAVE-TO LOOK-FOR<sub>c</sub>.

An English translation equivalent is:

KAREN L.: I'm looking, to find someone [unspecified] I like, with me and my dog. With my money, we could live all together at home. She [unspecified] could be with the two of us easily. They [unspecified, many] have moved out of this area from different places. And I'm still looking for someone. She/he [unspecified] was being punished. It was my fault. Now she/he [unspecified] is looking for him/her [unspecified]. I have to look for another girl myself.

EXAMINER: Who was looking? [that is, "Who are you talking about?"]

KAREN L.: LOOK<sup>[Durational]</sup> [meaning 'Someone [unspecified] was looking.']

Karen L.'s failure to specify the nouns associated with her many indexes gives rise to the impression of vagueness and lack of content in her signing. So far as we could ascertain, Karen L.'s frequently indexed verbs and use of pronominal indexes within the spatial reference framework of ASL show no errors of verb agreement. Her language pattern, then, shows preservation of the spatially encoded syntactic mechanisms of ASL but an overuse of pronominal indexes.

From our formal language testing we find that Karen L. suffers from impaired comprehension of ASL. Furthermore, she has marked difficulty in repeating signed sentences correctly. She was given signed sentences of increasing length and complexity and asked to repeat them exactly. She could handle the short sequences of three and four signs, but as the stimuli became longer and more complex, she would transpose signs and omit or add signs that had not been in the original stimulus. Her repetitions exhibited a variety of sublexical errors as well.

Gail D., the first person we described, is agrammatic; the few signs she produces are without any of the grammatical apparatus of ASL.

In contrast, Karen L.'s signing is morphologically rich and correct and shows a full range of correct grammatical constructions; however, she makes errors at the sublexical level. In addition, despite the grammatical richness, Karen L.'s signing is vague with respect to what and to whom she is referring. Her sign impairment differs not only from Gail D. but also from the next patient we present, Paul D., who has grammatical deficits of a different sort.

### 3.3. *Paul D.: A Paragrammatic Signer*

The dignified old man at the entrance to our laboratory moved with no trace of the left-hemisphere stroke he had suffered ten years before. Paul D.'s spryness belied his 81 years, and his formal, good-humored, self-possessed manner reflected the self-assurance of a man who has gained a certain social prominence. He has edited and contributed to several literary publications. For many years he was a teacher of deaf children and an early champion of their educational rights, leading the fight against the purely oral method of education. As a fundraiser for deaf colleges and deaf causes, he was unsurpassed, traveling throughout the country to give signed lectures that were by all accounts elegant and spirited. This remarkable deaf man was a powerful communicator in ASL and had a great command of written English.

Paul D. was previously studied by Battison and Padden (1974), and Battison (1979, discussed in Poizner and Battison (1980)). We report here our own intensive investigation of his language capacities.

Severely impaired by the stroke to his left hemisphere, Paul D. had made a fiercely determined struggle to regain his use of language. He had in part succeeded, but his residual failures to communicate were puzzling and frustrating to him and his wife. Uncovering the precise nature of the deficit was an important and intriguing challenge for us.

Paul D. was born in Europe to a hearing family. When he was 5 years old, a high fever resulted in the loss of his hearing. The next year his family emigrated to North America, and he was enrolled in a residential school for deaf children, providing him with a community of signers. He began learning ASL and written English at the school. On leaving the school Paul D. entered a college for the deaf. After graduation he worked as a printer, editor, fundraiser, and teacher. He married a deaf woman, and the couple became influential members of the deaf community.

From conversations with Paul D.'s wife and daughter and from hospital records we have been able to piece together what his condi-



tion was like immediately before and after his stroke. The stroke produced dramatic changes. His wife reported that during his first week of hospitalization he was totally unable to communicate. Although after a few days he was able to get out of bed and walk, it was not until the second or third week that he could nod yes or no in response to his wife's questions.

The following is an English translation of his wife's signed description of the events immediately before and after the stroke:

That day was supposed to be a holiday, but I decided to go to work anyway. My husband didn't have to work that day, and the two of us decided to meet for lunch. He would come to my office first, and then we would go downtown to have my passport picture taken. But about ten o'clock, he called me and said he couldn't come because he was too sick. Well, I said all right, and went on working until about two o'clock, when I just had a hunch that something was wrong. My daughter came and I told her that her father was really sick. She phoned a doctor for me, and made an appointment for five o'clock, after work. I drove home and found that he had messed up the whole apartment. He generally was a very neat and orderly man, but this time I found food messed up all over the kitchen. He was asleep on the bed, so I woke him up and asked what was wrong. He didn't say anything. I told him to get dressed, but he put his clothes on all wrong. I realized something was wrong with his mind, so I helped him dress. He kept falling down, and I tried to lift him up, all the while asking what was wrong. He didn't communicate at all. He couldn't walk, so I helped him get to the living room, but then I realized I couldn't get him down three flights of stairs. I was frightened and had to run for help, to ask a friend to phone the doctor. The doctor ordered an ambulance to bring my husband to the hospital. There they found he had had a stroke.

After two days in the hospital, they got him up out of bed to walk. He could walk all right, but he was weak. But in all this time, there was no communication, absolutely *none*. I would tell him a story, and there was just no response from him at all, for one whole week. I would come every morning, noon, evening, because I wanted to feed him. The first time that he attempted to communicate in any way was when I came in and he pointed to his sleeve several times, to show me that it was all wet. I found that he didn't even know that he had no strength in his arm. He had picked up a cup of hot coffee and it spilled over his shoulder and burned him. He was trying to tell me about it. But even after

that, there was still no communication from him. The second week, he tried to fingerspell my name for the first time. That was great, because then I knew he knew my name.

I tried to communicate with him a lot, telling him things. He seemed to understand me, but he himself didn't communicate, except for nodding his head for yes and no. That was all. Once I arrived and saw a box of candy by his bedside. I asked him, "Who brought the candy, your girlfriend?" He laughed, so I knew he understood, but he couldn't tell me. So I said, "Was it a woman?" He nodded yes. "With her husband?" He nodded no. "Alone?" Yes. "Well, who was it?" He seemed to know but couldn't tell me. Finally I gave him a list of names, and some clues, like "Does she have children?" That way, I was able to figure out who brought the candy.

He stayed in the hospital two weeks, and then one day he sort of moved his hand downward trying to get something across to me, and I finally guessed what he wanted by asking different things. I asked "Do you want to go home?" and he nodded yes and gestured again, moving his hand downward. On the last day before he was to go home, a speech therapist came to work with him. She showed him cards with different objects on them, like a pencil, pen, clips, and asked him to identify them. He couldn't. I showed him the signs, and he even pointed incorrectly to the cards. He didn't know. He also couldn't give the names for the objects. I just cried.

Anyway, we brought the cards home, and my friend and I worked with him. We drew pictures and words on flash cards, but nothing happened at first. He kept looking around and seemed happy, but I didn't even know if he understood that he was in his own home.

I started to teach him, one sign at a time. I would point to a table and sign TABLE, point to a chair and sign CHAIR, and identify all the things around him. But he didn't know any of the signs. I showed him things, signs, and words all the time. I had a deaf woman stay with him for a month and told her to communicate with him all the time, to teach him signing, talking, anything. Just to keep his mind alert.

About three weeks later, he decided to go for a walk, and he found his way back home. I came home from work and asked what happened—I noticed that his hair was cut. I know he must have gone to his barber himself, and that meant he really must be improving. I asked, "What did you do?" He gestured to me, and then he turned his pants pocket inside out, to show me that it

was empty. He was trying to tell me that he didn't have any money to pay the barber. I understood, and we drove back together to pay. I thought it was a really good indication that he was improving, but still it required a long time for him to relearn sign.

During that time, he couldn't write words at all. I had a hearing woman come to help him with different things for about six weeks, and then he had a chance to pick up some words again; she wrote notes to him. We had to teach him for a long time until he started to write English words again. He didn't use the TTY [teletypewriter for the deaf] for about two years. I think he was afraid to, but step by step we taught him. I would ask him, "Please call me. I want you to phone me so I know you are all right at home," because he was staying alone at the time while I was working. He knew how to dial the phone, so finally one day he called me. I typed "How do you feel?" He typed back something all garbled, because he couldn't yet write clearly, but that way I at least knew that he was there and able to phone.

### 3.3.1 *Neurological Information*

At the time of testing we asked a neurologist to examine Paul D., who had made an excellent recovery. The neurologist reported that he was alert, attentive, and cooperative, with normal good spirits. Strength, sensation, and coordination were normal. Paul D. had no loss of vision or loss of eye movement control. There remained slightly higher reflexes of his right extremities, but there was little evidence of the former paralysis of his right side. He had good use of both hands. We obtained a CT scan ten years poststroke (figure 3.7):

#### *CT Findings*

Paul D. has a subcortical lesion in his left hemisphere. There is an anterior focus deep to Broca's area, and included is the head of the caudate nucleus, putamen, globus pallidus, part of the thalamus, anterior limb of the internal capsula, and corona radiata. The lesion extends posteriorly into the white matter underlying the supramarginal and, to a lesser extent, angular gyri. The superior extension of the lesion involves the white matter deep to the motor strip and primary sensory areas representing the face. Finally, there is an enlarged left Sylvian fissure.

We examined Paul D. over a period of two years on many different occasions. Paul D. showed that, although his signing and written English had improved greatly over the ten years since his stroke,

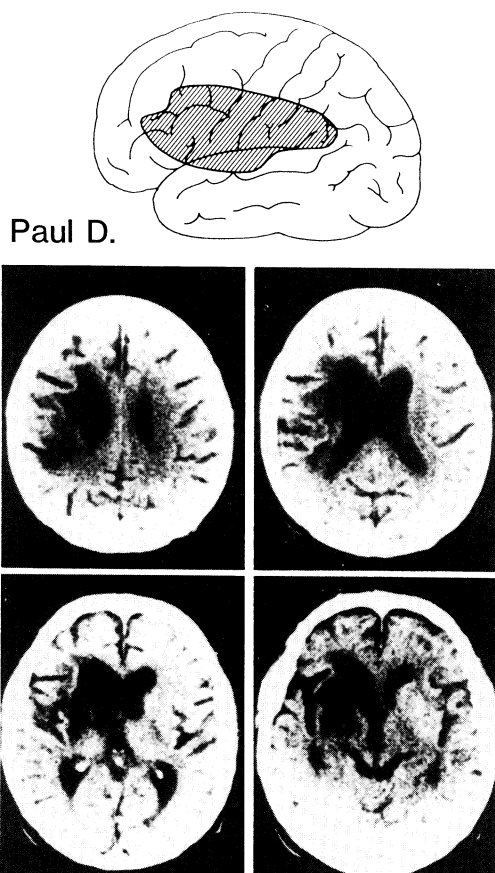


Figure 3.7  
Lateral reconstruction of lesion and CT scan of left-lesioned patient Paul D.

linguistic deficits in both remained quite evident. When we tested him, Paul D. was signing long sentences, telling narratives, telling us about his recent travels, and performing well on some of our language tests. He signed smoothly with both hands, although there were still times when he searched for the correct sign.

We have an anecdotal account of his ability to hide his deficits. One of our research assistants, a young deaf woman, had gone to visit Paul D. at her college. Because he is an elder of the deaf community, she was seeking his advice about her study program. The assistant did not know that Paul D. had had a stroke. When asked for her impressions of him and his linguistic capacities, she remarked on his spry, dignified, courtly manner, not mentioning anything unusual about his signing. On further questioning, however, it transpired that the assistant had done all the signing and Paul D.'s role had been limited to signing YES, FINE at appropriate intervals—an effective strategy for hiding language impairment!

As soon as Paul D. tried to communicate beyond simple routines, his impairment was strikingly evident—facile signing but full of linguistic substitutions (paraphasias). In fact, even his wife continued to have difficulties understanding what he was saying. On the day of their first visit to the laboratory, his wife told us that he had tried to talk to her about an experience they had shared on their trip abroad. “He remembered something,” she signed, “that I did not remember myself and wanted to tell me about it. But his signing was all mixed up, and I couldn’t understand him. Now he generally signs quite well, and he understands me, but I can’t always understand him.”

Uncovering the precise nature of the deficit was an intriguing challenge for us. Our analysis of Paul D.'s conversation, narratives, stories, and interviews revealed impairment at all levels but, most important, at the *grammatical* level. We compared his written English and his ASL signing to determine what effects his brain damage had on the two different languages.

### 3.3.2 *Wernicke-like Writing in a Deaf Signer*

#### *Impeccable Prestroke Writing*

Befitting his occupation as an editor and journalist, Paul D.'s pre-stroke command of written English was excellent. Recall that he had learned English only *after* he became deaf and after the family emigrated to America. We give two examples from handwritten letters penned before his stroke (figure 3.8).

This is a fraternal organization of, by and for the deaf, offering life insurance and disability benefits to deaf policyholders. Its

## a. Prestroke writing

This is a fraternal organization of, by and for the deaf, offering life insurance and disability benefits to deaf policyholders. Its head office is in Chicago. Its assets are \$5,000,000 and it has over \$8 millions in insurance coverage. It holds quadrennial conventions in leading cities on this continent. The only time this fraternal organization ever held its convention in Canada was in 1939. The headquarters were the Royal York. It attracted about \$500 conventioners.

## b. Poststroke writing

I spoke to the oxcom in the window  
 I sprintered the threen beside the window  
 Many times as I looked at the Capital I wonder  
 the many times were engaged at the same  
 time by the representatives as they behaved  
 the problems. The 48 States wherein the  
 problems thrashed by the senators finally  
 thumpered to the Impression. And the  
 gathering of the warrior.

Figure 3.8

(a) Paul D.'s prestroke writing is in impeccable English. His poststroke writing (b) approaches jargon.

head office is in Chicago. Its assets are \$5,000,000 and it has over \$8 million in insurance coverage. It holds quadrennial conventions in leading cities on this continent. The only time this fraternal organization ever held its convention in Canada was in 1939. The headquarters were the Royal York. It attracted about 2,500 conventioners.

The Society was organized in 1901 because of widespread discrimination against deaf applicants for life insurance coverage.

The second prestroke letter is:

I have never liked splinter groups. They weaken rather than strengthen an important cause, especially when the good of ALL people is concerned. You hit the nail on the head when you stated with truth that Judaism is synonymous with humanitarianism. Humanitarianism can best be served when everyone is pulling together to enhance the cause rather than to maintain "a house divided against itself." This is especially applicable to our deaf world where the need is acute for the people of all faiths and ideals to work hand in hand to better their welfare.

As these selections show, Paul D.'s writing is forceful, clear, and incisive, and in impeccable English.

#### *Wernicke-like Poststroke Writing*

The samples of Paul D.'s prestroke writing contrast sharply with his poststroke writing, although both include full grammatical sentences and express—or attempt to express—complex ideas. The following are a few selections written three years poststroke.

In the first selection Paul D. is describing the Capitol:

I walked toward the Capitol and entered the way up the stairs. I noticed the rooms were for the wayfarers and entered the deliberation room. The senators were in a huddle of a question.

I spoke to the axiom in the window. I sprintered the Green aside the window. Many times as I looked at the Capitol I wonder the many times were engaged at the same time by the representatives as they behaved the problems. The 48 states wherein the problems threshed by the senators finally thunbured [or thundured, not clear] to the impression. And the gathering of the warrior.

A second selection is from a letter to a friend.

I have five days ahead of putting ideas together and I believe you have an altogether idea of putting to dress it. Here I am to greet you back at home. You are fit to become a partner in the game of gameship. Here you have had a fine game at home. One week you held a week in one whole part. You have molded your brother and sister and trusted in their lucky way. How is your mother and father? Have you steered their way to welcome home and hail their stay? Have they questioned their way into their broadened life?

. . . Finally you come right out to face the life as it is. Are you serenely the inspiring way you are set to it? Why are you not so annoying to have such an pest here to you?

Paul D. also wrote in a letter:

I suppose I was driven on a sheet from which to gather a handful of facts. The sheet is way back at home—the first time I brought back. I prevented it here as I just am to pick up. This is my memory time to bring the back of the sheet. What a humming weather it was to take me to sum it up. It was a humid sum. Now the weather takes me to seal it off.

These poststroke samples show that Paul D.'s writing has become highly convoluted but is nevertheless couched in elaborate (unimpooverished) grammatical structure. The complexity of structure within the sentences and the variety of structure is essentially the same as in the prestroke writing. There are, of course, many incorrect word selections and many semantic misusages. The preservation of grammatical structure shows that there is no general impoverishment of syntax, nor avoidance or underemployment of any particular grammatical construction.

Within the generally well-preserved grammatical structure, however, there are substitutions of words and formatives (paraphasias). These substitutions are, for the most part, errors of selection rather than errors of combination; thus his errors in written English are unlike "slips of the tongue" carried over into writing. Another characteristic error in Paul D.'s written English is the inappropriate repetition of a given lexical item (perseveration). Some of Paul D.'s selection errors are illustrated in table 3.2.

Paul D.'s written English exhibits characteristics common to those made, in both speech and writing, by hearing Wernicke's aphasic patients. Although not exactly gibberish, Paul D.'s written language contains many incorrect word selections in a stream of generally well-



Table 3.2  
Writing errors

Error	Examples
Lexical substitutions	Rooms for the <i>wayfarers</i> entered the <i>deliberation</i> room in a <i>huddle</i> of a question spoke to the <i>axiom</i> as they <i>behaved</i> the problems you have <i>molded</i> your brother an <i>altogether</i> idea
Morphological irregularities	sprintered gameship
Grammatical irregularities	such <i>an pest</i> of <i>putting to</i> dress it a <i>girl</i> washes <i>his</i> dishes the gathering of the <i>warrior</i>
Perseverations	many <i>times</i> as I looked at the Capitol I wonder the many <i>times</i> were engaged at the same <i>time</i> A partner in the <i>game</i> of <i>gameship</i> . Here you have a fine <i>game</i> at home.

preserved grammatical sentences. In some cases the incorrect selections are semantically related to what Paul D. probably intended to write: "huddle" for something like "conference" or "committee"; "of the question" for "about" or "on the question"; "rooms for the wayfarers" instead of, perhaps, "rooms for the visitors"; "behaved the problems" for "acted on. . . ." Other selections seem harder to interpret: "I spoke to the axiom" and "and the gathering of the warrior." As we have seen, there are also perseverations: "Many times as I looked at the Capitol I wonder the many times were engaged at the same time. . . ."

We were eager to see whether Paul D.'s signing showed similar kinds of semantic error and whether ASL's syntactic structure would be similarly preserved in his signing.

### 3.3.3 Paragrammatic Signing

The first thing we noticed about Paul D.'s poststroke signing was that he communicated generally well, using long complex sentences. He told stories about the past and conversed freely (although with occasional searching for signs). We sometimes had trouble understanding the details of his conversation. There were many strange, inappropriate

ate, and even occasionally jargonlike signs. At first we were struck by the similarity of his signing to his written English. Some of his errors were unlike any we had seen before (and we have examined errors in signing from a great variety of sources and under many circumstances—in short-term memory, in children learning sign language, in slips of the hand, in the perception of signs under noise, in shadowing, and so on; indeed, deaf people have complained that we are interested *only* in their errors).

Two selections from his signing follow. The examiner's signs are translated into English. The patient's signs are presented in glosses using special notation and then translated into equivalent English. In the first selection, the examiner is asking questions for conversation and asks about Paul D.'s plans for the future (for example, what trips he and his wife are planning to take). Instead, Paul D. responds with something quite irrelevant and opaque:

EXAMINER: What are your plans for the next few months?

PAUL D.: I \*PLAN<sup>[Habitual]</sup> T-O SEARCH<sup>[Durational]</sup> FIND MISTAKE.  
PLAN \*H-A-Y H-A-V-E TO TELL-YOU EVERYTHING.  
ALL-WORKED-OUT. PAPER . . . \*NOT. WELL . . . .

['I (have been planning) to always search to find mistakes.  
Planning, (hay) have to tell you everything. Make it all work out.  
The paper . . . (it isn't). So . . . .']

The examiner is clearly puzzled and attempts to find out what Paul D. is talking about.

EXAMINER: What paper are you referring to?

PAUL D.: TALK BACK-FORTH \*MY \*W-A-Y LIST<sup>[Seriated External]</sup>  
PAPER, JOT-DOWN. BEFORE IN THERE<sub>a</sub> CALIFORNIA.  
\*SIT-DOWN<sub>b</sub> IN \*THERE<sub>b</sub>. . . .

['We were talking back and forth (in my way). Lots of lists and papers and writing down. Back in California, I sat down.']

The conversation took place in Paul D.'s home in another state, but he appears to refer back to the time, some months earlier, when he visited in California. There are errors in his signing, including errors of spatial agreement, as when he set up a locus for California at point a, but apparently referred to that locus two signs later at point b.

The examiner again tries to clarify what Paul D. is referring to.

EXAMINER: Oh, you're talking about our sessions in California.  
Have you been working on your signing?

PAUL D.: PRACTICE. \*SEE<sub>a</sub> SIGN<sup>[Emphatic]</sup> \*SEE<sub>a</sub>.

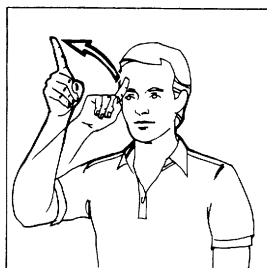
['Yes, practicing. (I see it.) I work hard on my signing. (I see it.)']

In the second selection Paul D. is describing the layout of his apartment, in particular, a glass-enclosed patio adjoining his living room.

PAUL D.: AND HAVE ONE \*WAY-DOWN-THERE [unintelligible]. MAN WALK, MAN SEE THAT \*DISCONNECT E-X-T-E-N-S-I-O-N O-F \*EARTH ROOM. HAVE FOR MAN CAN \*LIVE ROOF, LIGHT, SHADE<sup>[Serialized Plural]</sup> \*PULL-DOWN<sup>[[+Dual] + Habitual]</sup> AND HAVE GLASS WALL. . . . FOUR DIFFERENT. . . . TO-HAMMER<sup>[Habitual]</sup> MAN MAKE \*HAND \*MAKE M-O-B-I-L-E-S. ROUND-OBJECT-WALL<sup>[Allocative]</sup>. WONDERFUL \*BRILLIANT<sup>[Predispositional]</sup> MAN. ['And there's one (way down at the end) [unintelligible]. The man walked over to see the (disconnected), an extension of the (earth) room. It's there for the man (can live) a roof and light with shades to (keep pulling down). And there's a glass wall with four different. . . . He hammered. The man (makes hands), makes mobiles, many on the wall. A wonderful (always brilliant) man.']

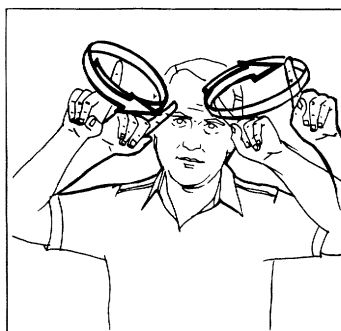
The errors that first impressed us involved Paul D.'s surprising tendency to use morphologically complex forms where simpler ones would have been appropriate. Figure 3.9 illustrates one such error: a morphologically illegal combination, \*BRILLIANT<sup>[predispositional]</sup>, meaning something akin to 'always brillianting.' The inflection for the predispositional aspect applies to signs referring to transitory qualities

Correct form for context



BRILLIANT (uninflected)

Paul D.'s error



\*BRILLIANT<sup>[Predispositional]</sup>  
meaning 'always brillianting'

Figure 3.9

Example of Paul D.'s morphological errors. In the context the uninflected sign BRILLIANT is appropriate. Paul D. produced instead a morphologically complex form \*BRILLIANT<sup>[Predispositional]</sup>. This is an illegal combination of sign and inflection based on a violation of a semantic restriction.

changing their meaning to permanent or inherent qualities; for example, the sign QUIET modulated for the predispositional aspect means 'quiet by nature' or 'taciturn.' However, because the sign form glossed as BRILLIANT already denotes an inherent quality, it is blocked from undergoing the inflection for the predispositional aspect in ASL. Thus Paul D. has produced an illegal combination of sign and inflectional form based on a violation of a semantic restriction. One might well expect simplifications (the substitution of a simpler form or the reduction of a morphologically complex form to a simpler one), but what we found instead was morphological overelaboration, along with various other kinds of error. We found Paul D.'s morphological errors most interesting. Before turning to these, we first consider some of the lexical substitutions that he made.

#### *Lexical Substitutions*

The lexical substitutions in Paul D.'s signing are similar to those in his writing. He produces signs that are semantically bizarre in the context, such as EARTH where the appropriate sign would have been ROOM, BED where the context called for CHAIR, DISCONNECTED where the context suggested EXTENSION, QUIT where an appropriate sign would be DEPART. Some examples are:

EARTH for ROOM  
 BED for CHAIR  
 DAUGHTER for SON  
 DISCONNECT for EXTENSION  
 QUIT for DEPART  
 HANDS for MOBILE  
 FINALLY for LAST  
 WIFE for HUSBAND  
 YEAR for HOUR  
 MISPLACE for LOSE-GAME  
 FINISH for LAST

It is clear that an overall characteristic of Paul D.'s lexical substitutions is that the errors are within the same lexical category as the form appropriate for the context. Nouns are substituted for nouns; verbs for verbs, and so forth. The within-category nature of these substitutions extends even further to semantically related items within the same lexical category (BED for CHAIR, YEAR for HOUR, and even EARTH for ROOM). This sort of thing is what makes his signing seem coherent but yet either not appropriate for the context or nonsense; that is, as opposed to Gail D., Paul D.'s impairment primarily involves selection at the lexical and the morphological levels.

*Classifier Substitutions*

Another clear example in which the basis for the substitution seems to respect divisions dictated by grammatical class are substitutions within the classifiers of ASL. In ASL signs a limited number of differentiated handshapes mark the semantic category or the size and shapes of nominals associated with them in sentences. These handshapes function similarly to morphemes known in spoken languages as *classifiers*, as has been argued by Newport and Supalla (1980) and by Supalla (1982). ASL classifiers, for example, those shown in figure 3.10a, mark semantic categories, such as human, animate nonhuman, vehicle, and upright object. These classifiers function as verbs of motion and location in sentences of ASL, specifying path and direction of movement of their noun referent.

Paul D., but not the other left-hemisphere-lesioned patients we studied, made grammatical errors in classifier forms. In signing the ASL equivalent of 'I saw the car pass by,' Paul D. signed CAR

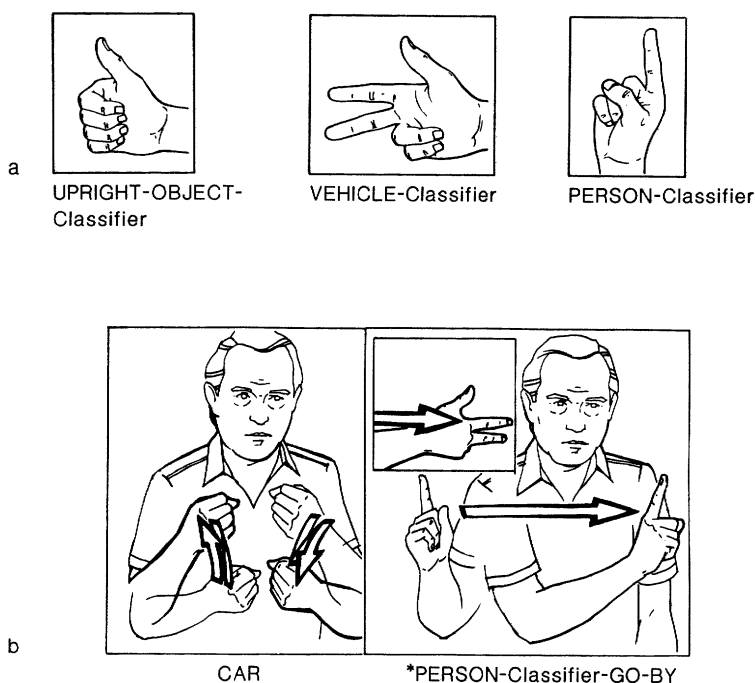


Figure 3.10

A classifier error of Paul D. (a) Three correct ASL classifiers. (b) Paul D.'s incorrect selection of PERSON-classifier for VEHICLE-classifier. The correct form, VEHICLE-classifier-GO-BY is shown in the inset.

\*PERSON-classifier-GO-BY (figure 3.10b), using PERSON-classifier, which is incorrect for that context, instead of the correct vehicle classifier, shown in the inset. The choice of classifier is determined by the particular noun sign that occurs in the utterance. The noun sign CAR selects the vehicle classifier. Even if a person had been in the car, this nonetheless would not have sanctioned the use of the person classifier in this context. What governs the use of classifiers are grammatical rules determined by lexical classes, not the pragmatics of the situation. Paul D. makes relatively frequent substitutions of classifier morphemes in his signing. These selection errors within this domain are a prelude to his more striking errors of substitution and, in fact, augmentation within the morphology of ASL inflectional and derivational processes. The following is a list of some of Paul D.'s substitutions in this category.

WOMAN LOCATED-AT-X-CL:/G/ \*WALK CL:/B/  
 [flat object classifier instead of person classifier]  
 MOTORCYCLE \*DRIVE-UP-CL:/B/  
 [upright object classifier instead of person classifier]  
 CAR \*PASS-BY-CL:/G/  
 [person classifier instead of vehicle classifier]  
 B-U-S DRIVE \*FLY-OFF-CL:/Y/  
 [airplane classifier instead of vehicle classifier]  
 ANIMATE-LAY-FLAT \*PRANCING-CL:/V/  
 [animate nonhuman classifier instead of person classifier]

### *Morphological Substitutions*

Besides the classifier errors, we found that Paul D. also made a number of errors in which he substituted one morphological form for another. The nature of these morphological errors brought up interesting questions about the differences between sign and speech. In ASL, unlike English and many other spoken languages, morphological and lexical information are conveyed concurrently. ASL has, for example, an inflectional form that changes a class of predicate signs referring to temporary states so that they refer to inherent characteristics; we call this form the inflection for the Predispositional Aspect. When the sign QUIET is used with this inflection, its meaning changes to 'characteristically quiet' or 'taciturn'; the sign WRONG<sup>[Predispositional]</sup> means 'error prone,' and the sign SICK<sup>[Predispositional]</sup> means 'characteristically sick' or 'sickly.' The uninflected sign SICK is made with soft repeated contact with the forehead. In the inflected form SICK<sup>[Predispositional]</sup>, the hand moves in a repeated, smooth, circular motion near the forehead. The inflectional form is conveyed by the pattern of movement—smooth, circular, and

repeated—which co-occurs with the lexical stem (handshape, target locus, and movement stem). As is typical for ASL morphology, the forms of inflection for specifying grammatical relations are intimately tied to the visual modality: The form involves contours and dynamic attributes of *movement* co-occurring with sign stems. This kind of organization—layered as opposed to linear—is characteristic of lexical stems and of derivational as well as inflectional forms. For example, the uninflected sign UNDER and a derived form meaning ‘subordinate’ share Handshape, Place of Articulation, and basic Movement shape, but they differ from one another only in features of movement (onset and offset, tension, and quality); otherwise, the two forms are identical.

Paul D.’s poststroke morphological substitutions often involved an appropriate root form with an inappropriate inflection or derivation. He also, on occasion, substituted one inflectional form for another and even produced nonsense inflections. Figure 3.11 and table 3.3 show some examples of morphological augmentation. In a sentence whose context called for the simple meaning ‘under,’ Paul D. signed UNDER<sup>[Idiomatic Derivative]</sup>, a form meaning ‘subordinate,’ instead of the appropriate uninflected sign UNDER; he signed HARM<sup>[Idiomatic Derivative]</sup>, meaning ‘hazing,’ instead of the appropriate uninflected sign HARM; he signed WALK<sup>[Durational]</sup>, meaning ‘walk continuously,’ instead of the appropriate uninflected sign WALK. An example of inflectional substitution occurred when he signed LOOK<sup>[Habitual]</sup>, meaning ‘look regularly,’ in a context that required instead LOOK<sup>[Multiple]</sup>, meaning ‘look at them.’

### *Neologisms in Morphology*

It has been suggested that a breakdown in sign language should not result in neologisms, because in spoken language neologisms are based on reorderings of linear segments of words. But even with the concurrent packaging of structural information in ASL, we did find a number of neologisms based on substitutions within one or another of the major parameters of ASL; we even found impossible morphological forms (for example, a legal sign that has undergone an inflectional movement not permitted with that form).

In the examples in the preceding section the particular combinations of inflections or derivations with root forms were morphologically legal ones, although inappropriate for the sign context. It is interesting, however, that Paul D. also created morphologically illegal combinations, for example, ‘characteristically brillianting,’ as discussed earlier. Both the sign BRILLIANT and the inflection for Predispositional Aspect (which changes reference from transitory states to


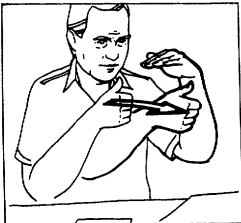

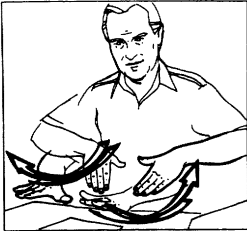

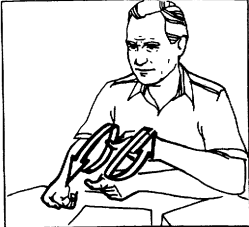


Correct form for context	Paul D.'s Morphological error
 <p>UNDER</p>	 <p>*UNDER [Idiomatic Derivative] 'subordinate'</p>
 <p>WALK</p>	 <p>*WALK [Durational] 'walk continuously'</p>
 <p>HARM</p>	 <p>*HARM [Idiomatic Derivative] 'hazing'</p>
 <p>LOOK [Multiple] 'look at them'</p>	 <p>*LOOK [Habitual] 'look regularly'</p>

Figure 3.11  
Morphological augmentations typical of Paul D.'s signing.



Table 3.3  
Morphological elaborations

Sign form appropriate for context	Morphological augmentations and substitutions	Form of morphological modulation co-occurring with basic sign
UNDER (uninflected)	*UNDER <sup>[Idiomatic Derivative]</sup> ('subordinate')	Tense sharp movement
HARM (uninflected)	*HARM <sup>[Idiomatic Derivative]</sup> ('hazing')	Alternative brushing movement
WALK (uninflected)	*WALK <sup>[Durational]</sup> ('continuously')	Enlarged movement
CARELESS (uninflected)	*CARELESS <sup>[Predispositional]</sup> ('characteristically careless')	Smooth circular movement
WRONG (uninflected)	*WRONG <sup>[Idiomatic Derivative]</sup> ('unexpectedly')	Soft wrist twist
DEBATE (uninflected)	*DEBATE <sup>[Multiple]</sup> ('debate all of them')	Addition of arc sweep
LOOK <sup>[Multiple]</sup> ('look at them')	*LOOK <sup>[Habitual]</sup> ('look regularly')	Substitution of soft repeated movement for arc sweep

that of inherent properties) occur separately in ASL and are well formed in Paul D.'s signing, but the combination of the sign and the inflection (shown in figure 3.9) is illegal in ASL on the basis of a semantic restriction: The sign BRILLIANT does not refer to a transitory state but to an inherent quality and thus cannot undergo the inflection. We know that Paul D. has semantic problems because he produces so many semantic substitutions; we suggest that a dampening of semantic values may also be the basis for his productions of illegal combinations of root signs and inflections. Paul D. selected an uninflected sign and an inflection that together form an illegal combination based on a semantic restriction; this incorrect selection may be due to Paul D.'s inability to differentiate clearly semantic values of morphemes, a kind of semantic dampening.

Figure 3.12 and table 3.4 show examples of neologisms in morphology in which Paul D. selected an appropriate root but combined it with a nonsense inflectional form. The figure shows an existing morphologically complex form, MONTH<sup>[Seriated Plural]</sup>, meaning 'month after month,' and Paul D.'s nonsense form, a kind of morphological neologism.

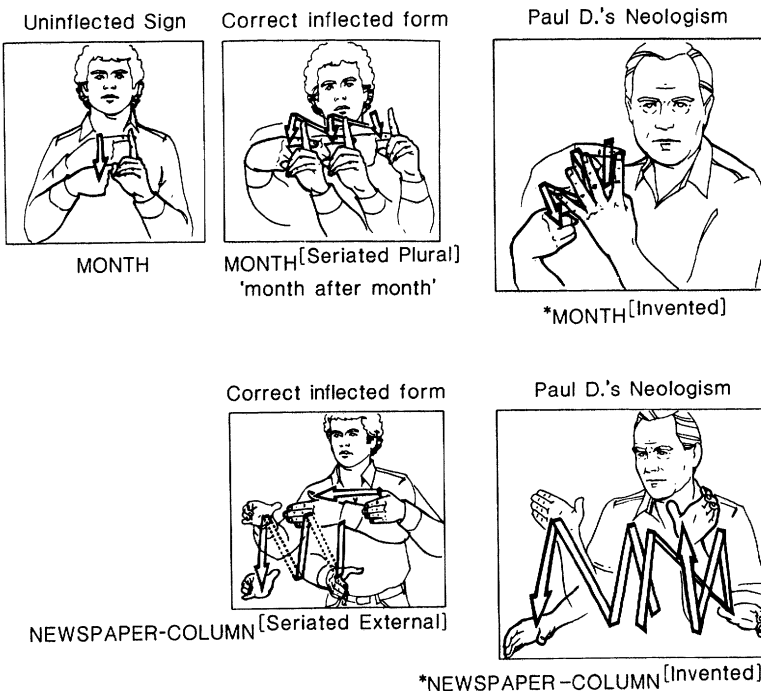


Figure 3.12  
Neologisms in morphology from Paul D.'s signing.

Many of Paul D.'s errors in signing, then, are morphological elaborations—morphologically complex forms appearing where simple ones would have been appropriate for the context. In this regard the errors in his signing are equivalent to those that impressed us in his written English. Because these linguistic errors appeared in both language modalities, we conclude that the errors do not result from features peculiar to sign or speech but from a more central linguistic deficit.

### 3.3.4 *Similar Breakdown in ASL and English: Lexicon and Morphology*

Paul D.'s ASL signing and written English exhibit similar lexical and morphological errors. In both ASL signing and English writing there is a preponderance of semantic (as opposed to sublexical) paraphasias and, more important, morphological augmentations. Indeed, there is no impoverishment; among the substitutions in both sign and speech, one finds a strong tendency toward overelaboration in the choice of items substituted. In Paul D.'s signing the semantic and morphological substitutions occur as if whole families of related

Table 3.4  
Morphological neologisms

Sign form appropriate for context	Sign form produced by Paul D.	Formal property
BRILLIANT (uninflected)	*BRIL- LIANT <sup>[Predispositional]</sup> (‘characteristically brilliant’)	Smooth circular movement
MONTH <sup>[Serialized Plural]</sup> (‘months passing’)	*MONTH <sup>[Invented Form]</sup> (‘months passing’)	Repeated movement on each finger substituted for repeated movement at different loci
NEWSPAPER-COL-UMN <sup>[Serialized External]</sup>	*NEWSPAPER-COL-UMN <sup>[Invented]</sup>	Inappropriate spatial alternation between the two hands

forms are simultaneously activated (see McClelland et al. 1986). A similar process is evident in his writing. The different types of families include semantically related lexical items, inflectional formatives, and derivational formatives (for example, “huddle” might be simultaneously activated with the semantically related word “conference”) and similarly with perseveration; a previously activated item might retain a high level of activation and hence might be incorrectly selected subsequently.

Semantic errors that occurred in Paul D.’s signing and writing include the following.

English: *Huddle* might be simultaneously activated with the semantically related word *conference*.

ASL: The ASL sign QUIT might be simultaneously activated with the semantically related (but formally unrelated) sign DEPART.

Morphological errors that occurred in Paul D.’s signing and writing include the following.

English: In describing the Cookie Theft picture, Paul D. wrote, “I see a girl outstretching her arms.” The two words *stretching* and *out* might be simultaneously activated.

ASL: UNDER<sup>[Derivational]</sup>, meaning ‘subordinate,’ might be simultaneously activated with the semantically and formally related basic sign UNDER.

### 3.3.5 *Modality and Language*

A major difference in form between ASL and English is that ASL tends to transmit structural information in a simultaneously layered fashion rather than in a temporally sequential fashion. Because the left hemisphere seems better adapted than the right for processing sequential rather than simultaneous signals (Bradshaw and Nettleton 1981; Levy 1982), the simultaneous display of linguistic structure in ASL allows the study of the interplay of these opposing attributes. This major difference in form between ASL and English, namely, a primarily multilayered concurrent organization rather than a sequential, linear one, presents a challenge and an opportunity for insight into the fundamental basis of left-hemisphere specialization for language. It has been claimed by some that in humans the left hemisphere is fundamentally specialized for temporally sequential analysis and that it is this capacity that underlies left-hemisphere specialization for language. Our analysis of Paul D.'s poststroke signing suggests that these claims are questionable. Our initial questions included the following: Do separate linguistic levels in the signed signal break down independently of one another, as they do in spoken languages, despite the radically different way linguistic information is packaged in the signed signal? The special layered organization of sign language at the lexical and morphological levels might in fact preclude left-hemisphere specialization with respect to this special aspect of the grammar. Accordingly, one might expect markedly different patterns of language impairment. Paul D.'s breakdown within ASL morphology thus indicates that the temporal sequential organization of the spoken languages considered and the rapid temporal processing that such an organization requires cannot be the basis for left-hemisphere specialization for language.

Let us summarize what has been discussed. There is a parallel breakdown at the morphological level in Paul D.'s signing and writing, as we have shown. This demonstrates that morphological breakdown in aphasia can be independent of language modality. Sign language, however, in a striking way shows its roots in the visual modality through the special spatialized organization underlying its syntax. We show in chapter 4, when we compare sign aphasia deficits across the three left-hemisphere-damaged signers, that Paul D. has problems with the spatialized syntax of ASL that differ from his impairment in English syntax. We propose that this sign-specific syntactic breakdown may be intimately related to requirements of a syntax that is specifically spatially organized.

Initially, we were interested to see what, if any, the effects of left-

hemisphere lesions for deaf signers might be, because the implications of this question have significance for a fuller understanding of brain organization for language in general. What is the effect of a radical change in the modality for brain organization for language? Sign language is, after all, so different from spoken language; not only do root and grammatical markers co-occur in time, but also spatial contrasts play a crucial role at all levels. Is there, for example, evidence of anything similar to aphasia for sign language?

In the first three patients examined here we found marked breakdown of their sign language resulting from left-hemisphere lesions. Furthermore, their sign language is not impaired across the board, but each of the signers shows evidence of *differential* impairment. One patient (Karen L.) shows errors primarily of the equivalent of phonology in her signing but maintained most of the grammar of the language. Even more interesting is that we find two different kinds of grammatical impairment for this sign language: one resulting in agrammatism with omissions of virtually all grammatical markings (Gail D.) and another resulting in paragrammatic signing with abundant but incorrect substitutions of grammatical markers (Paul D.). Components of this sign language thus appear to be differentially affected by different left-hemisphere lesions, despite whatever surface differences may obtain between sign and speech. Our first case studies indeed suggest clear aphasia for sign language.

The data that we have presented so far have come from our first examination of the spontaneous signing of three deaf patients. In the next chapter we present aspects of our formal language testing and standardized aphasia examination of these patients in order to come to a clearer understanding of the basis of their language impairments.

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