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Edited by

Loraine K. Obler

Lise Menn

Department of Neurology
Boston Veterans Administration Medical Center
and
Aphasia Research Center
Boston University School of Medicine
Boston, Massachusetts

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The Special Talent of Grammar Acquisition

SUSAN CURTISS

How could language development (acquisition of the knowledge to speak and understand one's native language) be considered a talent; that is, why should it be considered appropriate for this volume on the neuropsychology of talent? After all, language is an ordinary ability. All normal children acquire language and do so without overt instruction (in contrast, for example, to reading, writing, or arithmetic operations). In this sense it is unlike all of the other abilities covered in this volume, for in these other domains, either there is great variability within the normal population as to the degree of talent possessed or the ability normally requires overt instruction (e.g., reading), or both (e.g., chess, music). Although there are certainly differences in verbal talent, there is remarkable uniformity in the ability to acquire one's native language and in the developmental period and rate at which language acquisition occurs.

This special or unique status of language learning has led some to consider language acquisition as akin to physical growth, in that it is viewed as a fixed, genetically determined and maturationally constrained process, independent in important respects from other aspects of social and cognitive development. Language development is not typically thought of in these terms, however. Language acquisition does not take place in isolation from the rest of development. It normally occurs within the context of development in many areas, and its ties to and roots in nonlinguistic social and cognitive development are the focus of most theoretical models of language acquisition.

This chapter describes instances in which language acquisition nonetheless "behaves" as if it were a specialized talent. First, I present cases in which language acquisition stands apart as an area of developmental impairment. I then present cases of selectively intact language acquisition, that is, instances in which language acquisition proceeds in the absence of the social and cognitive developmental support that are concomitants to language acquisition in normal development. Through these data I attempt to build a case for the existence of specialized neuropsychological mechanisms for language acquisition, especially with respect to the

Susan Curtiss. Department of Linguistics, University of California at Los Angeles, Los Angeles, California.

acquisition of grammar. In doing so, I provide empirical support for the view that in certain important respects, the mechanisms underlying language acquisition may be different from, and may operate independently of, development in other domains. Finally, I attempt to fit this material into the larger context of the neuropsychology of talent.

Before proceeding, it may be useful to define what I mean by "grammar." "Grammar" refers to the system of knowledge comprising the structural principles, constraints, and rules constituting both those facts true of every language (Universal Grammar) and those true only of particular languages, such as English. Here "grammar" does not encompass the "communicative" component of language—that is, the system of rules and constraints governing the use of language in communicative contexts—or the "conceptual" or "semantic" component—that is, the system of rules for mapping the conceptual knowledge system onto linguistic forms, and rules for deciding the truth value or logical well-formedness of propositions or their component parts. This is not to say that these other areas are not part of language, or even what makes language most interesting to some individuals. They are nevertheless being separated from grammar here, and some empirical justfication for doing so will emerge as the cases are presented.

Methodology

Except where noted, the subjects of the cases discussed in this chapter were studied by our laboratory via in-depth investigation of their linguistic and nonlinguistic abilities. Our methodological aim was to obtain a detailed mental profile for each subject, which would then enable us to delimit and compare functioning within and across a substantial range of mental abilities.

In these investigations we examined in detail both receptive and expressive language abilities, including lexical and phrasal semantics, morphology, syntax, conversational pragmatics, and, to a lesser extent, phonology. Comprehension was analyzed by means of formal comprehension tests and observation of comprehension in spontaneous conversation. Production was examined through analysis of imitated, elicited, and spontaneous speech. Our examination of nonlinguistic function included (where appropriate) sensorimotor tasks; preoperational tasks of classification and number; examination of visuo-constructive ability, including drawing, copying, nesting, and hierarchical construction; observation of structured and spontaneous play; memory tests, including tests of short-term auditory and visual memory, examination of visual and spatial skills, including disembedding and visual closure; tests of temporal and logical sequencing; a variety of concrete operational tasks, including those of conservation, classification, reversibility, and perspective; and a variety of tasks involving number concepts and operations. A list of tests used is presented in Table 20-1. (For specific task descriptions and other methodological details, see Curtiss, Kempler, & Yamada, 1981).

Where possible, we attempted to (1) utilize tests of nonlinguistic function that require only nonverbal presentation and responses, (2) utilize tests that tap

TABLE 20-1. Test Used in Assessing Abilities of Case Subjects

Language tests	
Curtiss-Yamada Comprehensive Language Evaluation—R	Curtiss-Yamada Comprehensive Language Evaluation—E
Token Test	Curtiss-Yamada Comprehensive Language Evaluation—S
Peabody Picture Vocabulary Test—Revised	Developmental Sentence Scoring
Sentence Imitation (Yamada)	
Nonlanguage tests	
Uzgiris-Hunt Scales	Hierarchial construction
Classification (Sugarman, 1981)	Logical sequencing
Copying (Piaget & Inhelder, 1967)	Drawing
Object Nesting	Play
Seriation	Wepman-Morency Auditory Memory Span Test
Number battery (adapted from Gelman & Gallistel, 1978)	Knox Cubes Test
Conservation	ITPA[a] Visual Sequential Memory Test
Classification (Curtiss & Yamada, 1970)	Mooney Faces
Localization of topographical stimuli (Laurendeau & Pinard, 1970)	Witkin Children's Embedded Figures Test
Stereognosis	Southern California Figure–Ground Perception Test (Ayres, 1966)

[a]Illinois Test of Psycholinguistic Abilities

one ability at a time and (3) select tasks that would enable us to evaluate abilities on the basis of age level and cognitive-stage norms.

The Selective Impairment of Grammar Acquisition

The seemingly obvious choice of populations to include here would be developmentally aphasic children—children who are traditionally defined as manifesting impaired language development alongside normal nonverbal intelligence, normal peripheral hearing, no (obvious) central nervous system damage, and no significant emotional disturbance, that is, children having a selective language-learning impairment. Recent research on this population indicates, however, that it evidences nonlinguistic as well as linguistic deficits and, moreover, that it is heterogeneous, probably for etiology as well as for actual neuropsychological and linguistic dysfunction (e.g., Johnston & Kamhi, 1984; Johnston & Weismer, 1983; Kamhi, 1981; Kamhi, Catts, Koenig, & Lewis, 1984; Tallal & Piercy, 1975; Tallal, Stark, & Mellits, 1983). Thus, while it may yet turn out to be the case that a subgroup of children identified as developmentally aphasic do have only specifically linguistic deficits, this population currently presents too unclear and varied a picture to be included here.

The subjects I include here represent three cases of linguistic and social isolation, in which otherwise across-the-board successful postisolation development is limited by impaired grammar acquisition. These three cases are of Kaspar Hauser, Genie, and Chelsea.

Kaspar Hauser

Although there is some disagreement as to the validity of the case of Kaspar Hauser I feel comfortable including his case for several reasons. First, there are more than 2,000 documents regarding this case, and the vast majority of them substantiate its validity and provide interesting and detailed information about K. H.'s postisolation progress. Second, the key sources of information on this case were highly regarded professionals in their time, with undisputed credentials (von Feuerbach, 1832; Daumer, 1832; Pietler-Ley, 1927), and additional careful research and examination of the case has been conducted more recently (e.g., Heyer, 1964; Pies, 1966). Third, it is difficult to imagine that authors living in another century could or would have conspired to invent a case that presents such an unpredictable developmental story, one that, when turned upside down, illustrates the special talent of grammar acquisition. So, on to the facts of the case.

K. H. was isolated from the approximate age of 3 or 4 years until he was about 16. During these years, he was kept in a small, cell-like room, totally isolated, and was supplied with food and otherwise cared for while he was asleep (or, perhaps, drugged). The limited size of the room prohibited him from standing erect or lying flat, and during his imprisonment he neither stood nor walked, and he never spoke or was spoken to.

Upon his release and subsequent discovery in 1882, K. H.'s impressive intellectual capacity began to be revealed (and documented and described in numerous writings). He made strikingly rapid progress in almost every area. Within months of his discovery he displayed remarkable ability in drawing, memory, reasoning capacity, and even less expected areas, such as horsemanship. He lived only 5 years after he was found, but during that time was noted for his astonishing intellect. For example, he was consistently reputed to have philosophized about life in general, and his own peculiar circumstances in particular. Within that short 5 years after his discovery, he learned to read and write (within limits as noted below) and became competent in mathematics and several other academic areas.

His linguistic progress, however, reportedly stood alone as the single area of mental function that remained problematic. His language abilities were interestingly uneven: rapid and impressive in certain respects, notably deficient in others. Conceptual (or "semantic") aspects of language (German) were those he apparently mastered readily. Upon entering society he immediately began learning words, and within a few months he acquired a sizable vocabulary and began combining words into short "sentences." The vocabulary he mastered and the logical well-formedness and complexity of the propositions he evidently comprehended and produced as time went on were sufficiently sophisticated to allow him to participate actively in philosophical and intellectual discussions. In contrast, however, he apparently displayed consistent and persistent difficulties with the grammar of German, producing what might be described as both agrammatical and ungrammatical output.

> To the astonishment of all . . . he . . . very soon learned to speak, sufficiently, at least, in some degree to express his thoughts. Yet, his attempts to speak remained for a long time a mere chopping of words, so miserably defective . . . that it was seldom possible

> to ascertain . . . what he meant to express by the fragments of speech which he jumbled together. (Von Feuerbach, 1832, translated by Simpkin and Marshall.)

From a later description:

> His enunciation of words which he knew, was plain and determinate, without hesitating or stammering. But, in all that he said, the conjunctions, participles and adverbs were still almost entirely wanting; his conjugation embraced little more than the infinitive; and he was most of all deficient in respect to his syntax, which was in a state of miserable confusion. The pronoun I occurred very rarely; he . . . spoke of himself in the third person, calling himself Caspar. (Von Feuerbach, 1832, translated by Simpkin and Marshall.)

K. H. reportedly never mastered German syntax or morphology, evidencing a selective deficit in acquiring grammar. This grammar-learning impairment stood in marked contrast to his impressive intellectual development in all other areas written about, including conceptual or "semantic" aspects of language. It is testimony to his remarkable cognitive gifts that he could communicate so effectively and at such a high level, given his linguistic deficiencies.

Genie

The second case of impaired grammar acquisition is that of Genie. There are a number of published reports on the case (e.g., Curtiss, 1977, 1979; Curtiss, Fromkin, & Krashen, 1978; Curtiss, Fromkin, Krashen, Rigler, & Rigler, 1974; Fromkin, Krashen, Curtiss, Rigler, & Rigler, 1974), and the reader is referred to these for more information. Although certain details about Genie's early life remain unknown, there is considerable information on both the case history and her life subsequent to her discovery.

Genie was isolated for a period of 12 years, from the age of 20 months to 13 years, 7 months. Little is known about her life prior to her enforced isolation at 20 months, but during her first year, she had to wear a physically restraining Frejka splint for 7 months to correct a congenital hip dislocation. Other facts regarding her infant development raise the possibility of malnutrition and neglect.

Beginning at 20 months, Genie was confined to a small bedroom in the back of the family home, where she was harnessed to an infant potty seat. Isolated in this room for 12 years, she was fed only infant food and received practically no visual, tactile, or auditory stimulation of any kind. She received little linguistic input; there was no TV or radio in the home, and because of her father's extreme intolerance for noise, all speech in the home was kept to a nearly inaudible volume. Genie's brother and father were her primary caretakers, and by design, neither spoke to her.

Shortly after she was $13\frac{1}{2}$ years of age, Genie was discovered. She could barely walk, could not chew or bite, understood only a few individual words, and spoke not at all. Like K. H., Genie's intellectual development was uneven in intriguing ways. In large part her progress was rapid and impressive. From the time of her

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iscovery on, Genie avidly explored her surroundings and began to show clear
onceptual and intellectual gains. She quickly began organizing and classifiying her
nvironment (evidenced by her play activities and, a little later, by her language)
nd followed a course of steady growth and development. Her mental age (as
easured by standard psychological measures such as the Leiter International
erformance Scale, the WISC, and Raven's Progressive Matrices) increased 1 year
or each year postdiscovery. Within 4 years of her discovery, she had clearly at-
ined most aspects of concrete operational intelligence, including both operational
nd figurative thought (e.g., reversibility, decentrism), and had demonstrated not
nly fully developed but superior abilities in the domain of visual and spatial
unction (e.g., Gestalt and part/whole abilities; spatial rotation; spatial location;
onservation of spatial features; and knowledge about visual and spatial features,
uch as size, shape, and color). Table 20-2 presents some details of relevant task
erformance.

In marked contrast, Genie showed persistent impairments in verbal short-
erm memory and language acquisition. Like K. H., language acquisition was not
n all-or-none affair for Genie. Rather, her language development was marked most
notably by a large discrepancy between her acquisition of referential/lexical and
propositional knowledge on one hand (semantics) and her acquisition of gramma-
tical rules on the other.

TABLE 20-2. Profile

Test/task	Genie's Performance level
Drawing (spontaneous)[a]	Approximate 6- to 7-year-old level
Logical sequencing (Curtiss & Yamada, 1980)	$8\frac{1}{2}$- to 9-year-old level; at ceiling of test presented
Conservation[b]	6- to 7-year-old level (conserves area and length; number questionable)
Classification (Curtiss & Yamada, 1980)	8-year-old level; at ceiling
Spatial operations (Laurendeau & Pinard, 1970)	12-year-old level; appears to have all concrete operational spatial operations
Nesting (Greenfield, Nelson, & Saltzman, 1972)	At ceiling
Hierarchical construction (Greenfield, 1976, 1978; Greenfield & Schneider, 1977)	Able to copy all models, regardless of internal complexity; at least 11- to 12-year-old level
Auditory short-term memory (ITPA; Kirk, McCarthy, & Kirk, 1968)	3-year-old level
Visual sequential memory (Knox Cubes Test)	6- to 7-year-old level
Disembedding (Southern California Figure–Ground Perception Test)	10- to 11-year-old level

[a]Drawing assessed by criteria per Goodenough (1926), Kellogg (1970), and Goodnow (1977).
[b]Conservation assessed by a series of tasks modeled after Beard (1963); Goldschmid & Bentler (1968); Elkind (1961); Elkind (1966); Lovell, Healey, & Rowland (1962); Wallach, Wall, & Anderson (1967); Wohlwill & Lowe (1962).

Within a few months after her discovery, Genie began to produce si words and then acquired vocabulary rapidly. Within 3 to 4 months of her single-word utterances, she had acquired an expressive vocabulary of 100- words and had begun to combine words. Her early vocabulary was quite rich included words of color concepts, numbers, emotional states, and all level category membership (superordinate, basic, subordinate), including some ra subtle distinctions (e.g. "pen" vs. "marker," "jumper" vs. "dress"). Her acqu tion of lexicon and the expression of meaning relations, including multiprop tionality, steadily progressed and increased (see Curtiss, 1977, 1979, 1981, & 1 for more details). However, her ability to produce "sentences" developed insofar as she was able to produce increasingly longer strings and strings increased in propositional complexity. In contrast, her utterances remained lar agrammatic and hierachically flat, as seen in Examples 1a–j.

(1) (a) I like hear music ice cream truck.
(b) After dinner use mixmaster.
(c) Like kick tire Curtiss car.
(d) Ball belong hospital.
(e) Genie Mama have father long time ago.
(f) Think about Mama love Genie.
(g) Dark blue, light blue surprise square and rectangle.
(h) Teacher say Genie have temper tantrum outside.
(i) Father hit Genie cry longtime ago.
(j) Genie have Mama have baby grow up.

Her speech, even after 8 years, was devoid of almost all bound and freesta ing grammatical morphology and of most syntactic devices and operations. I major achievement in the acquisition of syntax was the acquisition of categor information, including some subcategorization facts. This knowledge was e denced, for example, by her ability to answer WH questions with the corr constituent category (usually) and by her frequent, although not exceptionl adherence to subcategorization facts and constraints of many verbs, as, for examp in producing strings like "Put car [in] garage" or "Mr. W say put face in swimming pool" or "Genie want buy nother shoe box" but not "Put car," "Mr. say," or "Genie want buy." It appeared for a time that she also had learned Engl phrasal and clausal word order constraints. However, over the years there w persistent, even increasing, violations of such constraints in production and pers tent miscomprehension of word order (e.g., in reversible actives). The dissociati between acquisition of "conceptual" aspects of language and acquisition of gra matical forms and rules reported in K. H.'s case, then, was a hallmark of Geni language, too.

Genie's linguistic limitations extended to the use of language for effecti interactive purposes. Despite the fact that her utterances were usually well form with regard to their logical structure and were generally truthful, relevant, bri and on topic, especially in response to questions or in conversational turns direct by others, as illustrated in Example 2, her means of initiating, participating in, a

controlling or regulating verbal interaction on her own were greatly restricted. She possessed an impoverished set of linguistic-pragmatic devices and relied heavily on simple statements of a proposition or on repetition of a proposition to perform a variety of pragmatic functions—introducing topics; continuing topics; acknowledging or responding to comments, requests or questions; making comments or requests; and asking questions—as illustrated in Example 3. Moreover, she failed to use social rituals (e.g., "Hi," "How are you?") or conversational operators (e.g., "Well," "O.K.")—the trappings that help to make a conversation fluid and interactively normal.

We see, then, that the rules underlying the use of language for communicative purposes were not uniformly affected by Genie's adverse language-learning circumstances. Those aspects of effective communication depending on an appreciation of conversational content and the communicative intent and needs of one's listener were least impaired, whereas those aspects of effective communicative interaction depending on socially conditioned skills of conversational participation were sorely deficient or absent altogether.

(2) (a) *G*: Neal come.
M: Yes, Neal is going to come tomorrow. Neal makes you happy. He's a friend of yours.
G: Neal not come happy. Neal come sad.

(b) *C*: Why aren't you singing?
G: Very sad.
C: Why are you feeling sad?
G: Lisa sick.

(3) (a) *G*: Think about Mama bus.
C: Did you see Mama on Saturday?
G: Saturday.
C: I need a "yes" or "no."
G: Yes. I want think about Mama riding bus. Think about Mama bus.

(b) (*Touching yellow crepe paper that a gift for her—a picture frame—received at school was wrapped in*)
G: At school. Paper at school. Picture at school.
C: The picture is from school, too?
G: From school.
C: That's a picture frame, actually.
G: At school. (*An interruption*; *then* . . .) Big present.

Chelsea

A third case showing the same general pattern as that of K. H. and Genie has only recently begun to be investigated. Brought to light by P. Glusker, it involves a hearing-impaired adult, Chelsea, who is attempting first-language acquisition in her 30s. No systematic investigation of Chelsea's language development has yet been carried out; thus the data are largely preliminary and anecdotal (Curtiss,

unpublished data; P. Glusker, C. O'Connor, V. Yancy, J. Watters, & N. Dronkers, personal communication 1982–1987). Nonetheless, they reveal a profile characterized by marked scatter in abilities, parallel in many respects to those seen in K. H. and Genie.

Although little testing of Chelsea's nonlinguistic intellectual function has been carried out, her performance on the Raven's Progressive Matrices and several Piagetian tasks demonstrates a sufficient intellect to support grammar acquisition. Yet, there is a clear and striking disparity between Chelsea's lexical knowledge and her ability to manipulate that knowledge on the one hand, and her ability to combine vocabulary into appropriate and grammatical utterances on the other. Her lexical knowledge has steadily progressed and is quite substantial. For example, in 1984 Chelsea scored above the 12th-grade level on the Producing Word Associations subtest of the Clinical Evaluation of Language Functions (CELF; Semel & Wiig, 1980), the highest norms for the test. In contrast, her multiword utterances are, almost without exception, unacceptable grammatically at the level of the phrase and the clause and are quite often propositionally unclear or ill-formed as well, as illustrated in Examples 4a–g.

(4) (a) The they.
(b) Breakfast eating girl.
(c) Orange Bill car in.
(d) The man is walking [unintelligible] truck car truck walking.
(e) The woman is bus the going.
(f) Daddy are be were to the work.
(g) They are is car in the Bill.

Thus her lexical knowledge seems limited to (denotative) definitional cores and does not appear to encompass either subcategorization information or logical structure constraints. Likewise, her expressive language, in violation of constituent structure, subcategorization constraints, phrasal and clausal word order, agreement phenomena, and so forth appears, at its best, to be limited to the production of combinations of semantically relevant substantives.

Chelsea's discourse skills appear, at least superficially, to be almost the reverse of Genie's. It is Chelsea's topic-related skills that are limited, but these limitations may reflect her comprehension difficulties as well as propositional limitations. Other discourse abilities seem remarkably developed (e.g., speech act range, use of social rituals, use of conversational operators) and enable Chelsea to engage in conversation that in some respects is interactively appropriate.

Summary

Taken together, the cases of K. H., Genie, and Chelsea suggest that there is a critical difference between acquisition of the conceptual and communicative aspects of language and acquisition of rules of grammar (here, syntax and morphology). This critical difference has two potential explanations. First, the learning capacity displayed by K. H., Genie and Chelsea and the mechanisms they utilized for

growth in other intellectual domains, including conceptual and communicative aspects of language, were insufficient and/or inappropriate for learning grammar. In K. H.'s case, even apparently extraordinary intellect was not sufficient. Second, either the learning principles governing acquisition of grammar were selectively impaired from birth, or Chelsea, Genie, and K. H. had passed the age at which they were still functional. Both explanations point to a task-specific grammar-acquisition ability, that is, a special talent for grammar acquisition.

Selectively Preserved Grammar Acquisition

If grammar acquisition is indeed a special and neuropsychologically independent talent, it should, in principle, be possible to identify individuals who are otherwise cognitively deficient but who show intact grammar-learning ability. Such individuals have been alluded to in the literature for some time. For example, a subpopulation of hydrocephalic children has been described as "hyperverbal" and as mentally retarded, with a "cocktail party syndrome" (Dennis, Lovett, & Wiegel-Crump, 1981; Swisher & Pinsker, 1971; Tew, 1977). Children with Williams syndrome have been similarly described (Jones & Smith, 1975; von Armin & Engel, 1965), as have children with Turner syndrome and Noonan syndrome (Silbert, Wolff, & Lilienthal, 1977). Detailed examination of the language-acquisition capacity and patterns of these populations has yet to be undertaken, however.

In our own lab, the extent to which language acquisition may be based on task-specific mechanisms has been the focus of research for some time (e.g., Curtiss, Fromkin, & Yamada, 1979; Curtiss *et al.* 1981). In the course of our work we have studied in detail several subjects who, although not part of any of the previously mentioned populations, illustrate the profile of an intact island of talent—that of grammar acquisition. These case studies involve children who are mentally retarded but who have surprisingly intact grammars, despite their pervasive cognitive deficits. Though we have data from several such cases,[1] we discuss just three of them here. In two of the three cases the etiology of the retardation is unknown.

Antony

The first case is that of Antony, a child of 6–7 years when we studied him (see Curtiss & Yamada, 1981 for a detailed description of the case). Antony's IQ estimates ranged from 50 to 56. At chronological age 5 year 6 months, his mental age was 2 years 9 months. Parental reports indicate speech onset at 1 year and full sentences at 3 years, despite numerous professional reports of pervasive developmental delays in many areas.

1. The data discussed in this section were collected jointly with Jeni Yamada or Daniel Kempler, with the exception of some of Marta's data, which were collected solely by J. Yamada and were drawn from Yamada (1983).

We found in Antony's language a profile quite the opposite of Genie's. Antony's language was well formed phonologically and syntactically and was structurally rich. It was fully elaborated with inflectional and derivational bound morphology and "free" grammatical morphemes, and it included syntactic structures involving movement, embedding, and complementation, although Antony made errors not atypical for his age, suggesting that he was still mastering some grammatical rules. Examples 5a–l illustrate Antony's abilities.

(5) (a) The wolf is not here.
(b) Are you Miss W.?
(c) Could I take this home?
(d) Jeni, what'd you touch?
(e) Why don't you fly?
(f) Jeni, will you help me draw pictures of Susie?
(g) I got my brother named David.
(h) That clock says it's time to get some prizes.
(i) I don't want Bonnie coming in here.
(j) I don't know who he gots.
(k) He eats carrot.
(l) A stick, that we hit peoples with.

Antony's linguistic strengths, therefore, lay in phonology, morphology, and syntax—that is, in the grammar.

Antony's language was semantically quite deficient, however. First, his lexical specifications were incomplete and sometimes inaccurate. This resulted in incorrect word usage, a problem frequently leading to miscommunication with others. Notably, none of Antony's lexical errors involved violations of syntactic class, subcategorization features, grammatical case, or word order. Almost all of his errors were errors in semantic feature specification. Errors with lexical substantives involved confusions or inadequate definitional differentiation between words within a particular semantic area (e.g., "birthday" for "cake," "cutting" for "pasting"). Errors with prepositions involved errors in marking direction, location, or semantic case or function (e.g., "to" for "from," "in" for "with"). Pronoun errors involved errors in gender or animacy (e.g., "who" for "what," "that" for "he"). At times, Antony exploited his grammatical knowledge to compensate for deficient lexicon, creating a different kind of error. These errors involved creating nouns from verbs in his vocabulary for words that already have a derivationally simple noun form (e.g., "sweeper" for "broom," "sewing" for "spool"). These latter errors reveal a productive knowledge of derivational morphology and the syntactic class such morphology creates.

A second area of semantic deficiency lay in Antony's formulation of propositions. Propositional content, unless quite simple, was often confusing and incompletely expressed. He frequently failed to grasp the intent or full meaning (including presupposition and implicature) of his own and others' utterances, causing consistent communication failures, as illustrated in Examples in 6 and 7.

(6) (*Anthony*
standing i
A: You
E: Who'
A: No, i
E: Every
A: Not

(7) *A*: I wat
E: But
day?
A: Noth
E: Noth
cook
A: Nop
E: Mak
A: He

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(6) (*Anthony's library teacher, Miss C, has just walked into the room and is standing in full view of Antony, rather close to him.*)
A: You guys, lookit who's in our class. I want to see who's in that class.
E: Who's in what class?
A: No, in ours.
E: Everyody's here!
A: Not Miss C.

(7) *A*: I watch *Bewitched*.
E: But what does your daddy do, Antony? What does your daddy do all day?
A: Nothing.
E: Nothing! I don't believe it. Does your daddy stay at home all day and cook?
A: Nope.
E: Make supper and . . .
A: He was not comin' home.

Antony's conversational abilities included a wide range of pragmatic functions and intentions (e.g., naming, turn taking, commenting, requesting, protesting, responding to requests and questions, and acknowledging), and he had learned the conventional means for expressing them (rejoinders, words and phrases of acknowledgment, request phrases, etc). However, he was not sensitive to the needs of his listener, his topic-maintenance skills were poorly developed, and he rarely appeared to be concerned with being relevant or informative (again, see Curtiss, 1981, for details).

Given his semantic and communicative deficiencies, Antony's language was well formed generally only out of context (see Curtiss, 1981, 1982, for details). It thus appears that Antony acquired the grammatical system separate from the semantic structures that are mapped onto sentences by means of the grammar and separate from the rules guiding the use of grammar for effective communication. To the extent that this is true, he may be said to have acquired an autonomous syntax, and his case illustrates the separability of grammar acquisition from the development of other aspects of language.

Antony's nonlinguistic profile reveals a further dissociation of grammar from other abilities. In structured and unstructured situations his attention span was markedly short. Many tasks we successfully administered to normal 2-year-old children proved too difficult for him to grasp. On those tasks for which he was able to give a measurable performance, he showed substantial deficiencies in every area except auditory-verbal short-term memory, as illustrated in Table 20-3. His drawings were prerepresentational, his play was at the 1- to 2-year-old level, he was unable to perform any of the classification tasks, and his logical reasoning abilities were at the 2-year-old level. His nonlinguistic cognitive level appeared to be at or just beyond sensorimotor stage VI (normally attained at approximately 20–24 months), with nonlinguistic symbolic abilities (e.g., play, drawing, copying) below that. His one area of nonlinguistic

TABLE 20-3. Antony's Nonlanguage Performance Profile

Ability	Antony's performance level
Auditory short-term memory	7-year-old level
Drawing	Prerepresentational
Copying	Prerepresentational
Nesting	28- to 32-month-old level
Hierarchical construction	Less than a 2-year-old level
Conservation	Couldn't administer, even via "Magic Show"[a]
Logical sequencing	2-year-old level
Classification	Unable to perform at all; below 2-year-old level
Play	1 to 2 year-old level

[a]Gelman and Gallistel (1978).

strength was auditory-verbal short-term memory, in which he performed above age level.

Antony thus showed a dissociation of grammar acquisition not only from development in other areas of language but from development in nonlanguage areas as well. In other words, he displayed a selective talent for grammar acquisition.

Marta

The second case is that of Marta, a teenager studied from the age of 16–18 years (Curtiss, 1982; Yamada, 1981). Marta's IQ estimates ranged from 41 to 44. All developmental milestones are reported to have been delayed, including speech onset and other linguistic developments. From the age of about 4–5 years, however, language clearly stood apart as Marta's area of greatest strength.

Marta's linguistic profile was much like Antony's. Her speech was well formed phonologically and fully elaborated morphologically, and it embodied rich, complex, and well-formed syntactic structures. Like Antony, Marta produced errors demonstrating that her utterances were not merely (delayed) repetitions of someone else's speech; her utterances, however, were generally much longer and propositionally more complex and convoluted than Antony's, as illustrated in Examples 8a–h. In addition, her lexicon was much richer and contained many more quantifiers and adverbs than Antony's, as is also illustrated in these examples.

(8) (a) Last year at [name of school], when I first went there, three tickets were gave out by a police last year.
(b) That's where my sister, J, lives!
(c) I don't want to get eaten by one.
(d) We're really excited about school starting, and I love it myself.
(e) She, does paintings, this really good friend of the kids who I went to school with last year and really loved.

(f) He was saying that I lost my battery-powered watch that I loved.
(g) The cook who does it, um sometimes give us these good enchiladas an' oh, they're so good!
(h) He's my third principal I've had since I've been here.

Although Marta had a larger vocabulary than Antony, their lexical semantic abilities were quite parallel. Much of Marta's lexicon was incompletely specified, not for grammatical features, but for semantic features. Thus she, too, often misused words, most frequently words referring to number, time, manner, and dimensionality (see Examples 9a–f). The propositional content of her utterances, though apparently rich and varied when only a small sample of her speech is considered, was largely repetitious of a small repertoire of themes and, at its best, was loosely structured.

(9) (a) It [her watch] was broken, desperately broken.
(b) *J*: How many nights did you stay there?
[at the hotel with the family]
M: Oh, about four out of one.
(c) "Jack," that's my father's last name, "Jack."
(d) (*M has just turned 16.*)
I was 16 last year and now I'm 19 this year.
(e) It's very soon that they asked us to fly out.
(f) (*J. Y. had just given M two pennies*)
J: How many pennies do you have now?
M: Five.

Marta's conversational performance was strongest in those areas incorporating conventionalized social routines and early developed (Dore, 1978) pragmatic functions and was weakest in the areas of topic maintenance, relevance, informativeness, and truthfulness as illustrated in (10). Marta, too, then, appears to have an advanced level of grammatical knowledge alongside dramatically less developed semantic and pragmatic ability.

(10) (*J. is explaining to M what they're going to do in their session that day. M just begins talking.*)
M: I might get my bangs [unintelligible] trimmed, 'cause this friend of my mom's is away, my mom's haircutting, go to the airport, 'n my haircutting came in! An' so we haven't made one yet. Just to get (*gesturing cutting at back of head*) back [unintelligible] here, 'n one [k]! y'know, [k] [unintelligible] really get the, thing, the what do you call it.
S: The hair, the scissors?
J: The scissors?
M: I was goin' there, cross the street from where I live it's right across from, [unintelligible] this is . . .
S: From your new, from where you live now?

M: Ycah, an' it's really nice, me 'n this friend went there, an' I went there an' I'm (*sort of sings*) grad-du-a-ting from it! I'm [unintelligible] (*slaps self as if in rhythm*) . . .
S: You're now what?
J: What are you?
M: [I think it's, they] go up to fifty an hour, a dollar an hour an' um,
S: Hm. A new class you mean, or a new place?
M: It's no, the place where I get my hair cut, pays an hour if it's a woman, I think, if it's a man it pays, he pays, five hours, I think, of work he pays, five hours, I think, of work he pays. He's out of town, so the woman works by herself, she knows where the phone is. An' this new girl my mother [as] got was so upset, an' she didn't know any kind of work. She was brand new, an' she didn't know, she didn't even , . . .

Marta's nonlinguistic performance showed further dissociations between her knowledge of grammar and other domains of knowledge, as illustrated in Table 20-4. She lacked almost all number concepts, including basic counting principles; her drawing was perseverative and at a preschool level; her play behavior was limited (symbolic play was noted on one occasion); her auditory-verbal memory span appeared to have an upper limit of three units; and logical reasoning and operational thought were at an early preschool level (preoperational). Unlike Antony, Marta did not appear to have any area of strength or well-developed ability in her nonlinguistic profile. Unlike Antony, however, Marta appeared to have some conscious cognitive appreciation of language as an object of contemplation in its own right, that is, metalinguistic ability. On imitation tasks, she was able both to detect and to correct surface syntactic and morphological errors and at times to detect semantic anomalies as well. In addition, she was sensitive to foreign accents and often made comments about such accents or the use of a foreign language (e.g., "They're speaking Spanish, can you hear it?"; "The mother's accent spits right out

TABLE 20-4. Marta's Nonlanguage Performance Profile

Ability	Marta's performance level
Auditory short-term memory	3-year-old level
Drawing	Preschool level
Copying	$3\frac{1}{2}$- to 4-year-old level
Nesting	28-month-old level
Hierarchical construction	2-year-old level
Counting	Unable to count to 5; did not have one-to-one principle
Conservation	Did not conserve
Seriation	Failed all aspects of task
Stereognosis	$3\frac{1}{2}$- to 4-year-old level

the mouth"). Thus not only did Marta acquire remarkably developed grammatical knowledge in contrast to all other aspects of mental ability examined but that knowledge developed beyond the stage of unconscious acquisition to a stage allowing for some conscious awareness and manipulation.

Rick

The third case is that of Rick, a mentally retarded 15-year-old who suffered anoxia at birth and evidenced pervasive developmental problems throughout his childhood. Rick was institutionalized most of his life in a state hospital for the severely retarded. His case is described in detail in Curtiss and Kempler (1987).

Rick's language profile is quite parallel to that of Antony and of Marta—well-developed phonological, morphological, and syntactic ability alongside poorly developed lexical and propositional semantic ability. He made frequent lexical errors and occasional morphological errors, both indicating that at least much of his speech was novel and productive. However, he also made frequent use of a small set of phrases in combination with novel phrases, giving his speech, over extended discourse periods, a somewhat repetitious quality. Some illustrations of his speech are presented in Examples in 11a–i.

(11) (a) He's the one that plays around like a turkey.
(b) You already got it working.
(c) If they get in trouble, they'd have a pillow fight.
(d) She's the one that walks back and forth to school.
(e) She can get a ponytail from someone else.
(f) It was hitten by a road; but one car stopped and the other came.
(g) She must've got me up and thrown me out of bed.
(h) I find pictures that are gone.
(i) Would you please give me the trash can?

Rick was an extremely social child and had well-developed interactive linguistic skills. He made appropriate use of social rituals and other conventionalized conversational forms. His semantic deficiencies impeded his communicative effectiveness, however, since he often misinterpreted or failed to understand the meaning of utterances directed to him and often made lexical and propositional errors of his own (see Examples 12 and 13).

(12) *R*: She looks like she has blonde hair.
Ex: What color is blonde?
R: Black.

(13) *Ex*: Who gets up first in the morning?
R: Me.
Ex: And then what?
R: Cindy gets up third.
Ex: Third?! Is there someone else getting up?
R: No.

TABLE 20-5. Rick's Nonlanguage Performance Profile

Ability	Performance level
Auditory short-term memory	6-to 7-year-old level
Visual short-term memory	Below basal (below 2.1 years)
Seriation	Preoperational
Drawing	Prerepresentational
Copying	Prerepresentational
Classification	2-to 3-year-old level

Rick thus showed a linguistic profile similar to that of Antony and of Marta in that he evidenced a highly developed grammatical system alongside impaired semantic knowledge; however, he showed more pragmatic competence that they.

Rick's nonlanguage profile (highlights are presented in Table 20-5) was most similar to Antony's, although Rick was more readily testable. Rick's drawing and copying were prerepresentational, and his logical reasoning and operative thought performance were also at an early preschool level. He could rote count to 20 and knew some of the basic counting principles, but he could count correctly only sets of five items or fewer, and his number reasoning was primitive (e.g., "What is the biggest number you can thing of?" Rick: "3"). His classification abilities were difficult to assess in that, with one exception, his manipulation of separate classes of objects appeared to be random and indifferent to object classes or category, even on tasks designed for use with children under 2 years (Sugarman, 1981). However, in every case he readily labeled each separate class of objects; in one instance, given four cups and four small cars, he placed one car in each cup, calling his product "car-cups," then first removed all of the cars and stacked the four cups. Still, even his best performance was at about a 2-year-old level. In contrast, he performed at the 6- to 7-year-old level on auditory-verbal short-term memory tasks.

Discussion

The cases presented here all share two common properties: (1) grammar acquisition was dissociated from other aspects of language learning—conceptual aspects, communicative aspects, or both, and (2) grammar acquisition was dissociated from nonlinguistic development. Moreover, the cases illustrate a double dissociation between grammar acquisition and development in other components within the domain of language as well as between grammar acquisition and development in other, nonlinguistic cognitive domains. This double, double dissociation marks grammar acquisition as a separate area of neuropsychological function and therefore a not unreasonable candidate for a specialized neuropsychological talent.

There is other evidence consistent with this possibility. Data on children with left hemispherectomy or hemidecortication have shown in some cases substantial, and in other cases rather subtle but persistent, deficits in grammar acquisition

alongside relatively normal or at least significantly better nonlinguistic abilities and abilities in noncomputational aspects of language (Day & Ulatowska, 1979; Dennis, 1980a, 1980b, 1981; Dennis & Whitaker, 1976; Zaidel, 1973, 1981). The marked deficits in cases of left hemispherectomy after at least early stages of language acquisition involve severe limitations in both comprehension and production of morphology and syntax. Specific deficits in the acquisition of linguistic structural knowledge in cases of hemidecortication *before* language acquisition include impairments involving phonological manipulations and recodings, processing and/or representation of certain nonlexical grammatical markers, and the assignment of noun phrase function and negative scope on the basis of syntactic structure. Recent research on adult dyslexics (Kean, 1984) shows similar deficiencies in this population in processing nonlexical grammatical formatives and in the assignment of referential relations between noun phrases (nouns or pronouns) based on syntactic structure. These deficiencies may appear remarkably limited compared to the gaping lacunae in grammar acquisition in the cases of K. H., Genie, and Chelsea. Yet, these cases, involving clear-cut neurological impairment as they do, provide strong evidence to support the existence of neuropsychological mechanisms specialized for grammar acquisition in the normal brain.

These data also suggest a tie between specialized grammar-learning mechanisms and the left cerebral hemisphere. Such a tie is supported by the results of neurolinguistic experiments with Genie, which indicated that she was using her right hemisphere for language representation and processing (Curtiss, 1977; Curtiss *et al.*, 1978; Fromkin *et al.*, 1974). This finding and the childhood hemispherectomy and hemidecortication data suggest only that the left hemisphere as a whole is functionally specialized for grammar acquisition. Data from a case report of stroke in childhood (Dennis, 1980c) and emerging data on dyslexia (Galaburda, 1983; Galaburda & Kemper, 1979; Galaburda, Sherman & Geschwind, 1983) suggest that certain areas *within* the left hemisphere are especially important for normal and complete mastery of the grammar. This possibility is, of course, consistent with the data on adult acquired aphasia, which impute special importance to certain areas of the left hemisphere for the maintenance of normal linguistic capacity.

Still other data suggest a critical period for the operation or utilization of grammar-learning mechanisms. The cases of K. H., Genie, and Chelsea all involve language acquisition after the proposed critical period for such acquisition (Lenneberg, 1967). In addition, age of acquisition has been shown to impinge critically on the character and extent of sign language acquisition. Mayberry, Fischer, and Hatfield (1983) demonstrated experimentally that individuals who acquired American Sign Language (ASL) in the teenage years performed worse on a variety of tasks testing competence in ASL grammar than those who acquired ASL in childhood. What is more, the later sign language was learned, the worse the performance. In additional work Mayberry (1984) reports that the signers who had learned ASL later (from 8 years up) not only performed more poorly but also performed differently. Similar findings are reported by Newport (1984). She investigated the relative effects of number of years signing versus age at acquisition on production and comprehension of ASL utterances involving grammatically complex verbs of motion. There was a small effect such that the later sign

language was acquired, the worse the performance. However, the main effect found was between native and early acquirers on the one hand and "late" learners (those learning sign language between the age of 12 and 21) on the other, with only native signers and early learners demonstrating mastery of the complex grammatical structure of verbs of motion. Moreover, the structural analyses and hypotheses entertained by the late learners were very different from those of the native and early learners (for related findings, see Fischer, 1978; Newport, 1981, 1982; and Woodward, 1973).

Conclusion

I have argued for the existence of specialized neuropsychological mechanisms for grammar acquisition, mechanisms that appear to be tied to the hemisphere prepotent for language at birth (usually the left) and to function within strong maturational constraints. There is good reason to expect that if there are specialized mechanisms required for its acquisition, grammar must rest on domain-specific organizational principles (i.e., principles of Universal Grammar). Therefore, having marshaled evidence for such mechanisms, I have also built a case for grammar being a distinct faculty or module of the mind, a module that, there is reason to believe, may in itself be modular (cf. Chomsky, 1981). In turn, if grammar is a separate module of the mind, one may assume that the mind is more generally modular in character, with different knowledge domains governed by distinct modules of mind, each of which embodies its own structural constraints and principles and is uniquely responsive to information that meets its structural specifications. It thus becomes possible in development and in mature function to exhibit selectively intact or impaired modules, even selectively enhanced or precociously developing modules of mind. Where the latter situation exists, we see domains of talent. Not surprisingly, then, since there appears to be a separate faculty of mind for grammar and specialized mechanisms for its acquisition, there appears to be a talent for grammar acquisition. Fortunately for us, it is a talent all normal individuals have.

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