The critical period and parameter setting in five cases of delayed L1 acquisition

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Three well-known cases of extreme linguistic isolation during childhood and two recent cases from the neurological literature involving left-hemispherectomy in children are examined. In all five situations, subjects underwent delayed L1 acquisition (with L1 onset ranging from 5 to 31 years). "End-state" utterances provided in published reports are analyzed for evidence concerning subjects' control of the Head Position, Null Subject, and Wh parameters. In addition, the early phrasal development of a subset of the five subjects is investigated in terms of the asymmetric Merge operation. Findings concerning ultimate attainment indicate that the younger cases set parameters more successfully, and that performance declines markedly with increasing age, while results regarding early multiword utterances suggest that these are strikingly "normal" as long as delayed onset of L1 occurs within, and right up to, the critical period boundary. This pattern, it is argued, is consistent with the notion that pre- and post-critical period first language learning involve qualitatively different processes.

Introduction

In *Biological Foundations of Language*, Eric Lenneberg (1967: 376–377) presented his classic formulation of the hypothesis that there is in humans a critical period for the acquisition of a first language, whose upper boundary is fixed by the onset of puberty around age 12–13, when "a steady state is reached, and … the capacity for primary language synthesis is lost". Lenneberg (1967: 176) also noted that:

> Our ability to learn foreign languages tends to confuse the picture. Most individuals of average intelligence are able to learn a second language after the beginning of their second decade, although the incidence of "language-learning-blocks" rapidly increases after puberty… This does not trouble our basic hypothesis on age limitations because we may assume that the cerebral organization for

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> language learning as such has taken place during childhood and… the matrix for language skills is present.

Since that time, the Critical Period Hypothesis (CPH) has been extensively debated, particularly (and perhaps somewhat ironically, given the above quotation) in the context of second language acquisition. A question that has been at the heart of this debate is the one that Ervin-Tripp famously posed in 1974, namely "Is second language learning like the first?" Over the decades, the question has been recast in a variety of ways, with increasing attention to the role of Universal Grammar in both early and later L2 acquisition. Since the 1980s, the essential strategy underlying this approach has been succinctly summarized by Hawkins (2001: 10) as consisting of "applying hypotheses about the principles and parameters of Universal Grammar to observable patterns of second language development (in order to)… confirm or disconfirm their involvement".

Three general positions concerning the role of UG in L2 acquisition have been widely debated, namely the "full access", "partial access", and "no access" positions. The first essentially rejects any biologically-grounded notion of a critical period, while the second and third could be said to be consistent with "weaker" and "stronger" versions of the hypothesis. Thus "full access" holds that the whole of UG is as available to L2 learners as it is to L1 learners. Strong versions of this hypothesis would include Flynn (1987) who claims that adult learners of an L2 have direct access to UG and that L2 acquisition does not involve transfer of, for example, parameter settings from L1, although differences between L1 and L2 can result in delayed acquisition of L2 settings.

Epstein et al. (1996) offer a later articulation of this position, also arguing that L2 acquisition is fully constrained by UG, while recognizing that L1 plays a role and that L1 and L2 developmental trajectories differ, albeit for reasons unconnected to the critical period. Schwartz and Sprouse (1994, 1996) offer a model which formally incorporates the role of L1 transfer while hewing to the "full access" position. Thus, the FTFA (Full Transfer/Full Access) model proposes that the L1 grammars of learners provide the initial state for acquisition of the L2, but that the learners retain unlimited access to UG throughout the process, and make use of that access when they encounter grammatical differences between the two language systems. This proposal has engendered a vigorous research program which continues to the present (e.g. Song and Schwartz 2009).

The "partial access" position holds that only some modules of UG are no longer available to older L2 learners. For example, according to the "no-parameter-resetting hypothesis" of Tsimpli and Roussou (1991), the functional module with which parameters are associated is subject to maturation and therefore unavailable to the adult L2 learner. In a Minimalist reformulation of this hypothesis,

Tsimpli and Dimitrakopoulou (2007) argue that where L1-L2 differences in the representation of uninterpretable features exist, these features resist resetting, causing the uninterpretable L1 features to be transferred to L2. This proposal closely resembles the Failed Functional Features Hypothesis (FFFH), advocated by Hawkins and Chan (1997) and Hawkins and Hattori (2006), whereby UG remains partially available to adult L2 learners who retain only limited access to the UG feature inventory; acquisition problems then arise when uninterpretable features present in the L2 are lacking in the learners' L1 grammar.

The third view is illustrated by Bley-Vroman's (1989) well-known argument concerning "the logical problem of foreign language acquisition" and its corollary, the "fundamental difference hypothesis" (FDH). Within this framework, nine fundamental characteristics (or ten, in Bley-Vroman 1990) distinguish adult foreign language learning from child language development, two of which are crucial. According to the first, which is labeled "lack of success" in the 1990 formulation, normal children always achieve mastery of their language, whereas adult foreign language learners do not; according to the second, "variation in success," children end up with essentially uniform systems whereas foreign language learning results in substantial variation in the types of grammars that are acquired.

These differences, the FDH postulates, occur because late acquired second languages are entirely unconstrained by the rules of UG and learners therefore have to rely on a combination of general problem-solving mechanisms and native language knowledge. The fundamental difference, Bley-Vorman (1989: 50) argues, is internal, linguistic, and qualitative:

> *Internal*: It is caused by differences in the internal cognitive state of adults versus children, not by some external factor or factors (insufficient input, for example).
>
> *Linguistic*: It caused by a change in the language faculty specifically, not by some general change in learning ability.
>
> *Qualitative, not quantitative*: The difference is not merely quantitative; the domain-specific acquisition system is not just attenuated, it is unavailable. Period.

In a re-examination of the FDH, Bley-Vroman (2009) acknowledges that recent developments in linguistic theory require some reconceptualization of the hypothesis. Essentially the elaborate and highly structured UG postulated in the context of the Government and Binding/Principles and Parameters approach has been thoroughly stripped down under current Minimalist assumptions, and a wide range of grammatical facts are now thought to have extra-grammatical causes (e.g. subjacency is now seen as resulting from an interaction between processing and semantic/discourse factors). So, the original view that child language development uses domain specific processes while foreign language learning depends on

domain general processes is no longer tenable, given that many of the processes of the language faculty are now thought to be reducible to language-independent principles. Nevertheless, Bley-Vroman contends that the two essential elements of the logical problem, namely "unreliability" (roughly equivalent to "lack of success" in the 1990 formulation), and "non-convergence" (roughly equivalent to "variation in success") remain as valid today as they were over twenty years ago. The original formulation of the logical problem thus still holds, although the details of the FDH do need to be revised. Briefly, the proposed solution is that it is the core system of the grammar that doesn't work, or doesn't work well enough, in foreign language learning and that the learner must then make extensive, perhaps even exclusive, use of various peripheral systems ("patches" and "viruses") that are in fact also available in child language development, although in the latter case they are but "a minor factor, more like a wrinkle in the system" (2009: 192).

An aside on the current status of parameters in generative theory

The above references to Minimalism force a brief discussion concerning the somewhat problematic status of parameters in current generative theory. Indeed, the notion has been subjected to radical critiques by researchers such as Boeckx (2010: 11–12) who has argued against the very existence of parametrization: "Given what we already know about the biological foundations of language, there won't be any explanatory room or causal role for Parameters… Minimalist inquiry points to the idea that Parameters don't exist; they are not real theoretical objects; they are epiphenomena". Kandybowicz (2009), on the other hand, foresees a less drastic consequence to this epiphenomenal take, namely that the domain of parametrization need only be conceived as being limited to the interface of the language faculty with PF, rather than entirely dismissed. This position is similar to that expressed by Chomsky (2008: 7) who, in a discussion regarding headedness, proposes that "ordering is restricted to externalization of internal computation to the sensorimotor system, and plays no role in core syntax and semantics". On a more applied plane, Yang and Roeper (in press: 2–3), emphasize the continuity that exists between the Principles and Parameters approach and the Minimalist Project with an eye to uncovering ways in which Minimalist innovations help provide new tools for the study of language acquisition; for example, unique combinations in early language (such as Adam's "no play toy") can be captured directly by assymetric Merge and can therefore be conceived of as grammatical expressions rather than as reduced or truncated utterances. At the same time, the authors argue, the call to discard parameters is misconstrued. Not only do these provide a terminological and taxonomical framework which

allows for the formulation of precise and testable research questions but, as of yet, "Minimalism has not supplemented the basic architecture of P and P for the task of language acquisition (and the use of parameters therefore) remains the best, and only, game in town" (in press: 3).

It is in this spirit that this study's primary objective is to test the CPH and FDH by examining evidence for parameter setting in five cases involving the *late* acquisition of a *first* language, the central question being: do the data reveal a pattern of "fundamental difference" in the ultimate proficiency attained by subjects who underwent "earlier late L1 acquisition" (i.e., late acquisition with pre-puberty onset) compared to subjects who underwent "later late L1 acquisition" (i.e., late acquisition with post-puberty onset) with respect to the parameters under investigation. A secondary objective is to examine the early phrasal development of a subset of the five subjects in terms of the asymmetric Merge operation, also for the purpose of comparing "earlier" and "later" late L1 acquisition. Finally, the results also need to be considered in light of relevant findings from the L2 literature on UG access and age effects.

As Schwartz has long argued (e.g. Schwartz 1992; Song and Schwartz 2009), a productive way to test the FDH is to compare the L2 developmental sequences of children and adults while keeping the L1 constant, to mitigate transfer effects; similar sequences would run counter to expectations based on the FDH, while dissimilar patterns would be consistent with it. Unsworth and Blom (2010) offer the same "controlling transfer effects" rationale in their exhaustive review of the conceptual and methodological factors that have to be taken into account when comparing L1 children and L2 children and adults. This study proposes that another productive way to test the FDH, in theory at least, is to compare developmental sequences resulting from the late L1 acquisition of children, adolescents, and adults to each other, but also to those uncovered in typical L1 and L2 acquisition. The key advantage of these comparisons is that the possibility of transfer effects is simply nonexistent; thus the results should speak directly to the FDH and "extent of access to UG" issues without the need to disentangle them from the transfer factor. In practice, of course, as one reviewer of this paper put it, the available data are "severely limited (one is tempted to say, fortunately)". Nevertheless, the findings can usefully supplement results derived from the type of L2 acquisition research discussed above, and contribute to the critical period/fundamental difference debate and its attendant questions concerning access to UG.

Method

Selection of the data

The data for this study are drawn from three well-known cases of extreme linguistic isolation during childhood followed by a late process of clinically-assisted L1 acquisition starting at ages 6, 13, and 31 years, and two recent cases from the neurological literature involving left hemispherectomy at ages 5 and 9 years. The language of both patients prior to surgery was described as severely limited, and thus both can also be considered to have undergone a process of late L1 acquisition subsequent to surgery. The cases were chosen because a sufficient number of sample utterances have been published in the literature to make it possible to investigate the previously mentioned variables. Background information for each case is supplied below:

1. BL (age at L1 onset: 5.5): As reported in Vanlancker-Sidtis (2004), BL presented with cyanosis (poor blood oxygenation) following birth, suffered from hemiparesis at 5 months, and began experiencing right-sided seizures at age 3 years. Pre-operative speech was severely dysarthric "indicating a significant role of the left hemisphere in speech in early development" (2004: 207). BL underwent left hemispherectomy at age 5.5 years, and within four months his speech was reported to have improved to normal. At the time of the Vanlancker-Sidtis study, BL was almost 50 years old. He had attended regular elementary and secondary school, had obtained a college degree and had worked as an accountant. At the time of testing, BL's spontaneous speech included sentences such as "I don't even remember my seizures, to tell you the truth" and "And, ah, you're not going to photograph me as I walk down here, are you?"
2. Isabelle (age at L1 onset: 6.5): As reported in Mason (1942), Isabelle had been locked in a room with her mute mother until the age of six and a half. The mother had been diagnosed with a lesion in Broca's area (but subsequently turned out to be deaf, with no lesion) and could not talk, read, or write; she communicated with the rest of the family by means "of crude gestures of her own origination" (1942: 295). She eventually escaped from her imprisonment with Isabelle who was then admitted to Children's Hospital in Columbus, Ohio, on November 16, 1938. At the time of her discovery, Isabelle was unable to speak, although her hearing appeared intact. Her first vocalization ("buh" for "ball") occurred nine days after her admittance to the hospital; ten days later, she was saying words such as "mama, fat, pretty, hot, bye"; two months later she was uttering sentences such as "That's my baby"; "Open your

eyes"; "Want some soup"; another month brought "I don't want you to go home" and a further seven weeks yielded "Where's my book?" By June 1940, her output included sentences such as "Why does the paste come out if one upsets the jar?" and "What did Miss Mason say when you told her I cleaned my classroom?"

3. Alex (age at L1 onset: 9.0): as reported in Vargha-Khadem et al. (1997), Alex failed to develop speech during early boyhood due to Sturge-Weber Syndrome affecting his left hemisphere, although he developed comprehension of single words and simple commands; after left hemidecortication at 8½ years of age and withdrawal of anticonvulsants at nine, he began to acquire spoken language, progressing within a few months from articulating consonants, to single words, and to full sentences. From age 9:4 to age 10:11 the mean length of his utterances increased from 0 to 11.6 words. At 10:11, he was uttering sentences such as "They found some seeds but a dog came and do you know what she did?" and "When they came back they found two little pigs eating the apples". A comparison to nine other left-hemispherectomized patients with early onset of disease and similar IQs who had, however, developed speech prior to the surgery, suggested that Alex had not appreciably suffered from his early mutism and severely limited comprehension.
4. Genie (age at L1 onset: 13.7): this is by far the best documented of the cases. Indeed, in her doctoral thesis, Curtiss (1976: 336) refers to 2500 two-word or longer utterances having been recorded. The data analyzed here are drawn from that thesis as well as from three journal reports (Curtiss et al. 1974 and 1975; Curtiss 1979) on the overall linguistic development of Genie over the five years following her discovery on November 4, 1970 at age 13 years 7 months. She had been locked up by her father since the age of 20 months, and punished for making any sounds. She was then admitted into the Children's Hospital of Los Angeles. She did not speak and showed little evidence of having developed any language comprehension beyond apparent understanding of a few individual words. She rapidly embarked upon a process of cognitive and emotional development, and immediately showed physical signs of sexual maturation. In July 1971, Genie left the hospital for placement in a foster family. Genie's further progress was closely monitored and documented until 1975 when the study ended and she was returned, first to her mother, and then to a series of foster homes and clinical facilities. The following milestones provide a brief overview of her language acquisition trajectory: 4 months after entering Children's Hospital, Genie began using a few words spontaneously; at 7 months, a two-word grammar emerged (e.g. "yellow balloon"; "Marilyn bike"); at 12 months, sentences expanded to 3–4 words (e.g. "want more soup"; "small two cup"); at 15 months, negation appeared (e.g. "no more take

wax"); at two years, complex sentences appeared (e.g. "Want go walk Ralph"; "Granpa give me cookie chew"; "Genie have momma have baby grow up"). There is little apparent progress beyond this stage over the following years of the study.

5. Chelsea (age at late L1: 32 years): as reported in Curtiss (1988, 1989), Dronkers et al. (1998), and Grinstead et al. (1998), Chelsea was born severely to profoundly deaf in a remote rural community, but misdiagnosed as mentally retarded during her childhood. She was raised at home with six siblings in a "normal" environment (excepting the linguistic aspect), but denied admission to local schools and even to a school for the deaf. She acquired no language and received no formal education until 1980 when, at the age of 32, a social worker referred her to a neurologist and audiologist and her deafness was finally recognized. With aids, her hearing was restored to within normal range and an intensive oral and sign language instruction program was begun. As of the late 1990s, she was living at home with her parents and was employed part-time as an assistant in a veterinarian's office. Initially, her language therapists attempted to foster natural language development, but when it became clear after several years that she was unable to develop even the bare "rudiments of natural language grammar" (Grinstead et al. 1998: 305), the focus turned to teaching her "word chunks, almost as if they were single words, to help her navigate her world" (Curtiss, personal communication). Hence, her spontaneous utterances consist of sentences such as "They are is car in the Tim" or "Peter sandwich bread turkey", even though she is capable of sounding much more grammatical when she employs the aforementioned chunks (e.g. "I go bathroom"; "Go work 8:30?").

The published speech corpora of BL, Isabelle, Alex, and Chelsea are of modest proportion (ranging from 208 to 362 words each), and are considered in their entirety. The data on Genie, as mentioned, are copious; therefore, only a representative selection of utterances that appear to bear directly on the variables under consideration is examined.

Procedure for analyzing the data regarding parameter setting

The sample utterances are analyzed for evidence regarding the status of the Head Position, Null Subject, and Wh parameters. Following Radford (2009), correct setting of parameters is held to have been demonstrated as follows:

1. The Head Position Parameter is considered to have been set when the subject correctly positions heads before their complements (e.g. "read books"; "in

libraries"), unless the complement is a Wh-expression and has been moved to sentence-initial position to satisfy the requirements of the Wh-Parameter (see below).

2. The Wh-Parameter is considered acquired when Wh-expressions are systematically placed in sentence initial position (e.g. "Where is the book?").
3. The Null Subject Parameter is considered acquired when null pro subjects are systematically avoided with finite clauses (e.g. "Am reading a book" is not produced in place of "I am reading a book"), although imperative null subjects (e.g. "Put down the book!"), truncated null subjects (e.g. "Enjoying that book?"), and null PRO subjects of non-finite verbs are of course permitted (e.g. "I want _ to read that book").

In the findings section below, the following conventions are followed:

- HP = Head Parameter
- WH = Wh-Parameter
- NS = Null Subject Parameter
- + = parameter appears to have been set
- – = parameter doesn't appear to have been set
- ? = it is unclear whether or not the parameter has been set
- na = the utterance is not applicable to the parameter in question

Findings

(a) BL's language samples (sentences 1–4, from Vanlancker-Sidtis 2004) as well as Isabelle's (sentences 5–8, from Mason 1942) suggest that both subjects underwent a highly effective process of ("earlier") late acquisition and there are no indications that any of the three parameters have been improperly set:

1.	That's an awful picture of you, by the way	HP+ NS+ WH na
2.	I was trying to see if it was a boy	HP+ NS+ WH na
3.	I am not sure. Don't have any idea about this one either	HP+ NS+ (truncated) WH na
4.	And I don't remember what they were like	HP+ NS+ WH+
5.	I love my baby	HP+ NS+ WH na
6.	I don't want you to go home	HP+ NS+ WH na
7.	Close your eyes	HP+ NS+ (imperative) WH na
8.	Why does the hand move around the clock?	HP+ NS+ WH+

Sentences 1–8 all display correct word order; subjects are supplied to the finite verbs in 1, 2 (both clauses), 3 (first sentence), 4 (both clauses), 5, 6 (first clause, with PRO supplied in second clause), and 8. An appropriate truncated null subject is found in the second sentence of 3, as is an appropriate imperative null subject in 7. The Wh-expression is fronted in the embedded CP of sentence 4 and in sentence 8.

(b) Alex (language samples are from Vargha-Khadem et al. 1997) also seems to have set the three parameters, although other issues are apparent with respect to reciprocal anaphors (10), irregular morphology (11), and agreement (13):

9.	He fell into the water with a big splash	HP+ NS+ WH na
10.	He made funny faces at each other	HP+ NS+ WH na
11.	The policeman blewed his whistle so hard	HP+ NS+ WH na
12.	They found some seeds but a dog came and do you know what she did?	HP+ NS+ WH+
13.	One afternoon three boys was going for a walk…	HP+ NS+ WH na

(c) The language samples presented here are drawn from Curtiss (1976, 1988) and Curtiss et al. (1974). Overall, Genie's L1 acquisition process appears to largely follow a normal but incomplete trajectory. She seems to have basically set HP, despite sentences 14 and 15 which have been widely quoted. The utterance date for sentence 14 is unknown, but 15 occurred in April of 1972, which is approximately 17 months after L1 onset, and there are numerous published counter-examples, including sentences 16–24 below (uttered at 26 to 55 months after L1 onset).

She also seems to have gone some way towards setting NS although her performance is inconsistent. Overt subjects have been appropriately supplied for the finite verbs in sentences 14 and 16–19. The null subject in 20 is justified since it is an imperative. Based on the gloss, sentence 15 may be an imperative too. Sentences 21 and 22 are more difficult to categorize; they might be truncated, thus justifying the null subjects, or the subjects may be omitted in error. Sentences 23 and 24 clearly omit the subject where it is required.

14.	Man motorcycle have (gloss: "The man has a motorcycle")	HP– NS+ WH na
15.	Applesauce buy store (gloss: "Buy applesauce at the store")	HP– NS+ WH na
16.	Mama wash hair in sink	HP+ NS+ WH na
17.	I do not have a red pail	HP+ NS+ WH na
18.	Dorothy say not lift my leg in the dentist chair	HP+ NS? (non-finite null?) WH na

19.	Mary have a office	HP+ NS+ WH na
20.	Shut the door	HP+ NS+ (imperative) WH na
21.	Thinking about toaster at old school	HP+ NS? (truncated?) WH na
22.	Feel better (response to "How's the neck?")	HP+ NS? (truncated?) WH na
23.	At school scratch face (G had a tantrum and scratched her face)	HP+ NS– WH na
24.	Tomorrow going school	HP+ NS– WH na

Sentences 25–27 are difficult to evaluate with respect to NS because Genie was trained to use several stock expressions including "I want X" (Curtiss 1976: 377) and therefore the overt first person singular subject may reflect rote learning rather than parameter setting, especially given that sentences that omit overt subjects such as 27 were produced within the same time frame . Still, sentences 25, 26 and 27 are intriguing as concerns their second clauses and do suggest that Genie has achieved some success with respect to setting NS, as sentence 25 correctly supplies an apparent null PRO controlled by its antecedent "I," while 26 and 27 supply appropriate overt subjects.

25.	I want live back M house	HP+ NS?/+ WH na
26.	I want you open my mouth (talking about her dentist)	HP+ NS?/+ WH na
27.	Want Curtiss play piano	HP+ NS–/+ WH na

No spontaneously produced WH-sentences have been reported, and those that resulted from active attempts to teach her question-formation are bizarrely formed. Genie did demonstrate good comprehension of Wh-questions (as early as 13 months), as shown in the exchanges below:

What kind of soup?	Green soup.
Where were you today?	Big gym.
Who gave those to you?	Judy.
Which dog is Andy's?	Fido.
When can you have the Hershey bar?	After dinner.

These examples are taken from Curtiss (1976: 322–324), who also pointed out that despite her comprehension, "Genie's attempts to formulate questions not only resulted in ill-formed utterances, but indicated that she was very confused as to what was expected of her" (1976: 383). After a year, attempts to coax Genie into producing Wh-questions ceased and, as mentioned, Genie made no attempts at producing any on her own. There is therefore no evidence that Genie has even

begun to set WH at the productive level. Sentences 28 and 29 illustrate the type of "ill-formed utterances" that Genie produced when she was encouraged to imitate questions.

28. I where is graham cracker on top shelf?
29. Where is may I have ten penny?

(d) Chelsea's performance appears random on both HP and NS, and several of her utterances are essentially unanalyzable. There are no reported Wh-utterances whatsoever. Language samples 36 and 38 are from Grinstead et al. (1998); all others are from Curtiss (1988):

30. You got big picture (gloss: "You have big photos hanging in the hallway") HP+ NS+ WH na

Word order is correct and an overt subject is supplied for the finite verb.

31. Hold the ball girl (gloss: "The girl is holding the ball") HP– NS+ WH na

The overt subject is supplied, but word order is incorrect.

32. Teeth brush (gloss: "She is brushing her teeth") HP– NS– WH na

The overt subject is not supplied, and word order is incorrect.

33. Orange Tim car in HP– NS na WH na

The head *in* is preceded by its presumed complement *car* (*orange car*?); there is no verb.

34. The boat sits water on HP+/– NS+ WH na

HP is correct for DP and VP, but not for PP. Overt subject is supplied appropriately.

35. The small a the hat unanalyzable
36. Missy girl same both girl (comparing the gender of two animals) unanalyzable
37. The girl is cone the ice cream shopping buying the man unanalyzable

Sentences 29–37 are examples of Chelsea's spontaneously generated speech. As mentioned earlier, Chelsea was also trained by her language therapists to use rote phrases, resulting in conversational interactions such as 38 below:

38. [Regarding the need to buy a new battery for her hearing aid]
C (Chelsea): Change. Throw away. Battery no good. Pay less.
S: How much do they cost?
C: Three dollar. Pay less. Fifty cent. (She only paid $2.50.)

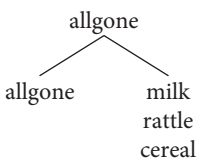
While Chelsea's utterances in 38 appear more grammatical than the preceding samples (possibly deserving an HP+ rating), as Curtiss explains, "the bits about changing the batteries on her hearing aids… are indeed rote phrases that she's memorized, although her ability to know whether the batteries are on sale and how much she has saved may well not be" (personal communication).

Chelsea's performance, then, could be taken to suggest that, with respect to the syntactic aspects under present consideration, she is indeed undergoing a fundamentally different process of L1 acquisition, one where she is unable to set parameters in the same way as the other subjects but has to rely on alternate cognitive and learning mechanisms.

Asymmetric Merge and the early word combinations of Isabelle and Genie

As discussed earlier in this paper, Minimalist concepts have provided new tools for the study of language acquisition. The operation Merge (strictly speaking, Merge + Label) is of particular practical relevance to the present study, given the available evidence, as it has been convincingly argued this operation provides a productive framework for the analysis of early word combinations at the phrasal level. Powers (2001, 2002), for instance, referring back to the classic "pivot grammar" proposal by Braine (1963), argues that the pivots in question are in fact heads of structures formed by Merge. The pivot words head the projection thus providing a frame for items from the second category of words, open class words, as illustrated below:

39.



Similarly, Roeper (2009: 33) argues that early two-word productions already exhibit the property of asymmetric Merge where one item is projected to dominate the other, listing a series of examples of typical early child two-word utterances such as:

40. baby eat (agent-action)
    baby highchair (agent-location)
    throw daddy (verb-goal)
    pick glove (verb-object)
    mommy sock (possessive-object)

On the other hand, Roeper notes, conjoined elements (where neither element dominates the other), such as "Mommy Daddy" or "knife fork" are generally not found in early child production.

Later three or four word combinations are also nicely captured through asymmetric Merge. At this point, the operation is simply applied and reapplied, as illustrated by the derivational steps involved in constructing the expression "mommy see duck":

41. see + duck → {see, {see, duck}}
    {see, {see, duck}} + mommy → {see, {mommy, {see, {see, duck}}}}
    "mommy see duck"

Thus, Merge can be seen as a fundamental mechanism that underlies normal L1 acquisition. It is worth noting that Merge, and similar operations, have been argued to remain available to the adult L2 learner at all stages of development (Tsimpli and Dimitrakopoulou 2007). The question here is whether the evidence from the five cases discussed in this paper is amenable to a Merge analysis. Strictly speaking, only Genie's corpus provides sufficient examples for a thorough examination of how she assembled words during her initial linguistic development. Isabelle's corpus does supply a dozen or so early 3–4 word utterances from the first four months of her development, offering some tantalizing clues. The data from BL are all from his endpoint stage, as they are for Alex (with the exception of a list of 54 individual words that had been acquired in the first three months following onset of speech); all of the sample utterances are well past the multiword stages discussed above and thus of no use for our purpose. With regard to Chelsea, no specific dates for the production of utterances are supplied. However several 2–4 word samples are recorded, and given the complete lack of linguistic development over time in her case, the notion of early versus late production loses a great deal of relevance; these data arguably provide useful material to contrast with the samples from Genie and Isabelle.

What becomes readily apparent when examining Genie's early word combinations is how "normal" the vast majority of them appear. As reported in Curtiss (1976), Genie's early two word grammar includes utterances that clearly parallel those reported in list 40 above:

42. Mike paint (agent-action)
    cereal kitchen (agent-location)
    take home (verb-goal)
    shave beard (verb-object)
    Dorothy bike (possessive-object)

Furthermore, her multiword productions can readily be characterized as resulting from successive applications of Merge, as shown by the following four examples (Curtiss et al. 1974):

43. Mark + paint → {paint, {Mark, paint}}
    "Mark paint"
44. love + Curtiss → {love, {love, Curtiss}}
    {love, {love, Curtiss}} + Genie → {love, {Genie, {love, {love, Curtiss}}}}
    "Genie love Curtiss"
45. more + soup → {more, {more, soup}}
    {more, {more, soup}} + want → {want, {want, {more, {more, soup}}
    "want more soup"
46. Mark + mouth → {Mark, {Mark, mouth}}
    {Mark, {Mark, mouth}} + hurt → {hurt, {{Mark, {Mark, mouth}}, {hurt}}}
    "Mark mouth hurt"

The handful of early multiword utterances by Isabelle include the following (Mason 1942):

47. Say please
    Come again
    Want some soup
    I love my baby
    Give me a penny

These are strikingly similar in their nature to the expressions listed above for Genie, and their structures can just as readily be characterized by a Merge account; they also stand in stark contrast, along with Genie's utterances, to Chelsea's constructions as reported in Curtiss (1988), which do not appear to exhibit any properties of the Merge mechanism discussed above:

48. The they
    Banana the eat
    Orange Tim car in

Thus, both Isabelle, whose delayed L1 onset occurs well within the critical period, and Genie, whose L1 onset starts right up against the critical period's boundary, undergo what appears to be unexceptional early multiword development, even though the former eventually reaches apparent full L1 proficiency, while the latter eventually stalls out in her linguistic development. Meanwhile Chelsea's 2–4 word combinations appear to consist of randomly conjoined lexical items: not only does she come nowhere near to developing any real language proficiency in the long run, but there is no evidence (as there is in Genie's case) that normal language acquisition processes such as those investigated here are involved at any stage.

Conclusion

Newport (2002: 737) offers a succinct overview of the notion of a critical period, which she defines as:

> a maturational time period during which some crucial experience will have its peak effect on development or learning… if the organism is not exposed to this experience until after this time period, the same experience will have only a reduced effect, or in extreme cases it may have no effect at all… (R)ecent research has shown that most critical periods show more gradual offsets and more complex interactions between maturational and experiential factors than the original concept of a critical period had anticipated.

According to Lenneberg, Newport further explains, language acquisition after the critical period can only proceed with difficulty or by means of different learning mechanisms. As discussed earlier, in his original proposal, Bley-Vroman (1989: 62) suggests that:

> If adults do not have direct access to UG, then in principle, interlanguages need not be "natural languages." This is not to say that an interlanguage can be just anything. After all, the learner does have data about the foreign language and at least an imperfect surrogate UG based on already known languages.

In the recently revised FDH proposal Bley-Vroman (2009) maintains the original explanandum: the logical problem is that foreign language learning has characteristics (namely "unreliability" and "non-convergence") that differ crucially from those of (normal, first) language development. The explanans, on the other hand, undergoes modification. The central idea remains that "elements of the language faculty itself provide the seeds of nonconvergence and unreliability" (2009: 187), even though foreign language learning is now thought to make use of processes which are in fact also used in first language development, but not in the same

way or to the same extent. The fundamental difference between foreign language learning and native language development thus remains, albeit in slightly less radical form.

As mentioned in the introduction, Lenneberg's formulation essentially applied only to first language acquisition, and the human ability to learn foreign languages at any age only confused the picture (but without troubling the basic hypothesis because L1 provided a matrix for acquiring L2). Obviously, the subjects considered here were not learning a foreign language in the context of a matrix provided by an already acquired first language; hence, as previously argued, the picture is not confused by extraneous factors, and Lenneberg's basic hypothesis can be put to a more direct test than might be available in an L2 context, as can a modified version of Bley-Vroman's hypothesis, one that is stated strictly in terms of first language development, perhaps formulated as follows:

a. Does "later late L1 acquisition", specifically L1 with post-puberty onset, possess characteristics akin to "unreliability" and "non-convergence"; in other words, will such acquisition result in imperfect grammars, or even no grammars at all?
b. Is there evidence pointing to significant differences in the nature or mix of the learning mechanisms that underlie "later late L1 acquisition"?

A third question, one that returns to a consideration of L2 issues, can also be posed:

c. Is there evidence pointing to differences between "earlier and later late L1 acquisition" and typical early (child) and late (post-puberty) L2 acquisition?

Bearing in mind the inevitably uncertain nature of any data obtained from limited reports (except for Genie's) concerning isolated children and young left-hemidecorticates, with ever-present attendant issues of physical and cognitive status, it would nevertheless seem reasonable to conclude that the findings presented here have indeed uncovered a pattern in the delayed first language acquisition of these five subjects that would be expected in the context of the critical period and fundamental difference hypotheses.

The two youngest subjects, BL and Isabelle, appear to have fully set the three parameters under study, and their published corpora give no hints of any abnormalities in other aspects of syntax or in morphology. In addition, Isabelle's early phrasal development exhibits the same properties of asymmetric Merge that have been demonstrated in normal child language development. The next youngest subject, Alex, also appears to have set all three parameters, but some of his sample utterances indicate that other aspects of syntax and morphology may have fallen

short of full proficiency. The next subject, Genie, was just undergoing puberty at the time she began her language acquisition; like Isabelle, her early phrasal development seems quite normal but later her linguistic progress appears to stall out. That is, she appears to have set the Head Parameter and to have partially set the Null Subject Parameter. However, in terms of productive capacity, Genie shows no sign of progress with setting the Wh-Parameter. These mixed results might well be expected in a case involving an onset of acquisition right at the tail-end of the critical period. Finally, Chelsea whose language acquisition began at age 32 demonstrates no sense of syntactic or morphological capacity with her most "grammatical" (in appearance) utterances being reported to have resulted from general rote-learning mechanisms. If anything, her interlanguage comes closest to "being just about anything" to paraphrase Bley-Vroman.

The age differences discussed above are in accord with the bulk of L2 acquisition studies carried out over the last several decades that have focused on the ultimate proficiency of learners who undergo prolonged naturalistic exposure. For a range of reviews of such research, see Long (1990), Hyltenstam and Abrahamsson (2000), Birdsong (2006), and Muñoz and Singleton (2011). While these reviewers include both advocates and skeptics of the CPH, all recognize that age correlates negatively with end state L2 proficiency. As such, this study's results merely conform to a well-established finding. However, the study also provides some tantalizing suggestions regarding the UG access issue. On their own, the findings concerning parameter setting would seem to be consistent with versions of the "partial access" position. However, the findings concerning the apparent lack of Merge in Chelsea's language add a wrinkle. As previously mentioned, Tsimpli and Dimitrakopoulou (2007) claim that adult L2 learners maintain access to this operation throughout the acquisition process, by way of UG. That no evidence can be found for Merge in Chelsea's language, nor for the notion that any of the parameters under consideration have been set, would clearly seem more consonant with a "no access" than a "partial access" position. The access to operations such as Merge that adult L2 learners retain, the Chelsea results suggest, could be inferred to occur only by way of the L1 "matrix" (to return to Lenneberg's terminology). By extension, Genie's failure to set the Wh-Parameter could now more plausibly be argued to result from a post-critical-period complete loss of access to UG, rather than from "no parameter resetting" or FFFH issues. In effect, the results are suggestive of a "full transfer-no access" model for all adult language acquisition.

The shape of this investigation was dictated by the nature of the available data and, clearly, the results can only be taken as limited and highly tentative. Nor can any easy suggestions be offered for further research along similar lines, given the extreme nature of these cases. However, a great deal of convergent evidence

concerning the CPH, the FDH, and the UG access issue, is available from sign language studies, particularly those that have compared the roles of deaf children and adults in the transformation in recent decades of Nicaraguan signing from a mere gestural system to a full-fledged linguistic one. Two brief examples, Senghas and Coppola (2001) and Senghas et al. (2004), can serve as illustrations. The first study examined sequential cohorts of Nicaraguan signers and found that the grammatical systematicity that was being added to Nicaraguan sign language originated solely in children aged 10 and younger. The second study revealed that two learning mechanisms which influence language development (segmenting previously unanalyzed wholes, and favoring sequential combinations) are available only to children but not to adolescents or adults. Thus, "children naturally possess learning abilities capable of giving language its fundamental structure" (1179) but this capacity is no longer available from adolescence onwards.

To return to the cases under consideration: Bley-Vroman (2009: 180) provides a quotation from Chomsky that "there comes a time when the (language acquisition) system just isn't working anymore". It seems that time had come for Chelsea, and was on its way for Genie; on the other hand, for BL, Alex, and Isabelle that time was still well off on the horizon.

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