

Patterns in the mind
Language and human nature

For Amy and Beth

RAY JACKENDOFF

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9 Language acquisition in unusual circumstances I

difficulties fall under the special-purpose part of the language faculty. As a result, we can show more vividly that general-purpose intelligence is not enough to accomplish the acquisition of mental grammar.

A genetic impairment of language acquisition

Some children who appear to be normal in every other respect are late in developing language. These children, when they do begin to speak, don't follow the normal course of acquisition we discussed in the last chapter. Such children are said to be "specific language impaired" (SLI) or "developmentally dysphasic." This diagnosis undoubtedly masks a wide range of disorders that could be distinguished with more sensitive techniques of testing; it is to be hoped that advances in linguistic theory can be used to help develop more detailed diagnostic and remedial tools for speech and language therapy.

A particular set of cases of specific language impairment has been examined in depth by the linguist Myrna Gopnik and her associates. This is a family of 30 members, extending over three generations, of whom 16 have been diagnosed as dysphasic. It is worth reproducing the genealogy of the family for what it shows about the distribution of the impairment. Figure 9.1 shows the impaired family members in bold face, and ages in 1992 in parentheses.



Figure 9.1

Introduction

Chapter 3 developed the Genetic Hypothesis, the idea that some aspects of language are built into brain structure and transmitted genetically. This knowledge gives children a head start on constructing a mental grammar for the language(s) they hear in their environment. Now, some people (my imaginary critic among them) are skeptical about the idea of innate knowledge that is devoted specifically to learning language—but they don't mind positing innate knowledge as long as it is basically general-purpose. Back in Chapter 3, my main reply was the Paradox of Language Acquisition: adults are better than children at solving problems in general, but they can't figure out the principles of mental grammar consciously anywhere near as well as children do unconsciously. This seems to point to some specialization for language learning that falls outside of our abilities at solving general problems.

I think it's misguided to get into an argument about whether the innate knowledge that makes language acquisition possible is *all* specialized for language or *all* general-purpose. Rather, the issue ought to be how the two factors balance each other, as summarized in the equation I gave in chapter 3:

$$\begin{aligned} \text{Innate part of language} &= \\ \text{Part due to special-purpose endowment for language} &+ \\ \text{Part due to general properties of the mind} & \end{aligned}$$

The all-or-nothing cases are when one part or the other is zero. But there are many possibilities in between.

Having looked at how normal language acquisition takes place, we are in a position to look further into the balance between special-purpose and general-purpose factors. Our evidence will be drawn from a variety of cases in which language acquisition does not proceed in normal fashion. In each case, we'll be able to see that the

This is a classic instance of the inheritance of a dominant gene: those who have the gene are language impaired and have a 50 percent chance of passing it on to their descendants. The grandmother has passed it on to 4 of her 5 children. The one child who is not impaired has no impaired children. The 4 impaired children have passed it on to 11 of the 24 grandchildren, 5 of whom are male and 6 of whom are female.

Suppose instead we tried to explain this pattern on the basis of the environment in which the children grew up. "The grandmother talked strangely, so some of her children, imitating her, spoke strangely too; and some of their children, imitating them, did likewise." But consider: why did some of the children pay attention to the strange way one of their parents talked, and others didn't? In particular, the eight-year-old grandchildren in the lower right corner of Figure 9.1 are fraternal twins, exposed to the very same environmental inputs. Why did one come out language-impaired and the other not?

Remember also that children growing up in bilingual environments typically learn *both* languages they are exposed to. If the impairment were just a result of imitating an impaired parent, we might therefore guess that children in these families actually would be able to talk like *either* parent—that is, either normally or strangely. That isn't how it works at all. In short, a strictly environmental explanation seems impossible.

Although the degree of language impairment varied from one individual in the family to the next, the overall pattern of impairment was remarkably uniform. All of the impaired individuals had a noticeably slow rate of speech, and they stopped to correct themselves much more often than normal speakers (in 5 percent of their utterances, as compared to 1 percent for normal speakers). More remarkably, about half of their "corrections" actually made the sentence *less* rather than more grammatical!

To get a more precise understanding of what was going on, Gopnik ran a number of tests on the language-impaired individuals. There were some where everyone did all right:

1. When asked whether a certain string of sounds was a word of English ("wolf": yes; "barsen": no), everyone did satisfactorily.
2. When asked whether a verb was used with the right collection of direct and/or indirect objects ("The girl eats a cookie," "The nice girl gives a cookie to the boy": yes; "The girl eats a cookie to the boy," "The nice girl gives": no), everyone did satisfactorily.

So some basic aspects of language were not affected by the impairment. The main area where Gopnik found difficulty was in the use of inflections such as plural and tense.

3. The following sentences are missing inflections:

The boy eat three cookie.

Yesterday the girl pet a dog.

Asked whether these sentences are acceptable English, normal speakers (including those in the family) have no trouble detecting the problem. But the language-impaired members missed many of these, and even "corrected" acceptable sentences:

Example: Roses grow in the garden.

Response: "Wrong: The roses grow in the garden."

And even when their responses were correct, they often acted unsure of themselves, in a way that a normal speaker never would.

4. Recall the "wug" test in Chapter 8, in which children were asked to supply the plural for a nonsense word. Children perform essentially like adults by age eight or so. But the language-impaired family members, even the adults, had trouble with this test. For example, one adult subject pluralized "wug" as "wugs," pronouncing the ending as *s* instead of the correct *z*. She pluralized "sass" as "sasss," simply prolonging the final *s*. Another adult pluralized "wug" as "wugness," "zat" as "zackle," "zoop" as "zoopees," "tob" as "tobyees," and "zash" as "zatches." (Incidentally, this was not a problem of hearing, for which they all tested normal.)

5. The language-impaired members often used an untensed form of a verb where a past tense was called for.

Example: Every day he walks 8 miles. Yesterday he . . .

Response: "Walk."

Tense was frequently absent in their spontaneous narratives as well—more frequently with regular verbs like "walk-walked" than with irregulars like "hold-held." By contrast, normal children, once they have learned the rule for past tense (see Chapter 8), *never* omit the past tense on regular verbs.

Obviously something strange is going on here. The language-impaired individuals persist in such errors and omissions, despite the fact that (with the exception of the grandmother) they have all undergone intensive language therapy in school, with constant correction of these very problems.

Gopnik's analysis of the situation is that *the language-impaired individuals basically have not caught onto the idea that there are rules of inflection*—they do not see that there is a standard way to alter a noun when it refers to a multiplicity and a standard way to alter a verb when it refers to past time. Rather, they are much like children in Stage 1 of learning the past tense (see Chapter 8). Either they treat the plural and past tense suffixes as uninterpreted noise, or else they treat the plural noun and past tense verb as entirely different words from the singular noun and present tense verb respectively.

This may or may not be precisely the right way to characterize the impairment: Gopnik's analysis is controversial, and at the time of this writing she has not yet systematically tested the individuals' abilities in dealing with larger syntactic constructions. But the fact remains that (1) the pattern of impairment is uniform across affected family members, (2) it is randomly distributed among children of affected family members, (3) it results in striking problems in the inflectional system, (4) it is impervious to teaching and correction, and (5) it persists through life. These results strongly suggest that the impairment is genetic, and that it specifically affects the ability to construct a mental grammar, leaving other cognitive abilities intact. In order for this to be possible, there must be at least one gene that is responsible for a special-purpose mental endowment for language acquisition. The part of Universal Grammar having to do with acquiring inflectional endings must not be a general-purpose learning strategy.

It is interesting to contrast these cases to others with opposite symptoms—where there is mental retardation but language ability is intact. One of these is *Turner's Syndrome*, in which one X chromosome of a female is damaged or absent. Turner's Syndrome individuals display distinctive physical characteristics such as short stature, infantile sexual development, heart defects, and drooping eyelids. Their cognitive development is often characterized as “uneven,” usually involving impaired visuo-spatial abilities such as visual memory and drawing, but also sometimes including difficulty with number concepts and auditory memory. However, typically their language development appears normal for their age.

A similar situation appears in individuals with *Williams Syndrome*, who have a distinctive “elf-like” facial appearance, a particular heart defect, and, commonly, abnormalities of many other organ systems. Williams Syndrome individuals almost invariably show mild to moderate mental retardation; they uniformly require

special educational placements as children, and for the most part acquire only rudimentary skills in reading, writing, and arithmetic. Particularly severe deficits show up in tests of spatial understanding such as copying patterns of blocks. Their language, though, is if anything more fluent and advanced than that of their age-mates; in fact, they tend to be so talkative and expressive that to the unwary observer they may not appear retarded at all (at least at first).

These syndromes give us further evidence for a difference between general intelligence and the ability to learn language. In Gopnik's cases of Specific Language Impairment, a genetic pattern produces deficits in language learning without affecting intelligence; while, by contrast, Turner's and Williams Syndromes produce the reverse. The combination of these two sorts of cases provides striking confirmation of the Genetic Hypothesis, the idea that part of our ability to learn and use language comes from specific genetic factors, not just from intelligence in general. That is, language is not a consequence merely of the size of our brains, but rather of the way particular parts of our brains work.

The critical period hypothesis

I've mentioned a number of times the fact that the children of immigrants usually manage to acquire the language of their new country faultlessly, even though the input from their parents is often far from perfect. Let's look at another aspect of this situation: the parents. Even if they are literate, well educated, attend language classes, and so forth, they still end up speaking with an accent and generally distorting the new language to some degree or another. Why do the children do better than the parents at learning the new language?

Looking at the situation more generally, we notice that the ability to learn a language the way a child does seems to tail off in the early teen years. The kind of conscious teaching that goes on in school French class is rarely effective—and (in the US at least) it comes too late in life for anyone to achieve genuine fluency. Many people undoubtedly learn to speak another language well enough to get by, and maybe even well enough to give lectures and write books, but it's rarely the same as their command of their first language. (One occasionally encounters people who go on being able to learn many languages fluently as an adult. I am not aware of any research on such prodigies, but my impression from the anecdotes is that they are

mostly people who grew up constantly using three or four languages in their day-to-day life.)

In the late 1960s, the neurologist Eric Lenneberg proposed that there is a *critical period* for language acquisition, a time of life when our brains are prepared to construct mental grammars. He proposed that this period extends from about two-years-old, the onset of the two-word stage, to about twelve, the point when people stop being able to learn languages without effort.

In addition to the sort of evidence we have just cited, Lenneberg drew on cases of language recovery after brain damage. Children may suffer damage to the language areas of the brain under a variety of circumstances, including injury, tumors, and removal of brain tissue to halt epileptic seizures. Under these conditions, the children become *aphasic*: there is loss of language function—often complete loss. However, Lenneberg observed that the younger a child is, the more likely it is that the child will recover full use of language. Very young children tend to recover almost completely, teenagers much less so. This parallels the received wisdom about the learning of foreign languages, suggesting that the unconscious ability to construct a mental grammar degrades severely after puberty.

The critical period hypothesis is often taken to mean that language learning ability is switched on before age twelve and then switches off. What Lenneberg actually proposed—and what subsequent evidence also suggests—is that there is a steady decline in language learning ability, starting very early in life, so that by the teenage years it has become comparatively feeble (and subject to much more variation among individuals).

Why should there be a critical period? We don't know. But if there is one, it provides strong support for a specialized capacity for learning language, separate from the general-purpose learning capabilities that remain active throughout the lifespan. Consequently, the critical period hypothesis has become a focus for arguments about the special-purpose nature of the language capacity.

Still, the idea of a mental capacity gradually shutting down over the course of one's childhood seems rather outrageous. How could it possibly be true? Fortunately, nature has come to the rescue here, providing us with numerous cases of animal learning that behave like this. So the existence of a critical period for language turns out to be completely plausible on biological grounds, bizarre though it may sound at first.

Let me briefly mention three of the best-known examples of critical periods in animals.

1. If one eye of a kitten is covered up until the age of three months, the kitten never learns to see properly with that eye, and comes to view the world monocularly. In this case the mechanism is known: the neurons of the visual system are growing their connections to each other and to the rest of the brain before this age, and stop growing afterward. Since visual input helps to guide the growth and organization of the connections, they do not get fully established in its absence. (It is worth mentioning that something similar happens to a human child's eye affected by strabismus or cross-eye: if it is not corrected early enough, the brain areas driven by the eye do not develop properly and vision cannot be restored, even if the eye itself is fine.)
2. One of the most famous experiments of the ethologist Konrad Lorenz was on the "imprinting" of goslings—their acquisition of the ability to follow their mother around. Lorenz discovered that, early in goslings' lives, anything that makes an approximately goose-like noise and moves in an approximately goose-like fashion is sufficient to imprint them. He showed this by making noises and waddling around himself, and he ended up with a troop of goslings following him all over the place. Imprinting seems to be tuned to occur only during a particular period shortly after hatching.
3. Bird species differ radically in how they learn their songs. In some species, such as the cuckoo, the song is entirely innate. (It had better be: cuckoos lay their eggs in other birds' nests, so baby cuckoos do not grow up hearing parental cuckoo songs.) In other species, such as the bullfinch, the song appears to be entirely learned: a young bullfinch raised in a cage with a canary will end up singing the canary's song.

More interesting are the species where there is an interplay of innate and learned characteristics. Chaffinches reared in isolation from birth sing only a rudimentary song. It is necessary for these birds to hear other chaffinches sing in order to acquire the full detail of the song. Acquisition goes on over a period of about ten months. If a chaffinch is isolated somewhere along the way until after it is ten months old, its song remains in its intermediate state, and no amount of exposure after the

age of ten months helps the bird learn more. So here we have a critical period quite analogous to that posited for language learning, with an interaction between nature and nurture.

The crucial test for the critical period hypothesis for language would be to treat a person the way the chaffinches were treated: raise them without language until the age of twelve. The critical period hypothesis suggests that they could not learn language. Of course, such experiments are unethical; but unfortunately society has performed the experiments for us.

Genie and others

The literature contains quite a few cases of "wild children," children discovered after apparently having been reared by wolves or bears. One of the most famous is Victor, the "Wild Boy of Aveyron," discovered in 1799 at an age estimated to be eleven or twelve. He was taken under the care of Jean-Marc-Gaspard Itard—who, incidentally, served as physician at the school for the deaf mentioned in Chapter 7, and who shared that institution's belief in the educability of the disadvantaged. Itard's intensive training did succeed in bringing out many cognitive and social skills. However, Victor never developed language beyond a few isolated words. This outcome is typical of these sorts of cases.

More promising have been the children raised by humans but subjected to a brutally deprived environment. One case in the 1940s was a girl, called "Isabelle" in the literature, who had been hidden away from early infancy, was given minimal attention, and in particular was never spoken to. Discovered at the age of six, she had no language, and her cognitive skills measured below those of a two-year-old. Within a year, though, she had learned to speak and was able to function as a normal child in school. In other words, she managed to learn her first language about as fast as an immigrant child of comparable age learns a second language.

Isabelle was discovered within her critical period. A better-known case is that of "Genie," who was discovered in 1970 at the age of thirteen—well toward the end of the critical period. Unlike previous reported cases of children raised in isolation, Genie's language development was intensively studied for ten years by linguists, primarily Susan Curtiss and Victoria Fromkin.

Genie had been isolated in a small curtained room since the age

of twenty months, tied into a potty chair by day and kept in a covered infant crib by night. She was minimally fed and never spoken to, and she was physically punished if she made any sounds. I'm not going to talk about the psychotic behavior of the family that led to such treatment; the curious reader is referred to more detailed sources. Here I will confine myself to the issues relevant to the critical period hypothesis.

At the time of her discovery, Genie was described as apathetic and socially unresponsive. Measures of cognitive development placed her at the fifteen-month level. Within a month, she had become alert, curious, and emotionally engaged, and she spoke a few words. Over the next year and a half, her cognitive abilities improved markedly, reaching a six- to eight-year-old level.

Genie's language ability initially went through analogues of the early stages of normal language acquisition. She spoke in one-word utterances almost immediately, and began producing two-word utterances within about seven months, with a vocabulary of about 200 words. In fact, her vocabulary was fairly sophisticated compared to her grammatical ability, including numbers, color terms, and questions with "how," "what," or "why"; these are all words that enter the normal child's vocabulary considerably later than the two-word stage. By a little more than a year after her discovery, Genie could produce larger sentences, including negation, some prepositions, and some plurals and possessives. So her "early" language development was quite rapid, and she did achieve the ability to produce an indefinite variety of new utterances by combining her vocabulary into patterns.

On the other hand, her progress more or less stopped there. For instance, she continued to form negative sentences by putting "no" at the beginning of the sentence, parallel to Stage 1 in the development of children's use of negation (Chapter 8). Her use of definite and indefinite articles remained minimal ("bathroom have big mirror"). Although she generally constructed sentences in the order subject-verb-object, her comprehension of the significance of this word order was erratic. In general, after many years of training, her language performance remained at about the level of a two-and-a-half-year old—despite general cognitive performance at a much higher level.

A number of questions remain in this case, having to do with Genie's severe social and sensory deprivation. In particular, it is certainly not true that Genie became cognitively and socially normal in all respects other than language. So although her linguistic achievements point to the effects of the critical period, there is still

some room to argue about more general-purpose cognitive impairments being partially responsible for her problems in language learning.

In the past decade a somewhat less equivocal (and much less publicized) case has emerged. A woman, called "Chelsea" in the literature, was born profoundly hearing-impaired to hearing parents. She was misdiagnosed as retarded, but was brought up in an otherwise normal family with normal social interaction; her hearing loss was finally diagnosed and she was fitted with hearing aids at the age of thirty-one. After nine years with hearing aids and training, she was reported to have a vocabulary of about 2000 words, could read at a grade 2 or 3 level, and could speak clearly enough to shop, order in restaurants, and hold a part-time job as a veterinarian's assistant. Yet after twelve years, her production of syntactic structure was still at roughly the two-and-a-half-year-old level: she tended to leave out subjects of sentences, saying things like "hit ball" and "cupboard put food." The function words and inflections were largely absent, and her word order was extremely variable. In short, she did not acquire English syntax after many years of exposure and intensive training.

Whatever questions may arise in this case or Genie's, the important thing to notice is the robust similarity of the results. Vocabulary was acquired, communication came to take place, but mental grammar, in particular the fine details of word order and inflection, did not develop. To my mind, the two cases together constitute substantial evidence for the critical period hypothesis.

Many more cases of late exposure to language

Once ASL came to be recognized as a language, it became possible to study its acquisition by children in just the same way as the acquisition of spoken language. It has been found that deaf children in families that speak ASL go through essentially the same stages of language learning as children acquiring spoken languages. In addition, hearing children of deaf parents are very much like immigrant children: they grow up bilingual, acquiring sign from their parents and spoken language from others in the environment.

However, as mentioned in Chapter 7, something like 90 percent of deaf children are born to hearing parents, into homes where sign language is not spoken. Increasingly, hearing parents of deaf children are encouraged to learn ASL and speak it with their children. But there is still an attitude in many quarters that deaf babies are "not

ready to learn to speak." In the majority of cases, a deaf child's first exposure to sign—and therefore to any language at all—is upon entering a residential school for the deaf, in many of which the language is spoken only surreptitiously. Many children are sent to these schools at the age of four to six, but many not until later.

These practices have provided us with valuable evidence regarding the critical period hypothesis, in that there are now large numbers of people who were deprived of language (but not of social interaction) until the point in their lives when they went to school. Elissa Newport and Ted Supalla investigated how the learning of ASL might be affected by the age at which deaf speakers began to learn it.

Newport and Supalla had the clever idea of testing adult speakers of ASL who had only limited skills in English—people who had been using ASL daily for thirty years or more, so they had had plenty of experience with it. These people differed in just one significant variable: the age at which they first came into contact with the language. Newport and Supalla classified them into three groups according to this variable. The "native" learners were children of deaf signing parents, so they were exposed to ASL from birth. The "early" learners were exposed to ASL first at ages four to six, upon arriving at a residential school. The "late" learners' first exposure was not until after age twelve, because they first attended strict oral schools before encountering ASL.

The subjects were tested for production and comprehension of a wide variety of grammatical constructions in ASL. These included basic and varied word order, as well as many forms of verbal inflection of the sort we discussed in Chapter 7—for instance, alteration of the motion of the verb to mark the spatial position of the subject and object, and alteration to mark repeated, drawn-out, incessant, or habitual motion.

Guess what happened. On tests of basic word order, everyone did well. But on tests of verbal inflection, the native speakers did somewhat better than the early learners, who in turn did considerably better than the late learners. In particular, late learners were inconsistent in their use of ASL inflections, sometimes using an inflection and sometimes not in contexts where it should always have appeared. Newport writes: "These results provide strong evidence for an effect of age of acquisition on control over a primary language: The later the language is learned, the less its use is native (with crisp and grammatically consistent forms) in character."

This pattern strongly resembles the patterns found with Genie and with the genetically impaired population. It shows that no matter

how much experience people have with a language, they can get only so far learning it if that experience doesn't begin early enough—and the earlier the better. Even the people who began at age four were at a disadvantage relative to those born into ASL-speaking homes.

As a further angle on these results, Newport, in collaboration with Jacqueline Johnson, went back to the initial insight that motivated the critical period hypothesis: the difficulty that adults have learning a *second* language. They looked at speakers of Korean and Chinese who had come to the United States and learned English. All the people they looked at had been in the USA for over ten years, immersed in an English-speaking world. Again, the crucial difference among the subjects was the age at which they had come to the USA.

Newport and Johnson tested these subjects on their judgments of grammaticality ("Is the following sentence acceptable English: The boy eat the hot dog"). The tests involved issues like verb tense, noun plurals, basic word order, use of the articles "a" and "the," and permutations of word order for wh-questions.

The results paralleled those for ASL speakers. Just about everyone got basic word order correct. But on tests that involved grammar any more complex than that, the people who arrived in the USA by the age of seven or so did uniformly better than everyone else. There was a steady decline over the ages of seven to fifteen, and the subjects who arrived after the age of seventeen were scattered randomly, well below the early learners. In addition, Newport and Johnson were able to show that these results could not be attributed to formal instruction in English, length of experience with English, motivation to learn English, or identification with American culture. The only significant variable was age of arrival in the USA.

Now it is true that people learning a second language late in life often get a lot better than Genie or Chelsea. It may well be that learning a first language early helps one to learn a second language later on, though not as much as starting the second language earlier. But qualitatively, the results have a strongly similar flavor. Basic word order and the acquisition of vocabulary seem to be largely independent of the critical period effect. But you have to be the right age to acquire complete command of finely tuned phonology (i.e. accent-free speech), the systems of inflection, and non-basic syntax such as negation and wh-questions.

Now I want to trace our argument backward, to remind you of why we're going through all this. We've established that there are critical period effects in the acquisition of the more complex aspects of mental grammar. These effects appear in a variety of circumstances

when language is acquired past puberty, and the various cases differ in degree, but not in their essential character.

Why were we interested in the existence of a critical period for language? Because we wanted to show that there are aspects of language learning that are not correlated with other kinds of learning. If parts of language learning stop being available after a certain age, while other kinds of learning continue, there must be something special about language learning—not all of it can be due to one's general-purpose ability to learn. So the critical period, like the Paradox of Language Acquisition, points to children having a specialized piece of their brains that is devoted to constructing a mental grammar. This piece is not only genetically programmed, but even genetically programmed to *turn off*. The picture is further confirmed by the genetically impaired language learners, who fail in some of the same ways as the late language learners. Evidently the same specialized parts of the brain are affected.

On the other hand, the jury is still out on the parts of language that *can* be learned by late learners and genetically impaired speakers. Are vocabulary and basic word order acquired by general-purpose learning? Or are they acquired by means of a different part of the specialized language capacity, a part that is not affected either by the critical period or by this particular genetic defect?

However the answers to these questions come out, we see that the ability to learn language is not monolithic. There is some sort of division between, on one hand, vocabulary and basic word order, and on the other, the more complex aspects of language such as inflection and altered word orders. The latter in some sense piggybacks on the former: inflection and altered word order depend on there being words and basic word order to start with.

I'm not done with this topic yet. The next chapter discusses some further cases of unusual language acquisition which are even more radical than the ones we have looked at so far.