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CHAPTER

9

The Emergence of Nicaraguan Sign Language: Questions of Development, Acquisition, and Evolution

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The emergence of a new sign language in Nicaragua over the past 25 years provides an opportunity to examine the relationship between intercohort contact and individual development in their link to historical language change. This chapter examines these forces in contemporary circumstances as they set a new language in motion. In Nicaragua, we have observed that a new sign language emerged only after a potential speech community (Gumperz, 1968) of older and younger members was brought together. The resulting development of the new language suggests that the interactions across age cohorts are crucial in language emergence. We propose, then, that language genesis requires at least two age cohorts of a community in sequence, the first providing the shared symbolic environment upon which the later cohorts can build. It requires the capacities of both children and adults to create a viable new language.

In this chapter, we consider specific changes in linguistic patterns of Nicaraguan Sign Language (NSL).[1] We identify which members of the

[1]Natural sign languages are used throughout the world by communities of deaf people. These languages (e.g., American Sign Language, British Sign Language, Swedish Sign Language) have their own complex grammars, just as do spoken languages, and natural sign languages should not be seen as codes of spoken languages. (Some artificial sign languages

speech community employ specific linguistic forms, and under what conditions. These findings suggest the necessary factors that individuals bring to this process: cultural and social (e.g., age cohort or generation), and developmental (e.g., ontogenetic stage). These factors have an effect on the lexicon, the syntax, and the use of this new language.

Rather than ask which of these factors created NSL, we ask how all these factors interact to create a language. We find that linguistic innovation involves not only the creation of new linguistic forms, but also the selection (i.e., the continued, regular use) of the constructions in which they appear. The case of the recent emergence of Nicaraguan Sign Language highlights the complex interrelationships between culture and individuals, and their respective development, and convinces us that theories of language change must be informed by both sociocultural and psychological principles. During the creation of a language, the sociocultural impact of any given individual changes with age, with individuals having their greatest effect on their environment after entering adolescence. The influence of psychological capacities also changes with age, as certain language-learning capacities are available only in childhood. The nature of the linguistic changes that result from intercohort (or intergenerational) contact, therefore, depends on the age of the individuals involved, as age determines the type of influence they exert in each of the sociological and linguistic domains.

Language is an inherently social phenomenon, and must be studied as part of larger, sociocultural systems (Duranti, 2001; Gumperz, 1968; Hymes, 1972). The perpetuation of linguistic changes is dependent on the suitability of those changes to the sociocultural environment and the learning capacities of individuals. Circumstances will favor some changes over others, and thus selection will occur (Mufwene, 2001). However, although the general process of natural selection is common to both sociocultural and linguistic domains, the mechanisms of information change, transmission and selection differ. Crucially, the effects that individuals have on their environment, and the subsequent effects of that changed environment, depend on individuals' cohort (or generation) and age. To accurately account for language emergence and change, we must examine both individual- and group-level phenomena, in both sociocultural and linguistic domains.

[e.g. Signing Exact English; Gustason, Pfetzing, & Zawolkow, 1980] have been invented to aid the acquisition of spoken/written languages.) See Senghas and Monaghan (2002) for a brief summary of these distinctions.

Keeping these domains in mind, we begin with an account of the sociocultural circumstances of the emergence of NSL. We identify distinct periods within the historical development of this language, and discuss the qualitative differences between them. Next, we discuss linguistic variation among deaf Nicaraguan signers. In doing so, we consider various characteristics associated with each of the historical periods described in this chapter. We also examine developmental factors within individual signers. In combining these factors, we demonstrate how environmental and ontogenetic factors interact. More specifically, we conclude that the linguistic environments surrounding Nicaraguan signers, combined with changing first-language acquisition capabilities of individuals, explain the linguistic changes observed. With this approach, this case uncovers important principles that apply to all cases of language emergence and change.

THE SOCIOCULTURAL HISTORY OF NSL

Let us place the individuals involved in the emergence of NSL within their recent and current historical settings. By doing so, we address the ways they might have regulated or directed changes in their communicative circumstances. The sociocultural environment that surrounded deaf Nicaraguans in the period prior to the emergence of a sign language differed in crucial ways from the environment present during the beginning and later phases of the emergence of NSL.

Establishing a Durable Speech Community

Until relatively recently, deaf individuals in Nicaragua had minimal contact with other deaf people. Ethnographic fieldwork (R. J. Senghas, 1997, 2003; Polich, 1998) and archival research (Polich, 1998) indicate that prior to the 1970s, there was no Deaf[2] community in Nicaragua, nor any established sign language. Although Deaf communities have existed in many parts of the world since as far back as the 19th century (cf. Erting,

[2]Consistent with other literature on deafness and Deaf communities, *Deaf* in this chapter is written with an upper-case *D* to signify cultural Deafness, that is, membership within a self-identified Deaf community, generally one that uses a sign language as its primary language. The term *deaf* written with a lowercase *d* refers to hearing loss, without necessarily denoting membership in a cultural and linguistic Deaf community. (See R. J. Senghas & Monaghan, 2002, for a discussion of these distinctions.)

Johnson, Smith, & Snyder, 1994; Monaghan, Schmaling, Nakamura, & Turner, 2003; Plann, 1997), circumstances in Nicaragua apparently prevented any such communities from forming. With no special schools available to deaf students until at least 1946, and no widely accessible special education available until 1977, a critical factor for the formation of a Deaf community was absent (cf. Schein, 1989).[3]

Typically, deaf individuals are the only deaf members in their immediate families, and usually they are the only deaf members of their extended families (Schein, 1989). In such situations, deaf individuals often develop *homesign* systems, that is, idiosyncratic and rudimentary gestural systems used to communicate within the family (Goldin-Meadow & Mylander, 1984, 1998; cf. Morford, 1996, for a review of homesign studies). For those few deaf Nicaraguans who had access to tutoring or special education clinics, the methods were *oralist*, that is, the emphasis was on speaking and understanding spoken Spanish, occasionally supplemented with a few signs to support Spanish acquisition. In other words, signing and gesture were discouraged, whereas spoken and written forms of language were encouraged.

In 1946, the government established the first special education school in Managua, Nicaragua's capital city. Initially, ten deaf and hard-of-hearing students enrolled in a program that covered primary and elementary grades. By the early 1970s, enrollments rose to approximately 50 (Polich, 1998). The school's pedagogy was oralist, and students with residual hearing sometimes practiced articulation with the aid of microphones and headphones (R. J. Senghas, 1997). Alumni of the first governmental schools report today that they did not socialize with one another outside of school, and they lost touch with one another once they no longer attended.

In 1977, the Nicaraguan government established a larger special education center in Barrio San Judas, Managua. This school's deaf program covered preschool through grade 6, and used oralist pedagogy. Initially, approximately 25 deaf and hard-of-hearing students were enrolled, within just a few years rising to over 100 (Polich, 1998). In 1980, the then new Sandinista government established a special education vocational school for adolescents. Many of the graduates from the elementary school entered this vocational program, where they attended classes in

[3]Schein's (1989) theory on the formation of Deaf communities includes issues of absolute size of the deaf population (or "critical mass"), relative population size, issues of inclusion and exclusion in the larger society, and the roles of schools and education.

carpentry, hairdressing, tailoring, and other vocations (R. J. Senghas, 1997). The students of the vocational school often rode public buses to the school, and having gained familiarity with public transportation, began to date and socialize with each other outside of school hours (R. J. Senghas, 1997, 2003; R. J. Senghas & Kegl, 1994). They would meet at ice cream shops, at each other's houses, or go to markets and public places together. In 1986, a hearing teacher, with assistance from other hearing adults, established a club in Managua providing assistance and opportunities for social interaction to deaf adolescents and adults. By 1990, this club had become a national association for Deaf Nicaraguans, and was directed by the Deaf members themselves.

Interviews with older deaf people today suggest that initially there was often confusion about what signs referred to which referent. As in other such cases, as the lexicon became more and more conventionalized within this emerging linguistic community (Gumperz, 1962), certain linguistic forms were left behind, for reasons varying from efficiency and ease of production to the charismatic nature of a particular signer.

Not surprisingly, in this community of adolescents and adults, signers occasionally disagreed over the appropriate use and meanings of particular signs. As a result, many of the Deaf Nicaraguans (and their teachers and parents) soon felt that a dictionary would be a useful tool to standardize the lexicon. After one earlier effort at compiling a dictionary in the late 1980s, the Deaf association in Managua launched a more concerted project with considerable support from the Swedish Federation of the Deaf (SDR). This dictionary was published in 1997 (ANSNIC [*Asociación Nacional de Sordos de Nicaragua*], 1997). The development of this dictionary coincided with instruction in NSL and written Spanish, also offered by the Deaf association. Throughout the dictionary project, most explicit discussion of the sign language by Deaf Nicaraguans focused exclusively on lexical signs and their meanings.

In an effort to make this dictionary an authentic *Nicaraguan* dictionary, the project team put a good deal of effort into excluding signs borrowed from other languages, despite the fact that these signs were commonly used in Managua. The explicit effort to avoid borrowed signs confirms that borrowing was indeed already occurring as a consequence of contact with signing visitors from other countries. Despite these efforts, some borrowed signs do appear in the dictionary. One example is the sign for *association*, often used to refer to the Deaf association. This sign, apparently borrowed directly from American Sign Language (ASL), did make it into the NSL dictionary (ANSNIC, 1997, p. 48; cf., for com-

parison, the ASL sign for *association* that appears in Sternberg, 1987, p. 24).

Evidence indicates that borrowing went beyond appropriation of particular signs, to incorporation of lexical principles. For example, initialized signs (signs that incorporate a handshape representing the first letter of a corresponding Spanish word) began to appear in patterns analogous to those found in other sign languages. Accordingly, the sign for *clean* adopted an L handshape, representing the first letter of the corresponding Spanish word *limpiar* (ANSNIC, 1997, p. 162). In this case, what is borrowed is a convention for generating and modifying lexical items, rather than lexical items themselves. Adults also develop new lexical conventions that spread throughout the lexicon, for example: the BUENO handshape in BIEN, BONITA, and SEGURO.

Increasingly through the 1990s and into the current decade, the Deaf association, with the support of SDR, has been advocating the training of sign language interpreters, as well as Deaf teachers' aides. The presence of Deaf adults as assistants in the classrooms not only allows for the course content presented by hearing teachers to be made much more accessible to deaf students, but, more importantly, also provides fluent signers as linguistic models for the younger students who are still in their early stages of first-language acquisition.

Thus, once adolescents were provided the opportunity to socialize and interact with each other, a Deaf community was formed. The durable nature of this community, unlike the earlier situations when deaf individuals were isolated from each other, provided a potential speech community in which a language could emerge. This Deaf community actively supported its members, created a dictionary of standardized signs, and ensured that later cohorts of deaf children would receive what they had not—early exposure to sign language in the classroom and other social fora.

Periods in NSL History

The emergence of NSL can be divided into three distinct periods:

1. Pre-Emergence Period (up to mid-20th century)—pre-contact
   a. Prior to interaction among deaf individuals in Nicaragua;
   b. Use of isolated homesign systems in families with deaf members;
   c. Earliest (small) schools with oralist programs for deaf students.

2. Initial Contact Period (~1977 through mid-1980s)—contact and consolidation
   a. Establishment of a larger program in San Judas;
   b. Establishment of vocational program for adolescents.
3. Sustained Contact Period (mid-1980s to present)—beginnings of an established linguistic community
   a. Establishment of a Deaf association;
   b. Control and direction of Deaf association assumed by Deaf members;
   c. Dictionary projects;
   d. Deaf individuals as linguistic models in schools.

Each of these historical periods has distinctive qualities. The transitions between these periods correlate with the changes in the types of influence the deaf individuals and groups have on their environments. Increasingly, over time, deaf individuals influence the structure of their social organization, and as a result the cultural forms produced (including language) increasingly bear their mark.

The first (Pre-Emergence) period has no established beginning date, and covers the period when deaf individuals in Nicaragua were not in contact with other deaf individuals. As mentioned, deaf individuals in Nicaragua at this time only rarely interacted with other deaf individuals. The communicative patterns of deaf individuals of this period would have been highly idiosyncratic (Coppola, 2002). With no linguistic community of deaf signers, no conventionalized sign language could develop or be maintained.

The social situations of deaf individuals of the Pre-Emergence period were structured by hearing people, primarily family members. Polich (1998) proposed the concept of the *Eternal Child* to characterize the type of dependent status of deaf individuals of this era. Even in the earliest deaf education programs, students did not interact with one another outside of school, instead returning to their homes once classes had ended.

The date for transition from the Pre-Emergence period to the Contact period could be reasonably assigned to several candidate dates. The scale of the San Judas program, and the fact that its deaf students continued to interact with one another after leaving this school, suggest that the establishment of the 1977 San Judas program is the most significant historical event, and is therefore our preferred choice for marking the transition from the Pre-Emergence period to the Initial Contact period. In any case, the period of deaf Nicaraguans' isolation from one another ends with stu-

dents interacting in special education schools that continue to bring them together even into adolescence.

The Initial Contact period is characterized by the creation—primarily by hearing people—of circumstances that enabled deaf individuals to interact socially, providing an opportunity for the homesigns that each brought into these situations to be shared and modified. At this time, signers began to converge on a common lexicon and develop common linguistic structure. Already a new language was being born. Signed conversations from this period were characterized by frequent redundant phrases for clarification of reference. By the 1990s, especially among the younger signers, the frequency of such redundancy had noticeably diminished. The Initial Contact period was relatively short, less than a decade, which ended with a linguistic community of adolescent and adult signers supplying a progressively richer linguistic environment to younger members—an environment markedly different from that of the Pre-Emergence period.

The Sustained Contact period is distinguished by the conscious choices by deaf individuals to form enduring formal and informal relationships, including the establishment and control of the Managua-based Deaf association. These enduring relationships include friendships, participation in the Deaf association, marriage and domestic partnerships, sometimes despite opposing pressure from individuals, families or institutions to do otherwise. In the Sustained Contact period, which continues to the present day, there is frequent contact not only among Deaf adults, but also between Deaf adults and children. Deaf adolescents and adults repeatedly return to the school to participate in events involving young Deaf children. They attend school promotion and graduation ceremonies at the end of the academic year. The larger Managuan Deaf community often comes together for the fiestas and social gatherings at the Deaf association. The association's center offers more than simply a place for socializing; Deaf adolescents and adults also attend seminars there on subjects ranging from elementary Spanish to vocational training, usually offered by other Deaf adults. Deaf adults can be trained at the center to become teachers' aides in the deaf classrooms at the special education schools.

With this sustained Deaf community contact, there has also arisen a political consciousness about the rights and powers of Deaf people. As members of the Deaf association, some individuals have become involved in local and even national-level politics, often lobbying for the rights of deaf individuals or working for recognition of Deaf people and their sign language. Consider the ideological effects of an "official" dictionary, and

the sign language seminars offered by the *de facto* national Deaf association. Recognition of NSL as a valid and effective language has reinforced the Ministry of Education's efforts to use sign language as a medium of instruction in programs for deaf students, with significant implications (R. J. Senghas, 1997).

While the dictionary and seminar projects have provided stabilizing influences on the language, they have also motivated the creation of alternate signs as part of oppositional positioning or regional identification by signers in the linguistic community. Such positioning might involve linguistic forms to assert or deny social identities and roles (cf. Schieffelin, Woolard, & Kroskrity, 1998). R. J. Senghas (1997) identifies one such event observed in an outlying town in 1993, where two deaf individuals argued about which of two signs was the "correct" one to use, a local form or the Managuan one. In times of linguistic doubt, signers can now consult sources of authority such as dictionaries and community leaders.

As we have indicated, in the beginning, hearing Nicaraguans structured the social and cultural environments of individual deaf Nicaraguans. Isolated deaf Nicaraguans responded socially and linguistically by developing homesign systems. Even in the first small oralist schools, signing remained limited and the social opportunities did not extend beyond the school grounds or school hours. Later, hearing people set up new social circumstances by establishing special education schools that brought many deaf Nicaraguan children together. Again, the deaf children responded socially and linguistically—but in these circumstances, deaf Nicaraguans began to have significant effects on the sociocultural environment of their deaf peers. They provided one another with a richer linguistic environment—one that included shared signing. Finally, with the addition of adolescents and adults to their community, Deaf Nicaraguans had significantly increasing influence over their sociocultural and linguistic environments. They could now structure intercohort social situations in which Deaf signers figure prominently, thereby providing models of sociocultural behavior, especially language use. The conditions were now in place for language emergence, change, and perpetuation.

EFFECTS OF ONTOGENETIC DEVELOPMENT ON NSL: CHILDREN'S MINDS MATTER

As already described, individuals act on their environment in sociocultural and linguistic ways, affecting themselves and the other members of their community from that day forward. However, another process is

simultaneously taking place over time—the individuals themselves are getting older. As people mature, both sides of the interaction are affected; the way individuals affect the environment changes, and the way they are affected by the environment changes. Thus, to understand how language emergence and change take place, we must factor ontogenetic development into the interaction between individuals and their changing language environment.

The actions of each member of the Nicaraguan Deaf community alter the environment for signers of all ages. However, the types of activities in which individuals participate change over the course of their lifetime. It is worth examining empirically how children differ from adolescents and adults in the nature of their effects on the language they are learning. We have observed that adolescents and adults actively form social communities in which language can emerge, consciously add vocabulary to the language, and aggressively ensure that their language is passed down to younger children. We now consider effects that change the internal structure of a language, for example, when individuals apply a form to a function different from that observed, fail to adopt a form, or introduce a novel construction. In the section that follows, we identify one such measurable change, and examine how, as individuals mature, their effect on the language takes on a different nature.

We also consider how a given language environment differentially affects individuals of different ages. It has been found that the age at which learners are first exposed to a language determines their eventual linguistic abilities, with those who start younger achieving greater proficiency (Lenneberg, 1967; Newport, 1990). For example, adults who moved to the United States from Korea during early childhood have a better command of English than those who moved here in adolescence or adulthood (Johnson & Newport, 1989). Similarly, Deaf adults in the United States who entered the signing community in early childhood have a better command of ASL than those who entered in adolescence or adulthood (Mayberry & Eichen, 1991; Newport, 1990). Evidently, as learners age, it becomes more difficult to learn language natively, whether signed or spoken.

Some parts of a language will be easier to master in adulthood than others. For example, among the native Korean speakers who had learned English, all had acquired a large vocabulary, but only those who were exposed as children had mastered the complicated use of articles like *a* and *the* (Johnson & Newport, 1989).

In the case of NSL, this familiar effect of age (ontogenetic development) interacted in an unusual way with the effect of language change

(historical development) over the course of the 1980s. With each passing year, individual proficiency at language learning declined, decreasing each learner's potential. At the same time, with each passing year, the ambient language became progressively richer, increasing each learner's potential. These simulatneous, opposing forces make it tricky (but not impossible) to differentiate the effects of the language on its learners from the effects of learners on their language.

We can tease apart the interaction by comparing the grammars of learners exposed to the language in different years and at different ages. Consider that all signers retain outcomes of earlier periods of their own development. Adults remember what they learned as children. For this reason, in the language of many adults, we find constructions that can be learned only in childhood, such as the native use of *a* and *the*, or the pronunciation of the English /r/ sound. The fact that they can use these constructions as adults reveals that their childhood environment included them. The fact that others (including many Korean immigrants to the United States) cannot use these constructions as adults reveals that their childhood environment did not include them, and that these particular constructions are difficult to learn in adulthood.

Of course, any constructions that are easy to learn in adulthood will be present in the language of all adults, regardless of age of exposure. For example, we can all use words we acquired only as adults, such as many of the words that appear on this page. For this reason, constructions that are learned easily by adults are not useful tools for determining the content or richness of an individual's childhood language environment.

The constructions useful for illuminating a learner's childhood linguistic environment will be those that are not easily learned in adolescence and adulthood. Such constructions will be present only in the language of those who were exposed to them as children. If an element is missing from an individual's version of NSL, we can conclude that it emerged after that individual had already reached adolescence. Conversely, the set of such constructions present in the language of each individual represents the total contributions of that person's age cohort and its predecessors. Constructions are distributed across cohorts today like rings on a tree, enabling us to date when each one entered the language.

Following this logic, we have examined the emergence of *spatial coreference* in the grammar of Nicaraguan signing (A. Senghas & Coppola, 2001). Most signs can be produced in a neutral location in front of the signer's body. However, a signer can choose to spatially modify a sign, producing it with a movement toward or away from a particular location.

These modifications, or *spatial modulations*, can serve various grammatical functions. In NSL (as in many other sign languages) they are often used for co-reference; that is, to indicate that several signs are associated with a common referent. Figure 9.1 presents the verbs *see* and *pay* in their neutral form and spatially modulated. In the spatially modulated versions, the signs' shared spatial modulation would indicate their link to a single person who was both seen and paid.

In this analysis, we identified spatial modulations in videotaped narratives elicited from Deaf Nicaraguan signers. We then coded how often utterances that referred to the same referent used the same spatial modulation. Although a common spatial modulation on two different signs will sometimes occur by chance, signers who frequently use common spatial modulations in cases of co-reference are more likely to be using them to indicate co-reference grammatically.

In order to examine the effects of the changing language environment, subjects were divided into two groups, or cohorts, based on their initial year of exposure: the *first cohort* entered the community between 1978 and 1983, the *second cohort* entered between 1984 and 1990. To examine the effects of the age of individual learners, subjects were further divided into three groups based on the age at the time of exposure: *early-exposed* (birth to 6;6), *middle-exposed* (6;6 to 10), and *late-exposed* (after age 10). The proportion of co-referential spatial modulations per verb for each group was determined, and is presented in Fig. 9.2.

Comparing the third pair of columns with the other two reveals an effect of age: late-exposed signers of both cohorts are equally (un)likely to produce co-referential spatial modulations. Evidently, spatial co-reference is not as easily mastered once one is older than 10, and late-learners of both cohorts were already past that age when they were first exposed to NSL. We take this low frequency of common modulations to be our best approximation of how often spatial modulations will co-occur by chance, or to what degree they might be learnable after early childhood.

In contrast, for the early- and middle-exposed signers, the year of exposure made a crucial difference; members of the second cohort produced spatially co-referent forms significantly more often than the first. As children, the second-cohort signers did not replicate the pattern of signing used by the older signers from whom they were learning. Instead, the second-cohort signers were much more apt to produce common spatial modulations in contexts with potential co-reference. In this way, they were using the form with a systematic pattern that they had not observed in the signing of their first cohort models.

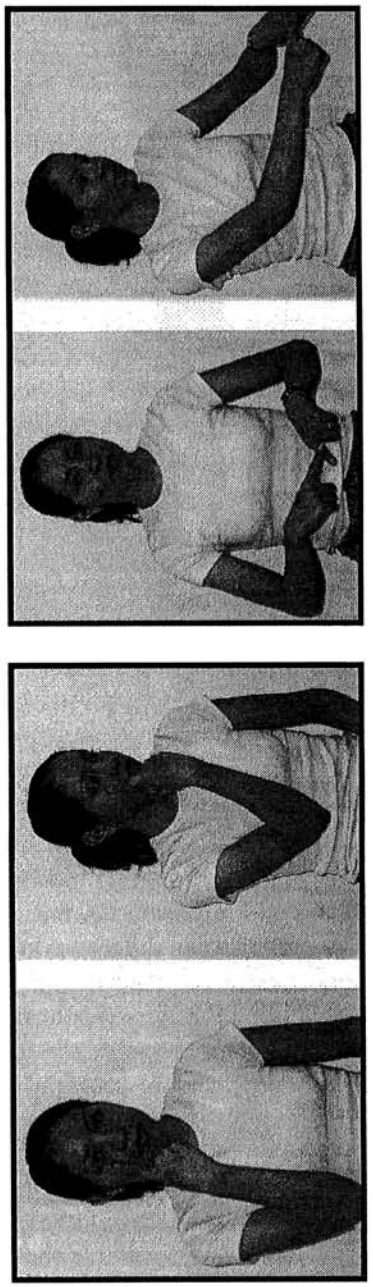

FIG. 9.1. The Nicaraguan signs *see* and *pay* produced in their neutral form, and spatially modulated to the signer's left.

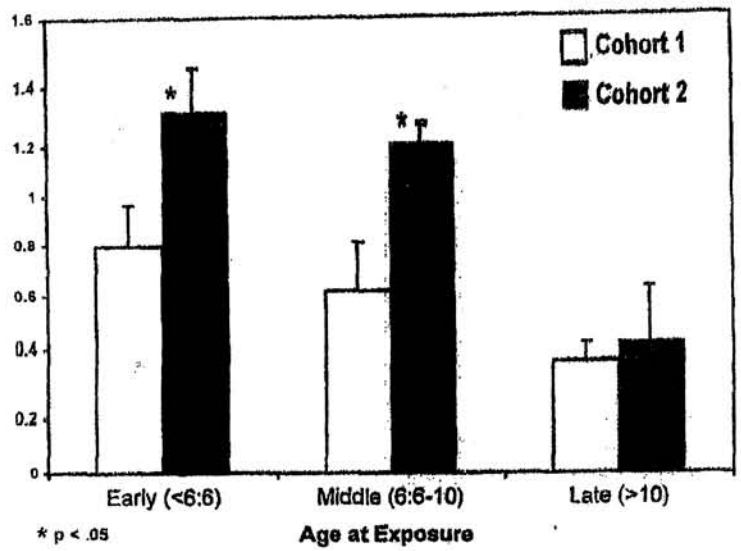

FIG. 9.2. Spatial modulations in co-referential contexts produced per verb by early-, middle-, and late-exposed signers of the first and second cohort (from A. Senghas & Coppola, 2001).

It seemed likely that the spatial modulations produced by members of the first cohort, even if they were occasionally produced, were not ever being used to indicate co-reference. To test this, we conducted a comprehension study to determine how spatial modulations are interpreted (A. Senghas, 2000). Early-exposed signers from both cohorts watched video clips of signed sentences that included a spatially modulated sign (along with several unmodulated fillers) and indicated the meaning of each sentence by selecting from a set of pictures. The difference in usage is striking. *None* of the first-cohort signers constrained their choices based on the direction of the spatial modulation; all of the second-cohort signers did. Evidently, even though first-cohort signers occasionally produce spatially modulated forms, they do so without regard for potential co-reference. The young signers that were exposed to such utterances in the late 1980s nevertheless acquired a system that is systematic and rule-governed; accordingly, their usage is constrained in both production and comprehension.

Based on these and related analyses (A. Senghas, 1995; A. Senghas, Coppolla, Newport, & Supalla, 1997), we conclude that the present-day use of spatial modulations to indicate co-reference was developed over the course of the 1980s by sequential cohorts of child learners. Some form of *spatial modulation*, that is, modifying signs with respect to specific locations, was probably already present in the homesign systems developed by some of the children with their families before they entered school (Coppola, 2002). In the early 1980s, children of the first cohort began producing these modulations more frequently. Then, crucially, the children of the late 1980s imposed a constraint on this device. They restricted the side toward which a sign was produced in order to indicate co-reference or agreement; that is, signs produced in a common location now unambiguously indicated a common referent.

At this point, the construction could be used to link a verb to its arguments, a noun to its modifiers. Now a common spatial modulation could be used to mean that a single person was both seen and paid. Because this constraint arose among the children of the late 1980s, who are today's adolescents, it can be observed in their language still, and in the signing of today's children, but not in the language of those who were already adolescents in the late 1980s, that is, today's adults.

Note that the particular innovation contributed by the second-cohort children was not the act of signing in space; it was the constraint on how space could be used. This innovation limits not only the way a set of signs can be produced; it limits what the set of utterances can mean, and in this way it makes the grammar more specific. For example, consider the sentence in which *see* and *pay* are both produced to the left. To a first cohort signer, the sentence could mean that one person was seen and another paid, or that a single person was both seen and paid. To early-exposed second-cohort signers, the first reading is not only unlikely—it is ungrammatical, even though such sentences must have been present in their environment when they were children.

ONTOGENETIC AND HISTORICAL TIME FRAMES MEET (CASCADING NICHE CONSTRUCTION)

Every cohort at every age has played an indispensable role in the emergence of NSL. Considering the community's history, together with the data on spatial modulations, it is clear that no single cohort "invented" NSL. We therefore do not propose a scenario in which the first cohort's language was agrammatical and the second cohort "innovated" a grammar.[4] We propose instead that the grammar of NSL has been developing from the Initial Contact Period onward, and every cohort since that time

[4]We do not find evidence to support a single-cohort view, although such a view is occasionally implied in others' discussion of our research (e.g., Slobin, chap. 8, this volume).

played a crucial role in this development. Each cohort, in turn, enriched the grammar of the language while they were children, during a period of early sensitivity to language structure. As they entered adolescence, they continued to learn the language and add to their vocabularies, but stabilized on their use of grammatical constructions such as spatial modulations. At this point, they also began to create and maintain or modify the social structures that enabled them to pass their progress on to a new cohort of children. The newer children, surrounded by a now-changed social and linguistic environment, quickly picked up the language of the day, and continued to develop it where their older peers left off.

This account is supported by the following findings: (a) the sociocultural environment of deaf Nicaraguans changed dramatically in the late 1970s and the early 1980s, from essentially no contact, to extensive peer contact, to intercohort contact among members of a new community; and (b) the linguistic environment also changed during this period, becoming grammatically richer. A close examination of spatial modulations in particular indicates that a system of spatial co-reference emerged and was available in the language environment from the mid-1980s on.

Furthermore, both the increasing intercohort contact and the linguistic enrichment stemmed from the very community that then benefited from them. In this way, at the community level, deaf Nicaraguans are constructing a niche, a new, changed linguistic environment for themselves, a niche that then provides a shaping influence on the members of the community.

Let us momentarily shift our attention away from the individuals and their linguistic community, and toward the changes in the language itself. Historical language change can be viewed as the evolutionary development of a language. This perspective is adopted by Mufwene (2001), and provides a useful approach for understanding the emergence of NSL. The concept of *natural selection* as applied to linguistic behaviors is especially relevant, because it is not only the appearance of novel linguistic forms that is of concern, but also their retention (i.e., selection for regular continued use) that marks true historical change. Novel forms would be more likely to be retained by speakers if those forms are seen as more effective at communicating, whether through increased efficiency, precision, flexibility, or compatibility with either the cognitive capacities of the speakers or the structures of the linguistic system (i.e., the language). As elements of the language and, ultimately, the language itself change, the environments of the speakers change, including the environments of those children in the process of constructing their cognitive capacities.

This brings us to the epigenetic process of cognitive constructivism that Piaget describes whereby an individual child, in the course of developing

cognitive capacities, changes its environment in ways that then, through feedback, transform the developing child in return, propelling development into more advanced stages (cf. Parker, chap. 1 and chap. 2, this volume). In this case, significant transformation also happens at the community level, as the changes to the environment derive directly from community interaction.

At the individual level, some of these adaptive and transformative abilities will not be direct or immediate as they interact in an important way with individual, ontogenetic development. Although the ability to creatively build up one's own language, and the ability to shape one's sociocultural environment are available to some degree throughout the lifespan, they are each especially prominent during a particular, limited period in ontogenetic development. Constructive linguistic abilities peak early in life; constructive social abilities peak later in life. As a result, the creative influence of an individual's childhood language abilities must await adolescence to exert their full effect. Only then, together with age peers, can the individual actively serve as a language model to a new, younger cohort that can benefit from the linguistic change. Thus, there will be a lag of five to ten years from when a new construction initially emerges to when it transforms the language environment of others. As a result, each age cohort transforms the environment of the subsequent age cohorts more than the environment of their own. What we have, then, is *niche construction* (Laland, Odling-Smee, & Feldman, 2000), but with a cascading, delayed impact.

Thus, across multiple cohorts, both adults and children play crucial roles in creating a language. NSL could emerge only when a cohort of adolescents and adults provided the social and linguistic environment from which it grew, and ensured the perpetuation of its signs and conventions. The grammatical elements to be perpetuated, however, depended on a complementary role that only children are equipped to play. Their capacity to acquire grammatical systematicity (even where it is absent in the environment) is essential for the initial appearance of linguistic structure.

CONCLUDING REMARKS: THE INTEGRATION OF CULTURE AND BIOLOGY

We argue that the emergence of NSL has been an evolutionary process, subject to evolutionary principles, including selection. This is not to imply that the appearance of this new language represents a reenactment of the original emergence of language in human societies, as the appearance of

the first language was situated in a vastly different sociocultural environment from that observed in this contemporary case.[5] Rather, it is the principle of selection, as it interacts with sociocultural and psychological development, that underlies both scenarios. Within the model of niche construction (Laland et al., 2000), selection is affected by environmental factors that themselves may be modified by the biological individuals subject to the selection. In this case, culture (language) meets ontogenetic development in a reciprocally changing, at times reinforcing, process.

Certain sociocultural and psychological conditions, brought together, can trigger the creation of a language, with all of its lexicon, grammar, and conventions of use. Since the late 1970s, the sociocultural influence of Deaf Nicaraguan adolescents and adults interacted with the language-receptive and language-creative mental abilities of preadolescent children to establish, systematize, and internalize the new grammar of Nicaraguan Sign Language.

Note that an individual's potential contribution, in both psychological and sociocultural domains, changes over the lifespan. Strong language-creating abilities emerge early in life, and decrease with age. Social self-determination emerges later in life, and thus, the ability to influence the environment of others increases with age. Ironically, this ability to provide fertile sociocultural conditions, which must occur first, develops later ontogenetically. For this reason, no single age cohort can progress through the developmental stages in the order necessary to create a language in a single pass. Consequently, language genesis requires at least two cohorts of the community in sequence, the first providing the shared symbolic environment that the second can exploit. Neither children, nor adults—independent of each other—can create a language. But a community in which both are available, interacting with each other and passing developments down as they age, can provide the fertile ground out of which language grows.

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[5]And as Deacon (1997) argues, the first emergence of language is likely to have arisen in ancestors with brains and minds organized differently than the modern configuration of *Homo sapiens* after the co-evolutionary development of the human mind and human language.

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