

The emergence of grammar: Systematic structure in a new language

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This report contains a linguistic description of a language created spontaneously without any apparent external influence in a stable existing community. We describe the syntactic structure of Al-Sayyid Bedouin Sign Language, a language that has arisen in the last 70 years in an isolated endogamous community with a high incidence of nonsyndromic, genetically recessive, profound prelingual neurosensory deafness. In the space of one generation from its inception, systematic grammatical structure has emerged in the language. Going beyond a conventionalized list of words for actions, objects, people, characteristics, and so on, a systematic way of marking the grammatical relations among those elements has appeared in the form of highly regular word order. These systematic structures cannot be attributed to influence from other languages, because the particular word orders that appear in Al-Sayyid Bedouin Sign Language differ from those found both in the ambient spoken languages in the community and in the other sign language found predominantly in the surrounding area. Therefore, the emerging grammatical structures should be regarded as an independent development within the language.

language genesis | sign language | word order

Language is universal to all cultures but bafflingly diverse in its actual instantiations. Since the earliest recorded history (*cf.* Herodotus, *History*, 2.2), people have felt that new languages could provide a window into the fundamental nature of all human language. Recently, it has been suggested that pidgin and creole languages, new languages that result from contact between existing languages, constitute such a window (1, 2). The newly created sign language of Nicaragua (3, 4) has also been adduced as a possible example. But creoles and Nicaraguan sign language were created in unusual social and linguistic environments, which are not characteristic of the use, acquisition and transmission of language in a typical human society. Creoles were created under circumstances of social and linguistic discontinuities, the coming together of people with different linguistic and cultural backgrounds. The sign language under study in Nicaragua is passed from cohort to cohort in the school and was neither fostered nor transmitted in a family and community setting. These unusual circumstances may have an effect on the linguistic structure of the emerged languages. To neutralize such possible effects, one must look for a language that had arisen spontaneously within a socially stable community. The sign language of Martha's Vineyard (5) was such a language, but that language disappeared a century or so ago and was never described.

This report contains a linguistic description of a new and isolated language, a sign language created spontaneously without any apparent external influence in a stable existing community. We have found that one of the most important organizing principles in language, the grammatical relation between subject (S), object (O), and verb (V) in an utterance, has been fixed at a very early stage in the development of the language. Word order is significant because it provides a conventionalized means

of expressing the relation between elements in a sentence without relying on extralinguistic context. We report the details of our findings here.

Al-Sayyid Bedouin Sign Language (ABSL) has arisen in the last 70 years in an isolated endogamous community with a high incidence of nonsyndromic, genetically recessive, profound prelingual neurosensory deafness (6). What distinguishes ABSL from all other documented new languages are the unique social circumstances of its creation and use. These circumstances are exceedingly rare and show neither discontinuity of social structure nor interaction with other languages.

In the space of one generation from its inception, systematic grammatical structure has emerged in the language. Going beyond a conventionalized list of words for actions, objects, people, characteristics, and so on, a systematic way of marking the relations among those elements has appeared in the form of highly regular word order. These systematic structures cannot be attributed to influence from other languages, because the particular word orders that appear in ABSL differ from those found both in the ambient spoken languages in the community and in the other sign language found predominantly in the surrounding area, Israeli Sign Language (ISL). Therefore, the emerging grammatical structures should be regarded as an independent development within the language and a reflection of a basic property of language in general. Before presenting our evidence for this regular pattern, we document the emergence and character of this unique linguistic community.

The Al-Sayyid Bedouin group was founded ≈ 200 years ago in the Negev region of present-day Israel. The group is now in its seventh generation and contains $\approx 3,500$ members, all of whom reside together in a single community exclusive of others. Consanguineous marriage has been the norm in the group since its third generation. Such marriage patterns are common in the area and lead to very strong group-internal bonds and group-external exclusion.

Within the past three generations, ≈ 150 individuals with congenital deafness have been born into the community, all of them descendants of two of the founders' five sons (6). Thus, the time at which the language originated and the number of generations through which it has passed can be pinpointed. All deaf individuals show profound prelingual neurosensory hearing loss at all frequencies, have an otherwise normal phenotype, and are of normal intelligence. Scott *et al.* (6) identify the deafness as (recessive) DFNB1 and show that it has a locus on chromosome 13q12 similar to the locus of several other forms of nonsyndromic deafness.

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Abbreviations: ABSL, Al-Sayyid Bedouin Sign Language; ISL, Israeli Sign Language; S, subject; V, verb; O, object; IO, indirect object; N, noun.

See Commentary on page 2271.

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In a detailed anthropological study of deafness in the Al-Sayyid community, Kisch (7) showed that the deaf members of the community are fully integrated into its social structure and are not shunned or stigmatized. Both male and female deaf members of the community marry and always to hearing individuals. Kisch was the first to report that the deaf members of the community and a significant fraction of its hearing members communicate by means of a sign language. Siblings and children of deaf individuals and other members of a household (which may include a large extended family) often become fluent signers. Neither Kisch nor anyone else, however, has previously attempted to analyze the structure of the language.

Members of the community generally recognize the sign language as a second language of the village. Hearing people there routinely assess their own proficiency, praising those with greater facility in the language. Those who have any familiarity with ISL (8), including those in younger generations who have attended schools for the deaf outside the village, recognize that the two sign languages are distinct. This observation is confirmed by ISL signers who viewed ABSL narratives on videotape and found them unintelligible. Nor do Al-Sayyid signers understand the Jordanian sign language used in simultaneous interpreting on Jordanian television programs received in the area.

Signers readily use their language to relate information beyond the here and now, such as descriptions of folk remedies and cultural traditions, some of which are no longer in force. We have documented personal histories of deaf members of the community and witnessed conversations about topics as diverse as social security benefits, construction techniques, and fertility.

Many of the signers in this community are hearing, a highly unusual linguistic situation, but one that is predicted to arise as a consequence of recessive deafness in a closed community (9). One result of the recessiveness is that there is a proportionately large number of deaf individuals distributed throughout the community. This means that hearing members of the community have regular daily contact with deaf members and that, consequently, signing is not restricted to deaf people. Furthermore, each new generation of signers is born into an environment with adult models of the language available to them. ABSL thus presents a unique opportunity to study a new language that has grown inside a stable community without known external influence.

Methods

Subjects. We have identified three generations of signers. The first generation in which deafness appeared in the community (the fifth since the founding of the community) included fewer than 10 deaf individuals, all of whom are deceased. Information on their language is limited to reports that they did sign and one very short videotape record of one of these individuals. We have worked with eight signers of the second generation, seven deaf and one hearing, all currently in their 30s and 40s, except one in her 20s. The third generation of signers ranges from teenagers to young children. In this study, we report only on the language of the second generation. Preliminary results from the third generation, however, reveal interesting differences between the systems of the two generations.

Data Elicitation and Analysis. All research was conducted in signers' homes in the village. For all tasks, the signer addressed another signing member of the community to ensure that their language was produced in a communicative context. Two tasks were presented to the second generation of signers: (i) spontaneous narratives given in response to a request to recount a personal experience and (ii) descriptions of single events portrayed by actors in a series of short video clips. The responses to these tasks comprise our corpus.

The video clips used in our work were designed for field

elicitation by the Language and Cognition Group at the Max Planck Institute for Psycholinguistics (Nijmegen, The Netherlands). All responses were videotaped, translated by a hearing signer from the same generation, and transcribed. The transcriptions consist of glosses for each individually identifiable sign production.

Signs were assigned to constituents according to both semantic and prosodic criteria. The utterances were divided into sentences based on signs for actions or events, each of which was classified as the predicate nucleus of a sentence.

We classified other signs as noun (N) arguments, adjectives, numerals, and negative markers, based on their meanings. Subjects, objects, and indirect objects (IO) were identified depending on their semantic roles in a clause and the standard mapping of these roles onto syntactic positions (10). We were also aided by translation to Hebrew by a trilingual consultant, a hearing native signer whose father was deaf, as are two of his daughters. Constituency was further determined by careful observation of prosodic cues. Breaks in the utterance were identified by shifts in the rhythm marked by a pause or lowering of the hands, together with a change in head or body position and facial expression. These same prosodic cues to major constituent breaks occur in ISL (11), and we have observed them in other sign languages as well.

We were able to provide an unambiguous syntactic parse for most strings by using semantic criteria, but some could only be parsed correctly by attending to prosodic criteria and comparing them with the translation that our consultant provided independently. One signer, for example, describing his personal history, produced the following string: MONEY COLLECT BUILD WALLS DOORS. The first prosodic constituent is MONEY COLLECT. Like the majority of sentences in our data, it is unambiguous: semantics, prosodic criteria (described below), and the consultant's translation, "I saved money," confirm that it is an O-V sentence. It is the sequence BUILD WALLS DOORS that fully illustrates our methodology. The semantics indicates that WALLS and DOORS are patients related to the verb BUILD. In principle, then, it could be an example of a V-O string contrary to the pattern we have found generally in the language. However, the prosodic analysis indicates otherwise, as we now demonstrate, and that analysis was confirmed by the consultant's translation.

In our analysis, we applied criteria for determining prosodic constituency developed in a study on ISL (11). Because prosodic constituency is largely correlated with syntactic constituency (12, 13), we use prosodic criteria as one point of entry into the basic syntax of the system. In the Nespor and Sandler study (11), major prosodic breaks (intonational phrases) were systematically marked by a combination of manual and nonmanual phonetic cues. Three distinct manual cues were found to mark prosodic breaks: (i) holding the hands in place, (ii) pause and relaxation of the hands, or (iii) repeating the final sign in the constituent. Nonmanual cues at the intonational phrase boundary included both (i) a clear change in head or body position, and (ii) a concomitant change in facial expression, the latter interpreted by the researchers as sign language intonation. These breaks separate major prosodic/syntactic constituents, such as topics and relative clauses, from the rest of the sentence, and they separate sentences from one another.

In the string BUILD WALLS DOORS, the nominals are semantically related to the verb; they are patients. Syntactically, however, the nominals could either be objects of the verb in the same sentence, i.e., "I built walls, doors . . ." or, alternatively, they could be in a separate fragment, conveying a list: "I built. Walls, doors . . ." on par with "I began to eat. Chicken, pickles, corn . . ." Under the first interpretation, we have (S)V-O order in a single syntactic unit. In the latter interpretation, we do not. Instead, the first sentence is just

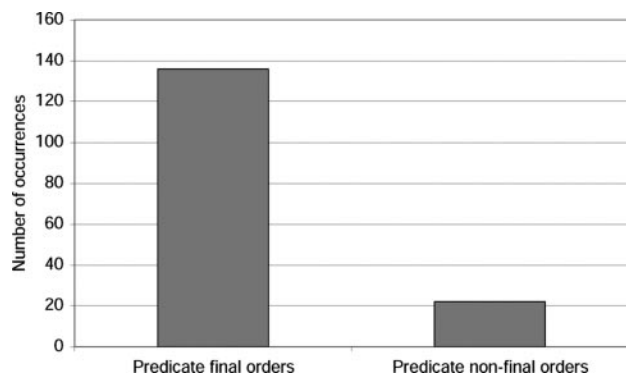


Fig. 1. Frequency of predicate-final orders compared with non-predicate-final orders. Predicate-final orders combine all occurrences of predicates appearing in the final position of a clause. Non-predicate-final orders include all other predicate positions. Predicate-final orders overwhelmingly outnumber non-predicate-final orders, 136 to 22.

BUILD, and the last major prosodic constituent is the fragment WALLS, DOORS. Our prosodic criteria clearly selected the second structure.

The break between BUILD and WALLS is characterized by holding the hands in position at the end of BUILD, and then moving the body first forward, then up, and enumerating the things being built, WALLS and DOORS. In addition to changes in manual rhythm and body posture, the facial expression also changed at the boundary between BUILD and WALLS. The facial articulation on BUILD was a contraction of the lower eyelid (Action Unit 7 in ref. 14). At the boundary between BUILD and WALLS, the lower eyelid contraction changed to neutral, and the eye gaze also shifted, making eye contact with the addressee. That is, manual and nonmanual prosodic cues indicated clearly that the words WALLS and DOORS were not in the same sentential constituent as BUILD, and the string is parsed as (V N, N). Crucially, the prosodic analysis shows that it would be erroneous to parse this string as a (V-O, O) sentence in which WALLS and DOORS are the objects of BUILD in the same clause. Our analysis, that the string represents a sentence consisting of a verb followed by a list fragment, was confirmed by our third criterion, translation. The spontaneous audio-recorded translation of the string by the consultant on the project was as follows: “I saved some money. I started to build a house. Walls, doors.”

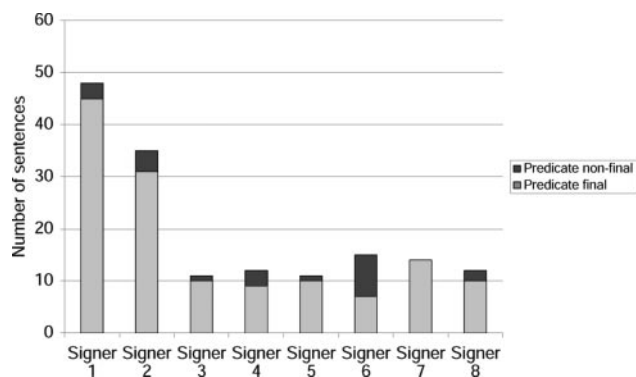


Fig. 2. Frequency of the two word orders (predicate-final and non-predicate-final) for each subject. In all signers but one, predicate-final order clearly outnumbers non-predicate-final order. Subject 7, the only hearing subject, produced only predicate-final sentences. Signer 6, the youngest subject, produced more non-predicate-final than predicate-final sentences (8 and 7, respectively).

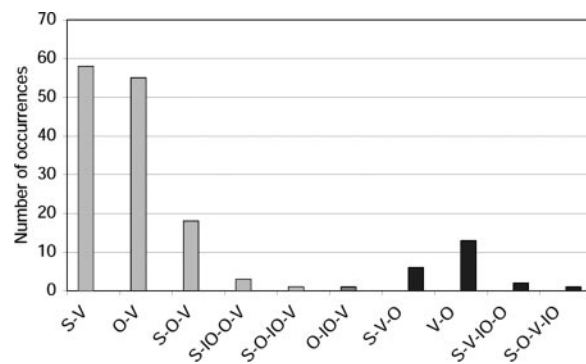


Fig. 3. Frequency of order of all major constituents in the data set. Most clauses contain one argument per verb, with the argument preceding the verb; in those with more than one argument, the subject always precedes the object. We found no consistent ordering of direct object and indirect object with respect to one another. Overall, the tabulation is consistent with a basic S-O-V order and inconsistent with any other basic order.

We describe our analysis of this string in considerable detail; it is instructive because of the potential ambiguity and the atypical word order of one possible interpretation. However, the vast majority of sentences in our data were unambiguous, and straightforwardly (S)O-V.

Results

We report here on the order of signs within sentences and within phrases in the language, based on a tally of all sentences in our database that consist of more than one sign. Sentences consisting solely of a predicate and utterances consisting solely of nouns were set aside. We first tallied the order among the major elements of the remaining clauses: the predicate and its arguments. Fig. 1 shows the order of predicates relative to arguments within the clauses considered in our count. Of 158 clauses, 136 are predicate-final.

This strong tendency for predicate-final order characterizes all but one of our subjects. Fig. 2 shows the relative frequency of the two word orders distributed over our eight subjects. Seven subjects show a very clear preference for the predicate-final order. One subject (subject 7, the only hearing subject) did not produce any non-predicate-final sentences, which is significant, because this signer is bilingual (Arabic and ABSL), yet there is no influence of the local Arabic dialect’s S-V-O order on the ABSL word order in his signing. Only subject 6,

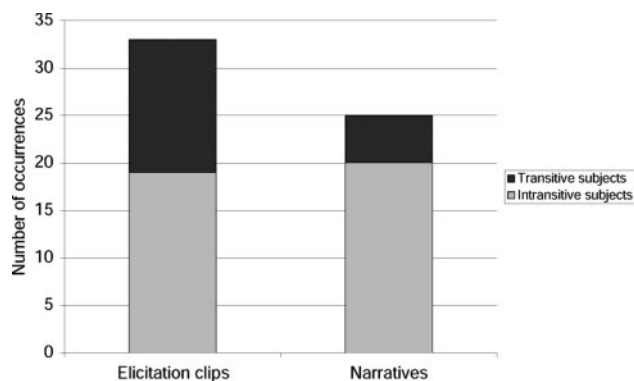


Fig. 4. Frequency of transitive and intransitive subject arguments in S-V sentences. Intransitive subjects occur almost twice as much as transitive subjects. However, this pattern is not equally distributed in our data. In narratives, transitive subjects in S-V are quite rare (5 of 25); in sentences elicited by video clips, the two types of subject are common (14 transitive and 19 intransitive).

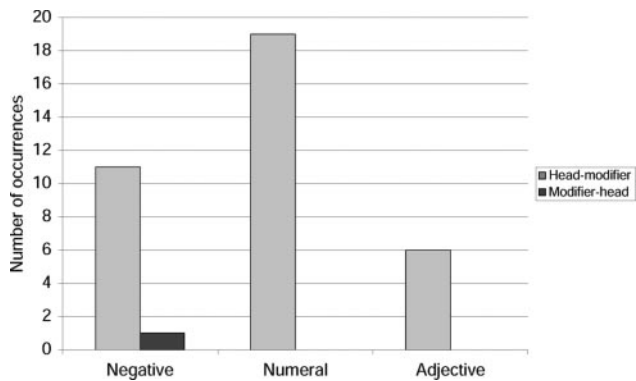


Fig. 5. Frequency of relative orders of a modifier and its head. For all types of modifiers, the modifier follows the head. This consistency across type implies an underlying common head–modifier order within phrases.

the youngest signer among the subjects, shows a different pattern: a slight preference for non-predicate-final order (8 of 15 sentences).

Fig. 3 shows the frequency of the relative orders of subject, object, indirect object, and verb within the data (following standard practice, we lump together object and indirect object unless a clause contains both). Of all of the clauses, 126 contain only one noun, of which 58 contain subjects and verbs and 68 objects and verbs. Where two nouns are mentioned in a clause, subject precedes object (in all 32 cases). Subject never follows verb. Thus we conclude that the prevalent word order for ABSL sentences is S–O–V. A binomial test yields statistically reliable *P* values of <0.00001 for this and all other word-order effects reported here.

Either subject or object may be unexpressed, resulting in S–V or O–V strings. For example, in the observed description of a video clip showing a woman giving an apple to a man, WOMAN APPLE GIVE; MAN GIVE [“The woman gave an apple; (she) gave (it) to the man”], the first clause is S–O–V, and the second clause is IO–V. Another signer responded to the same clip with the following string: WOMAN GIVE MAN TAKE. In this string, the object is unexpressed, resulting in two S–V sentences. S–V sentences, then, may consist of a transitive subject and an unexpressed object, or they may consist of an intransitive subject (e.g., MAN WALK). The relative frequencies of the two types of subject are shown in Fig. 4.

We next considered the order of modifier elements within phrases (adjectives, negatives, and numerals) relative to their head nouns and verbs. As shown in Fig. 5, in all instances but one, the modifier follows its head.

Discussion

Overall, we find statistically significant structural regularities in the order of signs in the language: S–O–V order within sentences, and head–modifier order within phrases. These

word orders cannot be attributed to the ambient spoken language. S–O–V word order is not characteristic of any language that ABSL signers may have had contact with. The basic word order in the spoken Arabic dialect of the hearing members of the community, as well as in Hebrew, is S–V–O. This generation of signers had little or no contact with ISL, whose word order appears to vary more widely in any case (8). Furthermore, the head–modifier order cannot be ascribed to the ambient colloquial Arabic dialect of the community. In this dialect and in Semitic languages generally, although adjectives do follow nouns, numerals precede nouns, and negative markers only rarely follow their heads. Hence, the robust word-order pattern exhibited by the data are all the more striking, because it cannot be attributed to the influence of other languages; rather, this pattern should be regarded as an independent development within the language. Table 1 compares the word order in our ABSL data with those of other languages in the region.

The S–O–V order we have observed in ABSL is the most common word order in languages generally, according to Dryer’s (15) comprehensive survey of spoken languages. There has also been speculation in the last decade about what the word order of the earliest true languages might have been. Bickerton (16) observes that S–V–O is the most common order in creole languages, hypothesizing that this order is dictated by the fact that it maximally separates subject from object. Newmeyer (17) hypothesizes S–O–V order for “Proto-World” on the basis of a number of factors, an order that accords with what we have found in ABSL. He also hypothesizes that this protolanguage had inflectional affixes that marked the grammatical roles of sentence constituents, in addition to word order; ABSL, however, has no inflection of any sort (18).

Among “home signers,” or young deaf children who spontaneously create a sign system without input from either a spoken language or a sign language, Susan Goldin-Meadow (19) finds consistent word order appearing early in their gestural productions. Although these children have no contact with other deaf signers, they regularly produce two-gesture strings in which actions appear in final position. She further finds that intransitive actors and patients are more likely to appear in such strings than transitive actors. Like home signers, second-generation ABSL signers consistently produce sentences in which predicates appear in final position, but unlike home signers, they produce longer sentences with two or more nominals appearing before the predicate. Second-generation ABSL signers are exposed to sign language from an early age and have more opportunity for extended sign language interaction with peers and adults than home signers.

Of greater significance to us than any particular word order is the discovery that, very early in the life history of a language, a conventionalized pattern emerges for relating actions and events to the entities that perform and are affected by them, a pattern rooted in the basic syntactic notions of subject, object, and verb or predicate. Such conventionalization has the

Table 1. Constituent order in ABSL and surrounding languages

Language	Sentential constituents	N-modifier order	Negation	N-numeral order
Spoken Arabic dialect	S–V–O	N-modifier	Negation-head (split negation)	Numeral-N
Classical Arabic	V–S–O	N-modifier	Negation-head	Numeral-N
Hebrew	S–V–O or V initial	N-modifier	Negation-head	Numeral-N
ISL	S–V–O, O–S–V, or S–O–V*	N-modifier	Negation-head or head-negation	N-numeral or numeral-N
ABSL	S–O–V	N-modifier	Head-negation	N-numeral

Major constituent order in ABSL differs from that of any surrounding language. Within constituents, head–modifier order in ABSL is consistently head-initial, whereas the order varies in the surrounding languages, depending on the modifier.

*S–O–V word order in ISL is quite rare.

effect of liberating the language from its context or from relying on the semantic relations between a verb and its arguments. If a language does not have a conventionalized word order, a sentence such as “Kim Jan kiss” is ambiguous; it can mean either that Kim kissed Jan or that Jan kissed Kim. Once languages have had time to accrue such mechanisms as verb agreement, marking properties of subject or object, or case marking on noun to indicate their relation to the verb, the roles of participants can be made clear, even without consistent word order. In the absence of such mechanisms, word order is the only way to disambiguate a message linguistically. The appearance of this conventionalization at such an early stage

in the emergence of a language is rare empirical verification of the unique proclivity of the human mind for structuring a communication system along grammatical lines.

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1. Bickerton, D. (1981) *Roots of Language* (Karoma, Ann Arbor, MI).
2. DeGraff, M. (1999) *Language Creation and Change: Creolization, Diachrony and Development* (MIT Press, Cambridge, MA).
3. Kegl, J., Senghas, A. & Coppola, M. (1999) in *Language Creation and Language Change: Creolization, Diachrony, and Development*, ed. DeGraff, M. (MIT Press, Cambridge, MA), pp. 179–237.
4. Senghas, A., Kita, S. & Ozyurek, A. (2004) *Science* **305**, 1779–1782.
5. Groce, N. E. (1985) *Everyone Here Spoke Sign Language: Hereditary Deafness on Martha's Vineyard* (Harvard Univ. Press, Cambridge, MA).
6. Scott, D., Carmi, R., Eldebour, K., Duyk, G., Stone, E. & Sheffield, V. (1995) *Am. J. Hum. Genet.* **57**, 965–968.
7. Kisch, S. (2004) in *Genetics, Disability and Deafness*, ed. Van Cleve, J. V. (Gallaudet Univ. Press, Washington, D.C.), pp. 148–173.
8. Meir, I. & Sandler, W. (2004) *safa bamerxav: eshnav lesfat hasimanim hayisraelit (Language in Space: A Window on Israeli Sign Language)* (Univ. Haifa Press, Haifa, Israel).
9. Lane, H., Pillard, R. & French, M. (2000) in *The Signs of Language Revisited: An Anthology to Honor Ursula Bellugi and Edward Klima*, eds. Emmorey, K. & Lane, H. (Erlbaum, Mahwah, NJ), pp. 77–100.
10. Jackendoff, R. J. (1987) *Linguist. Inq.* **18**, 369–411.
11. Nespors, M. & Sandler, W. (1999) *Lang. Speech* **42**, 143–176.
12. Selkirk, E. (1984) *Phonology and Syntax* (MIT Press, Cambridge, MA).
13. Nespors, M. & Vogel, I. (1986) *Prosodic Phonology* (Foris, Dordrecht, The Netherlands).
14. Ekman, P. & Friesen, W. V. (1978) *Facial Action Coding System* (Consulting Psychologist, Palo Alto, CA).
15. Dryer, M. S. (1996) in *Handbook on Syntax*, ed. Jacobs, J. (Walter de Gruyter Publishing, Berlin), Vol. 2, pp. 1050–1065.
16. Bickerton, D. (1984) *Behav. Brain Sci.* **7**, 173–203.
17. Newmeyer, F. J. (2000) in *The Evolutionary Emergence of Language: Social Function and the Origins of Linguistic Form*, eds. Knight, C., Studdert-Kennedy, M. & Hurford, J. (Cambridge Univ. Press, Cambridge, MA), pp. 372–388.
18. Aronoff, M., Meir, I., Padden, C. & Sandler, W. (2004) in *Yearbook of Morphology*, eds. Booij, G. & van Marle, J. (Kluwer–Academic, Dordrecht, The Netherlands), pp. 19–39.
19. Goldin-Meadow, S. & Mylander, C. (1998) *Nature* **391**, 279–281.