Protolanguage in ontogeny and phylogeny

Combining deixis and representation

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We approach the issue of holophrasis versus compositionality in the emergence of protolanguage by analyzing the earliest combinatorial constructions in child, bonobo, and chimpanzee: messages consisting of one symbol combined with one gesture. Based on evidence from apes learning an interspecies visual communication system and children acquiring a first language, we conclude that the potential to combine two different kinds of semiotic element — deictic and representational — was fundamental to the protolanguage forming the foundation for the earliest human language. This is a form of compositionality, in that each communicative element stands for a single semantic element. The conclusion that human protolanguage was exclusively holophrastic — containing a proposition in a single word — emerges only if one considers the symbol alone, without taking into account the gesture as a second element comprising the total message.

Keywords: animal language, child language, bonobo, chimpanzee, evolution of communication, symbolic combination, holophrase, single-word utterances, two-word utterances, gesture

Bickerton's (1990) defines protolanguage as a form of language that is part of our biological heritage but lacks most of the formal properties of full-blown human language. Her uses modern-day "fossils" including early child language and the interspecies communication of chimpanzees as clues to reconstruct the protolanguage that evolved into modern human language. Bickerton begins his accounts of protolanguage with word combinations. However, utilizing data from ape and child language, we begin protolanguage with an earlier form of communication, single words. This is where the issue of holophrasis — a whole sentence contained in a sentence — can best be addressed.

Our thesis is that an important component of protolanguage "fossils" are the combination of two different types of element, deictic gestures — pointing,

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touching, reaching — plus representational symbols, defined as words, lexigrams (arbitrary visual symbols), and representational gestures. Representation differs from deixis in that representational elements are decontextualized (Volterra, 1987): they can carry the same meaning outside the particular situation in which they are used. Just as children produce representational gestures (for example, nodding 'yes'), as well as deictic ones (Capirci, Iverson, Pizzuto, & Volterra, 1996), so do our ape participants (for example, a wave toward the self meant 'come') (Greenfield & Savage-Rumbaugh, 1990).

At the early stages of child language, speech and gesture are primarily interrelated not through representational gestures, but through deictic ones (Pizzuto & Capobianco, 2005); similarly, in home sign, an extremely common type of combination is the combination of a deictic gesture and a representational one, the latter paralleling the representational nature of a word or lexigram, which is considered a two-sign sentence (e.g., Goldin-Meadow & Mylander, 1984). Later, both child and ape, raised in a symbol-rich environment, produce more complex types of protolanguage, involving more than one representational element (e.g., Bowerman, 1973; Greenfield & Savage-Rumbaugh, 1990; Greenfield & Smith, 1976). These are the kinds of productions on which Bickerton's (1990) analysis of protolanguage "fossils" focused.

This relationship between manual gesture and language is buttressed by the common neural substrate for grammars of action and for linguistic grammar in circuitry involving Broca's area in the human brain and the Broca's homologue in nonhuman primate brains (Greenfield, 1991). It is also buttressed by the discovery in Broca's area of mirror neurons and their utility for processing both manual action and linguistic communication (Greenfield, 2006; Molnar-Szakacs, Kaplan, Greenfield, & Iacoboni, 2006; Rizzolatti & Arbib, 1998)

Combinations of deixis and representation indicate that single elements that are frequently considered holophrastic are actually compositional. Similarly, in child and ape protolanguage as well as in full-blown adult speech, "holophrastic" examples are seen where it is not that single words communicate multiple elements; instead, all elements but one are so obvious to speaker (and often hearer) that they do not need to be expressed. For example, Vygotsky's famous example of a single word, "coming," uttered by one of a group of people waiting for a bus (Vygotsky, *); the bus is taken for granted in this situation and therefore does not need to be expressed.

An example from our own data illustrates the holophrastic analysis of early single-word utterances in child language: child points to his close friend's empty bed and says her name, "Lara." According to the classical holophrastic analysis (Stevenson, 1893; de Laguna, 1927; Guillaume, 1927), the word Lara contains a whole sentence. Greenfield & Smith (1976) challenged this holophrastic analysis

and decomposed the communication into word plus nonverbal element. Thus, "Lara" is not a holophrase: its reference does not encompass either the concept of possession or the possessed object, her bed. The word "Lara" in itself has delimited reference; it refers only to his friend. Reference to the possessed object is constructed through the deictic act of pointing to the bed, a nonverbal semiotic element. This type of gesture–word combination has been termed *supplementary* because each element — gesture and word — adds new information (Goldin-Meadow & Morford, 1985; Capirci et al., 1996).

In the present paper, we extend this view from ontogeny to phylogeny, using a species comparative framework to make this same claim about ape language. We utilize cladistic analysis to develop an evolutionary reconstruction of the linguistic issue at hand; this reconstruction by its very nature provides indirect evidence concerning the evolutionary capacity for protolanguage. By examining behavior in the clade, (a group of species that all descended from a common ancestor) consisting of humans, bonobos, and chimpanzees, we can use similarities among all three sibling species as clues to what foundations of human language may have been present in our common ancestor five or six million years ago.

The historical study of Nicaraguan sign language (Senghas, 2003) can help to distinguish the biological aspects of language behavior (that may have been present in a common ancestor) from those that reflect the cultural development of humans as language users. In the absence of a sign-language model, deaf Nicaraguan children developed a signing system that has the basic characteristics of Bickerton's protolanguage, similar to the home sign developed by deaf children of hearing parents in the United States and China (Goldin-Meadow, 2003) and to pidgin languages. We take this as the linguistic limit of what can be developed without a cultural environment provided by language-using humans.

On the other hand, once these deaf children joined a school with older children — using sign in a communicative environment — the sign language codified and became more complex with each succeeding generation (Senghas, 2003). This also is similar to the development from pidgin to creole in the children are raised in a pidgin environment. We argue that this increasing complexity represents those aspects of language that require an environment provided by language users beyond the protolanguage level. Importantly, none of the phenomena described in this paper are beyond the initial complexity level of home sign and therefore may be relevant to the protolanguage of protohumans and to the common ancestor of our clade.

Additionally, the symbolic communication of the modern child and/or the ape — while influenced by input from a larger corpus that is mainly non-protolanguage — nonetheless can draw from and organize only that which its development can handle. Therefore it is likely representative of what our ancestors, with ape-like

brains, actually did. This view is supported by the finding that when young children imitate complex adult sentences; they reduced them to their own linguistic level of complexity (Slobin & Welsh, 1968).

How can the rearing of chimps and humans in a modern cultural environment shed light on the condition of human protolanguage before developments in language which themselves helped create that culture? One answer is that language evolved in a communicative environment. Therefore, the capacity of both children and apes to adapt to a communicative environment is an important part of what has evolved; this ability to acquire and learn a communication system can be assessed in any environment, including a modern cultural environment. We attribute the fact that humans create a much more complex culture than do apes to the fact that the cognitive (and presumably neural) capacity of apes is about at the level of a two year old child (Antinucci, 1989). Like apes, two-year-old children also do not have the capacity to create complex cultures.

We also maintain that many of the major characteristics of communication in the ape–human environment also exist in single-species ape environments without direct human intervention, suggesting that our common ancestor may have utilized similar communication, including: cultural traditions and transmission; a considerable repertoire of communicative gestures and vocal signals; combinations of gesture with another mode of communication; conventionalization of gesture; and use of deictic signals in intra- and inter- species environments (e.g., Goodall, 1986; Hofstetter, Cantero, & Hopkins, 2001; Hohmann & Fruth, 2003; de Waal, 1988; Katia, Call, & Tomasello, 2004; Pika, Liebal, & Tomasello, 2005; Plooji, 1978; Pollick & de Waal, 2007; Savage-Rumbaugh, et al., 1986; Whiten et al., 1999).

These same cognitive capacities allow apes to develop communicative skills while interacting with humans in a symbol-rich environment. At the same time, the representational nature and quantity of the lexigram symbols used in our studies likely actualize their symbolic and combinatorial capacities to a greater extent than in the wild, perhaps bringing the apes closer to protolanguage.

Method

Children

We present qualitative examples following the tradition in linguistics research, as well as quantitative data to indicate prevalence and lack of exceptionality. In addition to our own data, we draw heavily upon the published data of others to support the generality of the phenomena we describe. All of the child studies are

naturalistic investigations of early communication in context during the first year of language development (approximately one to two years of age). We draw on data from children acquiring English (Greenfield & Smith, 1976; Butcher & Goldin-Meadow, 2000; Morford & Goldin-Meadow, 1992; Ozcaliskan and Goldin-Meadow, 2005), Italian (Volterra et al., 2005), and home sign (Goldin-Meadow, 2003; Goldin-Meadow & Mylander, 1984). The oldest study, by Greenfield & Smith, utilizes a combination of maternal diary and observer notes as its data source; the others utilize video records. Additional methodological details are presented in the published reports.

Apes

Comparative data are presented from four bonobos (*Pan paniscus*) — Kanzi, Mulika, Panbanisha, and Nyota — and one chimpanzee (*Pan troglodytes*) — Panpanzee, who was co-reared with Panbanisha. The common rearing environment experienced by Panbanisha and Panpanzee leveled the environmental playing field, making it more likely that any observed differences would be biological. Note that, without human intervention, basic communication patterns of bonobos and chimpanzees are very similar (de Waal, 1988). We focus here on a few important points concerning method; other details are available elsewhere (e.g. Greenfield & Savage-Rumbaugh, 1990, 1991, 1993; Greenfield & Lyn, 2006; Lyn, Greenfield, & Savage-Rumbaugh, 2006).

All five apes were reared in a communicative environment consisting of English speech, gesture, and written visual symbols (lexigrams) placed on a keyboard. Point gestures used to indicate lexigrams differ from communicative gestures in that communicative points indicate the final referent. Earlier reports show that the apes are utilizing points to lexigrams not to refer to the lexigram symbol, but to its referent.

Human caregivers were not restricted in their use of gesture, and they did combine gesture with lexigram. However, our video analysis of 5½ hours of caregiver input to Kanzi indicated that the human caregivers were more restricted than Kanzi in the semantic relations they expressed in this way. These findings indicate a creative (vs. a rote) nature to Kanzi's combinations of gestural and representational elements. In addition, Kanzi and Panbanisha (bonobos) and Panpanzee (chimpanzee) made semantically based errors on vocabulary tests, very similar to the errors that humans make (Lyn, in press). Because incorrect usage was never modeled or trained, error data provided hard evidence that lexigram use was creatively constructed rather than performed by rote.

Kanzi, the first bonobo to acquire lexigram meanings, was exposed to lexigram communication later than the other apes and produced his first lexigram

at 30 months of age. The other ape participants were exposed to lexigram and English communication from birth and produced their first lexigram around 12 months of age.

We have quantitative data for Kanzi for five months, about 4½ hours per day, beginning at age 5½ years. We have a parallel quantity of data for Panbanisha and Panpanzee, beginning at age 3½ years, near the end of their co-rearing period. Because of our interest in creative combination, only spontaneous combinations were analyzed in the present paper. Immediate lexigram imitations (full or partial) and utterances structured by the caregivers (e.g., "Say that more clearly") were excluded from consideration here. Structured imitations made up 2.5% of Panbanisha's corpus (27,344 utterances) and 2.6% of Panpanzee's corpus (21,676 utterances); Imitations made up 7%, and 10%, respectively. Although Kanzi was older, the later onset of his lexigram communication and his rearing environment did not include other apes utilizing lexigrams could be interpreted to mean that the language of all three was at an equivalent level (Lyn, Greenfield, & Savage-Rumbaugh, under review).

Developmental databases of observer notes furnished our qualitative data. Panbanisha's and Panpanzee's databases started at one year of age, Mulika's database started at 1½ years of age, and Kanzi's database started at 4½ years of age. For Kanzi, we supplemented the database with published data analyses of his earlier productions from 2yr 6mo (when he produced his first lexigram) through 3yr 11 mo (Savage-Rumbaugh, et al., 1986). For Nyota, we utilized a developmental video database that began at age 1; our analysis of Nyota's data focused on the period before lexigram–lexigram combinations were constructed.

In a prior study, we assessed the reliability of real-time observer notes in comparison with coding from 4.5 hours of video (Greenfield & Savage-Rumbaugh, 1990). All communications noted in the real-time notes were also noted by the independent video observer. However, the real-time record was more conservative in that the observer missed some communications that were picked up from the video. Each example to be presented according to its source — observer notes or video record.

Combining gesture with and word or lexigram: Parallel phenomena in child and ape

Frequency of different kinds of two-element combinations

Gesture-word was by far the most frequent form of combination for the bonobo Kanzi at 5½ years of age. At 3½ years of age, the bonobo Panbanisha and the

Table 1. Frequency of gesture–lexigram and lexigram–lexigram combinations in five-month databases

	Kanzi (bonobo) Age 5½–6	**Panbanisha (bonobo) Age 3½–4**	**Panpanzee (chimpanzee) Age 3½–4**
Gesture+Lexigram (total)	439	253	294
with deictic gesture	399	172	274
with representational gesture	40	81	20
Lexigram+Lexigram (total)	277	389	351
TOTAL: 2-element combinations	716	642	645

chimpanzee Panpanzee produced more lexigram–lexigram combinations than gesture–lexigram combinations. Nonetheless, the absolute frequencies of gesture–lexigram combinations were large for all three apes (see Table 1), as they were for children learning Italian (Capirci et al., 1996).

Another similarity between child and ape data is that gestures are predominantly used for deixis and words or lexigrams are primarily used for representational purposes (Child data (Italian): Capirci et al., 1996; Pizzuto & Capobianco, 2005; child data (home sign): Goldin-Meadow & Mylander, 1984; ape data: Table 1).

In addition, six lexigram–gesture combinations were among Kanzi's 25 most frequent two-element combinations during the first 17 months of his symbol use (Savage-Rumbaugh et al., 1986, p. 225). These six gesture-lexigram types (each produced multiple times) were as follows (capital letters denote lexigrams, small letters denote gestures, here as elsewhere in this article):

CHASE person
BITE person
GRAB person
CHASE come
BALL pat(slap)
Person BITE

Four out of six of these combination types included deictic gestures (indicating a person); the other two were symbolic gestures describing an action (pat, come). In the case of "BALL pat", the gesture "pat" indicates the action, while the "BALL" lexigram indicates the object of that action. In the case of "CHASE come," "CHASE" requests a specific play action, while "come" requests the play partner to approach and get into position for the chase. All of these gesture-lexigram types are *supplementary* — gesture and word each have separate referents that supplement each other in constructing a predicate–argument relationship (Capirci et al., 1996).

Developmental sequencing

For Matthew and Nicky, Greenfield and Smith's two child participants, combinations of gesture and word preceded by many months the ability to combine two words together. In Matthew's case, there was a gap of more than five months between his first gesture–word combination at 10mo, 9days and his first two-word utterance at 15mo, 23days. Later researchers have found that word–gesture combinations precede two-word combinations for children acquiring English and Italian (Butcher and Goldin-Meadow, 2000; Goldin-Meadow & Butcher, 2003; Morford & Goldin-Meadow, 1992; Ozcaliscan & Goldin-Meadow, 2005; Volterra et al., 2005).

This pattern could hold for the bonobos as well. Nyota's first combination types were recorded in his video database. At the age of 1yr 8mo, when Nyota was using only a few lexigrams, several lexigram–gesture combinations were recorded in the course of an hour. No lexigram–lexigram combinations had yet been recorded.

We now turn to qualitative examples, with frequency data indicating their lack of exceptionality.

Indication

Indicative gesture–word combinations are termed *complementary* because the gesture helps locate and identify the referent of the word (Goldin-Meadow & Morford, 1985; Capirci et al., 1996). We use indication, the fundamental referential operation, to illustrate the complementary use of deixis and representation.

Children. From a very early age, gesture is used to indicate a referent, and the referent is expressed symbolically, with a word. Here is Matthew's earliest example:

(1) DA (dog) point
He says *da* (dog), pointing to a dog going down the street. (Matthew, age 10mo 9days, maternal diary)

In this example, *dog* is not a holophrase: its meaning does not "contain" more than the referent dog. However, the child has made a more complex message by combining gesture and word. Nicky produces similar constructions:

(2) SH (shoe) point
Pointing to his shoe. (Nicky, age 18mo 4days, observer notes)

Apes. Both bonobos and chimpanzees combine a deictic gesture with a representational symbol (visual lexigram rather than spoken word) to construct the same kind of indicative or naming relation. The two earliest bonobo examples were

produced by Panbanisha and Nyota (The term "point" is used for all indicative gestures, specifying gestural function rather than form). We utilize the definition of pointing provided by Kita: "The prototypical pointing gesture is a communicative body movement that projects a vector from a body part. This vector indicates a certain direction, location, or object" (Kita, 2003, p.1)

(3) MILK point
Pointing to a glass of coffee-flavored milk that was in a nearby bin. (Panbanisha, 4/25/1987, record 2, age 1yr 5mo, observer notes)

(4) M&M point
Although the caregiver has driven to Flatrock, a location in the Language Research Center woods, where M&Ms are supposed to be hidden; the bonobo knows that the M&Ms are hidden in the staff office. After searching at Flatrock, the bonobo then turns away and indicates the other direction (toward the buildings). He then leads her to the Staff Office and to the cupboard where the M&Ms are hiding. (Nyota, 12/10/1999, age 1yr 8mo, video)

This example of a complementary gesture-lexigram message is a mixture of the two pragmatic forces of indication and request. We return later to topic of requests.

Panbanisha produced the following indicative, directly reproducing Nicky's *shoe* example presented earlier:

(5) SHOE point
tapping my boot several times. (Panbanisha, 9/9/1989, record 16, age 3yr 9mo, observer notes)

Kanzi and Mulika made similar indicative combinations:

(6) Point POTATO
Pointing to potatoes. He showed no interest in having any right then, however. (Kanzi, 2/25/1987, record 27, age 6yr 4mo, observer notes)

(7) JUICE point
Pointing to the juice in the refrigerator. (Mulika, 12/1/1985, age 2yr 6mo, observer notes).

So did the chimpanzee:

(8) MONSTER point
Touching the monster mask. (She is not asking to do anything with it, just drawing attention to it) (Panpanzee, 6/22/1989, record 8, age 3yr 6mo, observer notes)

As with the child examples, in these cases a gesture is used deictically to indicate a referent, which is named. These messages an are not merely holophrases; at very least, each can be decomposed into gesture plus lexigram.

Frequency and generality. For Matthew, the frequency of indication reaches its height at 18mo, 18days of age; in 2 hours and 45 minutes, Matthew points at and names 6 different objects. For both boys, such examples continue through their last observation session, even when they have begun to combine word with word.

Analyzing the ape data, we find 11 instances of this construction in Panbanisha's five-month corpus, only 2 in Panpanzee's. However, gesture-lexigram constructions can be used to request as well as to indicate, for example:

(9) MULK ('milk') reach
Child reaches for milk, saying *mulk*. (Nicky, age 18mo 4days, observer notes)

Whereas requests were more common than indication for the apes, the reverse was generally true of children (Greenfield & Savage-Rumbaugh, 1993). Because chimpanzees in the wild announce the arrival of other creatures in their vicinity (e.g., Goodall 1986) and bonobos announce their travel routes (Savage-Rumbaugh, Williams, Furuichi, & Kano, 1996), we conclude that this difference is a matter of differential frequency, which could have been shifted since the *Pan-Homo* split through natural selection. What is most important for present purposes, however, is the underlying competence shown by all species in combining deixis and representation to make reference.

Agent–action relation

As children and apes develop, semiotic combination grows beyond *complementary* to *supplementary* uses of gesture (Volterra et al., 2005). In supplementary use, gesture and word convey different information. We present agent–action as an example of a supplementary relation that is constructed by combining gesture and symbol.

Children. Here is Nicky's first message in which he encodes action with a word and agent by means of a gesture:

(10) DANCE point
Pointing to a picture of a bear dancing (Nicky, 22mo 21days, observer notes)

Matthew produces a similar example:

(11) EAT point
Pointing to a porcupine on TV who is eating (Matthew, age 17mo 13days, observer notes)

Apes. In similar fashion, the chimpanzee uses a lexigram to represent the action and a deictic gesture to specify the actor. In the next example, communication is between bonobo and chimpanzee, not between human and ape.

(12) CHASE point
Pointing to Kanzi's foot, wanting Kanzi to chase her. He obliges. (Panpanzee, 12/2/1987, record 18, age 1yr 11mo, observer notes)

The bonobos in our study create similar combinations, for example:

(13) Gesture (touching person) TICKLE
Touching Experimenter 2, wanting her to tickle. Experimenter 2 obliged. (Panbanisha, 12/21/1987, record 4, age 2yr 0mo, observer notes)

Frequency and generality of agent(gesture)+action(symbol) combinations. This construction was frequent among all children and apes. In five-months, Kanzi produced 12 types and 122 tokens. In five months, bonobo Panbanisha constructed 9 types and 42 tokens, while chimpanzee Panpanzee produced 10 types and 24 tokens.

Children also produce this construction with some frequency. For Nicky, this construction achieved its highest frequency at 22mo 21days, when, in three hours, he produced four types and five tokens of this construction. Matthew produces this construction again at 15, 17, and 18 months of age.

Generalizing to children, Goldin-Meadow (2003) reports an example in one of her deaf children of hearing parents that is extremely similar to Nicky's.

(14) DANCE (sign) point
David points to a picture of a bear who is dancing.

The generality also extends to children learning to speak English (Goldin-Meadow & Butcher, 2003) and Italian. Volterra et al. (2005) report the following example:

(15) NANNA ('sleep') point
Pointing to pigeon (video)

Agency: A holophrastic exception? Children often take themselves for granted as agents (Greenfield, 1982); when talking about their own actions at the one-word stage, they do not bother to specify themselves as agent by utilizing a gesture, for example:

(16) KICK
Kicking in the air (Nicky, 22mo 21days, observer notes)

During three hours, there are 17 such examples, 13 of which involve his own actions. Matthew produces many similar examples:

(17) EAT
Eating his egg (Matthew, 19mo 21days, observer notes)

During 3¼ hours, Matthew produced 11 such constructions, all concerning his own actions. Tomasello (2000) would call this holophrasis, based on interpretation of a global semantic intention. However, this interpretation would require evidence that self is part of what the child intends to communicate to another, as opposed to simply an assumption for oneself. However, this interpretation is problematic because, in any situation, one can always say that more contextual elements are present than are linguistically realized.

Object associated with another object or location

Both children and apes combine deictic and representational elements to communicate that an object is associated with a specific location or with another object. This is a supplementary relationship between two different arguments.

Children. Here is Matthew's first example:

(18) CACA (cracker, cookie) point
Pointing to the door to the next room where cookies were kept (Matthew, age 14mo 29 days, maternal diary)

Here, gesture specifies a habitual location and word specifies a desired object that occupies that location. Concerning the holophrastic issue, *caca* by itself refers only to "cookie;" it does not have the larger meaning of "cookie in the next room." However, word combined with gesture does carry this more complex meaning.

An example from Nicky:

(19) MILK reach
Reaching for an empty glass (Nicky, age 19mo 29 days, observer notes)

Here a reaching gesture specifies the glass as a location, as well as his desire for the milk, while the word *milk* denotes a substance that he wants in or is often found in that location. Again, the *milk* is not a holophrase in that it does not "contain" the meaning of "milk in glass" or "want milk in glass", but word plus gesture does convey that meaning.

Apes. In the next example, Mulika uses a gesture deictically to specify location; she uses a lexigram to specify a desired object she expects at that location.

(20) MELON point
Gesturing in the direction of Scrubby Pine Nook, wanting to look for melon there. (Mulika, 9/20/1985, age 1yr 9mo, observer notes)

Frequency and generality. Neither Nicky's example nor Matthew's is an isolated one; Matthew's. At 22mo 21 days, Nicky produces seven types and eight tokens of this construction in three hours. At 16mo 2days, Matthew, in 2 hours 55 minutes, produces five types and six tokens. In three separate child studies, Morford & Goldin-Meadow (1992), Goldin-Meadow & Butcher (2003), and Ozcaliskan & Goldin-Meadow (2005) have found gesture-word constructions expressing the association between an object and its habitual location.

Sources of ape–child differences in gesture–symbol combinations

While there are species differences in our data, all three species begin their symbolic constructions by combining deixis and representation to "compose" more complex meanings. These meanings include both complementary and supplementary use of gesture. The *Pan-Homo* differences in combining one deictic element with a representational one relate mainly to content; content differences relate, in turn, to differences in the species way of life.

Unique to human children: Constructing messages indicating possession

Perhaps because permanent possession of objects is more important in the human than the ape way of life (and especially in our culture), this relationship is constructed by children, but not by apes (despite the fact that they do use lexigrams to name people and apes). In our opening example, Nicky used the word *Lara* pointing to Lauren's empty bed. We found no such examples in the ape *corpora.*

Deixis plus representation as a dynamic force in language ontogeny: Implications for protolanguage

Greenfield & Smith (1976) established that nonverbal elements in a message — most notably gesture — at the one-word stage were later incorporated into two-word utterances. This implied a dynamic role for gesture–word combinations in expanding an ontogenetic protolanguage. In a direct test of this dynamism, Ozcaliskan and Goldin-Meadow (2005) found that the types of supplementary combinations children produced changed over time and presaged changes in their speech. Gesture–word combinations also predict later vocal production in children learning Italian (Capirci et al., 1996). This dynamism could also have been a motor for the phylogenetic expansion of protolanguage in evolution. This analysis is consonant with our argument for the compositionality of protolanguage — the gestural signifier is transformed into a symbolic signifier.

Because the lexigram-using apes were raised in an interspecies communication situation, one can think of them as using their native communicative capacities (those utilized in intraspecies communication in the wild) to learn a foreign protolanguage (the humanly devised lexigram system). It is these protolinguistic *learning capacities* that are relevant to the evolution of language. As we do not have language fossils, cladistic analysis is our best tool for reconstructing behavioral evolution (Parker & McKinney, 1999). When one finds behavioral capabilities in a clade descended from a common ancestor, the potential for these behaviors likely existed in the common ancestor as well.

The main point is that in all three species the first semiotic combinations are between a deictic gesture and a representational element (word, lexigram or representational/symbolic gesture). The larger implications for language evolution may be the same as the implications for ontogeny: language neither developed out of gesture (Corballis, 2003); nor did it develop by speech alone (Lieberman, 1984). Instead, it may have evolved as a communication system with equipotential modalities designed to integrate deixis and representation.

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