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Comparing communicative competence in child and chimp: the pragmatics of repetition*

PATRICIA M. GREENFIELD
University of California, Los Angeles

AND

E. SUE SAVAGE-RUMBAUGH
Georgia State University and Yerkes Primate Research Center, Emory University

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ABSTRACT

Through an analysis of chimpanzee–human discourse, we show that two *Pan troglodytes* chimpanzees and two *Pan paniscus* chimpanzees (bonobos) exposed to a humanly devised symbol system use partial or complete repetition of others' symbols, as children do: they do not produce rote imitations, but instead use repetition to fulfil a variety of pragmatic functions in discourse. These functions include agreement, request, promise, excitement, and selection from alternatives. In so doing, the chimpanzees demonstrate contingent turn-taking and the use of simple devices for lexical cohesion. In short, they demonstrate conversational competence. Because of the presence of this conversational competence in three sibling species, chimpanzees, bonobos, and humans, it is concluded that the potential to express pragmatic functions through repetition was part of the evolutionary history of human language, present in our common ancestor before the phylogenetic divergence of hominids and chimpanzees. In the context of these similarities, two interesting differences appeared: (1) Human children sometimes used repetition to stimulate more talk in their conversational partner; the chimpanzees, in contrast, use repetition exclusively to

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forward the non-verbal action. This difference may illuminate a unique feature of human linguistic communication, or it may simply reflect a modality difference (visual symbols used by the chimpanzees, speech used by the children) in the symbol systems considered in this research. A second difference seems likely to reflect a true species difference: utterance length. The one- and two-symbol repetitions used by the chimpanzees to fulfil a variety of pragmatic functions were less than half the maximum length found in either the visual symbol combinations addressed to them by their adult human caregivers or the oral repetitions of two-year-old children. This species difference probably reflects the evolution of increased brain size and consequent increased memory capacity that has occurred since the phylogenetic divergence of hominids and chimpanzees four to seven million years ago.

INTRODUCTION

From the perspective of the field of child language, the study of the communicative and linguistic capabilities of chimpanzees has two distinctive contributions to make. The first is to provide evidence concerning the evolutionary background of human language. The second is to provide evidence concerning the unique features of the human capacity for linguistic communication and its development. Our comparison of the communicative functions used by children and chimpanzees contributes to both areas. The similarities between three sibling species, humans (*Homo sapiens*), chimpanzees (*Pan troglodytes*), and bonobos or pygmy chimpanzees (*Pan paniscus*), contribute to an understanding of the ancient phylogenetic background of human linguistic communication in general and child language in particular, while the differences aid in identifying some of the distinctive features of human language, features that have evolved since the divergence of hominids from chimpanzees in more recent evolutionary history.

The research to be reported provides symbol-rich environments for primates with whom human beings share 99% of their genetic material (King & Wilson, 1975). Commonalities in communicative functions under these conditions indicate a common potential to develop these functions when stimulated by the social environment – a potential likely to have been derived from our common phylogenetic ancestor. This conclusion follows from an important evolutionary principle: when competencies are found in all sibling species, they are likely to be found in the ancestral species as well (Parker, 1990), all the more when there have not been environmental pressures toward convergence after the species differentiated. Indeed, humans and chimpanzees have not been subject to such pressures for convergence, for they have been living in increasingly divergent environments since the split in our family tree at some point between four and seven million years ago. An evolutionary reconstruction from contemporary

behavioural evidence can never be certain. Nonetheless, the logic of evolutionary thinking indicates that, in so far as we find common communicative skills in all three sibling species, the genetic POTENTIAL (although not necessarily the actualization) of these skills was likely present in our common ancestor.

With respect to the unique features of human linguistic communication, the differences between humans and chimpanzees are particularly revealing, given the circumstances of these studies (a human communicative environment for all three species) and the results to be reported (a number of similarities in communicative function shared by all three species). In such a context, DIFFERENCES that set humans apart from the two species of chimpanzee suggest features of human linguistic communication that are likely to have developed AFTER human beings evolved as a distinct species. As such, these features become good candidates for unique qualities of human language. By (1) comparing members of three sibling species, all raised in human communicative environments, and (2) using analytic methods that set differences against a background of similarities, our research is able to provide more rigorous evidence than other designs concerning unique qualities of human linguistic communication.

Conversely, methods of child language research can illuminate questions concerning chimpanzee symbol use. Discoveries in the field of ape language have stimulated much debate concerning whether apes do or do not have language. (The term 'ape' includes chimpanzees (two species), gorillas, and orangutans.) However, the field of child language is capable of replacing unresolvable arguments with a more fruitful and constructive perspective, the developmental approach. Language does not appear full-blown in the human child. It develops quite gradually. Would we want to say that a one-year-old child has language? A two-year-old? A five-year-old? A ten-year-old? Clearly this would be a rather fruitless discussion. It is similarly fruitless to ask if apes taught humanly-devised symbol systems DO or DO NOT have language. More fruitful in the case of both child and ape is to ask what elements of language are present, what elements are absent at a particular point in development. More specifically, we need to look for parallels between ape language and human language IN THE EARLIEST STAGES OF DEVELOPMENT, and, if we can establish these, see how far the apes can travel on the developmental path to full-blown human language. This comparative developmental perspective is the context for the research that follows.

Up to now, the comparative study of communication and language in children and apes has focused almost exclusively on grammar and semantics. In this article, we focus instead on repetition and its pragmatic role in communicative and conversational competence. There have been five earlier articles reporting on the pragmatic competence of apes, three on chimpanzees (Van Cantfort & Rimpau, 1982; Fouts, Fouts & Schoenfeld,

1984; Greenfield & Savage-Rumbaugh, 1984), one on a gorilla (Paterson, Tanner & Mayer, 1988) and one on an orangutan (Miles, 1990).

Contrary to the view developed in child language by Ochs Keenan (1977), the ape language literature conflates repetition with imitation, assuming that all repetition serves the function of imitation: to produce a copy. Repetition in the symbol use of language-trained chimpanzees has therefore been looked upon as a negative factor, a trait which differentiates the symbol use of child and chimpanzee (Terrace, Sanders, Pettito & Bever, 1979; Sanders, 1985). (Because of the implicit assumption that all repetition is imitative in function, the ape literature uses 'imitation' rather than 'repetition' as a general term; we shall, however, follow accepted practice in child language, using repetition as the general term.)

As Ochs Keenan (1977) has pointed out, there has been a confusion between form and function in the very use of the term imitation. While the word seems to denote a particular FUNCTION – the intention to copy a model, it has been assumed that all instances of the FORM of repetition – the repeating of a conversational partner's previous utterance – involve the function of imitation. Instead, Ochs Keenan (1977) proposes that repetition be considered as a category of linguistic FORM which can serve many diverse PRAGMATIC FUNCTIONS in a conversation. Imitation is but one of these functions. This conceptualization provides the framework and terminology for the present study.

At the same time a repetition serving a particular pragmatic function can have a role in the larger discourse structure. A repetition ratifies a topic as shared 'old' information, a candidate for a subsequent comment (Ochs Keenan, 1977). In this way, repetition provides unity or cohesion in a conversation (Halliday & Hasan, 1976; Keller-Cohn, 1979). A secondary focus of our research will be on the role of repetitions in creating discourse structure.

An assumption behind the view in chimp language studies seems to be that repetition occurs in the absence of semantic knowledge or meaning (Sanders, 1985) and is therefore a rote response. Sanders (1985) tested the possibility that his chimpanzee, Nim Chimpsky, was using repetition to learn about the syntax and semantics of language, as children do (Bloom, Hood & Lightbown, 1974), but he concluded from his analysis that this was not the case. He went on to argue that the chimpanzee's linguistic repetition was most likely an operant response whose function was to obtain a reward (Terrace, Pettito, Sanders & Bever, 1979; Sanders, 1985). From this view it follows that, if language-trained chimps repeat others more than human children do, this would indicate a basic difference in the linguistic capacities of the two species.

Terrace *et al.* (1979), in their treatment of repetition, pointed out that there was, indeed, a quantitative difference in repetition between human children

and his chimp, Nim Chimpsky, with Nim repeating others much more than the typical child. In fact, 44% of Nim's utterances, including expansions, were repeated from the preceding utterance (Sanders, 1985). However, ape language projects de-emphasizing drilling and emphasizing a naturalistic communication environment and meaningful communication (Patterson, 1981; Miles, 1983) have found lower rates of repetition than did Project Nim, which relied heavily on rote language drill as a teaching method. The implication is that reinforced rote language drill cannot lead to the meaningful use of symbols in a chimp, any more than it can in a child. Even Nim, when he was in a more natural conversational situation, repeated the signing of his partner much less (Sanders, 1985). Sherman and Austin, two chimpanzees whose language-learning environment was structured, but avoided an emphasis on rote drill, also manifest lower rates of repetition than did Nim Chimpsky (Greenfield & Savage-Rumbaugh, 1984). In addition, when not specifically focusing on the subject of repetition, child language researchers have often systematically deleted repetitions from their corpora, leading to a general underestimation of the rate of repetition in child language (Nelson, 1980; Van Cantfort & Rimpau, 1982). Therefore, rate of repetition cannot be taken as a line which separates the linguistic competence of human and ape.

However, the qualitative conceptualization of repetition by Terrace *et al.* (1979) and Sanders (1985) is also flawed as a basis for comparative analysis of the two species. In the child language literature, the view of repetition has been considerably broader than that of Terrace and colleagues. Repetition in child language has been of interest from a variety of points of view: as a manifestation of the symbolic function (Piaget, 1962), as a methodological tool for the study of grammatical development (Slobin & Welsh, 1973), as a mechanism of language learning (Bloom *et al.* 1974; Ramer, 1976; Lieven, 1977; Moerk, 1977; Landahl, Mishra & Gould, 1987), as a device for the expression of pragmatic functions in conversation (Ochs Keenan, 1977; McTear, 1978; Casby, 1986), and as means for the construction of coherent discourse (Ochs Keenan & Klein, 1975; Ochs Keenan, 1977; McTear, 1978; Keller-Cohen, 1979; Casby, 1986). It is on the last two of these that we focus in the present study.

The selectivity of repetition, a creative rather than rote process, has been emphasized in each of the roles of repetition considered by child language researchers. This perspective contrasts markedly with the much narrower and more negative perspective on repetition of Terrace *et al.* (1979). Although Sanders (1985) broadened his approach beyond the earlier article, he considered (and dismissed) only the language learning function in chimpanzee language. In studying the acquisition of communicative signals in colonies of chimpanzees, Tomasello, Gust & Frost (1989) have concluded that conventionalization, rather than imitation is the major method of signal learning. That is, chimpanzees do not learn a communicative gesture by

observing and imitating another animal using the gesture; instead, they use, often with abbreviation, a naturally occurring social action in a way that will be comprehended by their communicative partners.

Although repetition has not been the major focus of an investigation, there have been some clues suggesting there is a conversational use of repetition by chimpanzees in both captivity and the wild, with both humans and other chimpanzees as conversational partners. With captive chimps, Gardner & Gardner (1975) have examples of partial repetitions as a response strategy to *wh-* questions posed by humans. Drumm, Gardner & Gardner (1986) investigated the use of partial repetition of a human signing partner's utterance as a pragmatic device indicating positive response. Van Cantfort & Rimpau (1982) give an example of Washoe's conversational use of imitation with expansion with a human partner. Fouts, Fouts & Schoenfeld (1984) provide one example of a chimpanzee–chimpanzee conversation involving repetition. Although the researchers do not provide a pragmatic analysis, information concerning accompanying behaviour allows us to conclude that the repetition is being used to express agreement (see coding criteria below). With chimps in the wild, Goodall (1986) presents an example of a type of conversational exchange, the inquiring pant-hoot, in which one chimpanzee repeats the vocalization of another in order to provide a meaningful response. However, there has been no full-scale, systematic study of the pragmatic functions of chimpanzee repetition. This is one purpose of the present paper.

In all of its functions in child language, repetition seems particularly important at the early stages of language development (e.g. Rees, 1975; Bloom, Rocissano & Hood, 1976), although it still appears in adult speech (Ryan, 1973; Ochs Keenan, 1974; McTear, 1978). More specifically, the progressive decrease in the use of repetition to express pragmatic functions in conversation from age one (the one-word stage) to age three has been documented by Casby (1986), while repetition was found to be the first stage of verbal play discourse by both Garvey (1974) and Ochs Keenan (1977), with subsequent decline thereafter.

For the very young human child who still lacks complex syntax, repetition enables the language learner to take part in the conversation (McTear, 1978; Casby, 1986) and perform different speech acts (McTear, 1978). Repetition allows the child with limited linguistic means to provide relevant information in a conversation, thus participating in a process of contingent turn-taking (Casby, 1986). More specifically, repetition establishes a shared topic, a joint focus of attention, old information which may then be commented upon through the addition of new information (Ochs Keenan & Klein, 1975; Bloom, Rocissano, & Hood, 1976; Ochs Keenan, 1977; McTear, 1978). These advantages also hold true for an older child trying to acquire a second language (Keller-Cohen, 1979).

Our empirical research up to now has indicated that children and

chimpanzees share early aspects of pragmatic and syntactic development. For example, informativeness, an ontogenetically primitive interface between cognition and language in human children (Greenfield & Smith, 1976; Greenfield, 1980), functions in the same way in language-trained chimpanzees (Greenfield & Savage-Rumbaugh, 1984). In the area of grammar, Kanzi, a bonobo chimpanzee, has reached the level of a two-year-old child in his ability to learn and invent protosyntactic rules (Greenfield & Savage-Rumbaugh, 1990).

Repetition of others, both non-verbal and linguistic, is an ontogenetically primitive development in human children. In the area of non-verbal imitation, chimpanzees have been found to develop much like human children, as study of the first year of life of a cross-fostered chimpanzee has shown (Gardner & Gardner, 1988). In the wild, chimpanzees have been observed to attain the highest stage in the Piagetian sequence of sensorimotor imitation (Piaget, 1962). Stage VI, deferred imitation (Goodall, 1986). (In discussing Piaget, we follow his custom of using the term imitation, rather than repetition.) In Piaget's theory, Stage VI has special implications for language development, for it is interpreted as an index of the child's newly developed representational abilities.

But how do language-trained chimpanzees do on the more specifically linguistic forms and functions of repetition? In this article, we focus on their use of repetition to serve pragmatic functions in conversation. Our subjects are members of two chimpanzee species, *Pan troglodytes*, the more commonly studied chimpanzee, and *Pan paniscus*, also called the pygmy chimp or bonobo.

Through our analysis of chimp–human conversation, we will show that two *Pan troglodytes*, Sherman and Austin, and two *Pan paniscus*, Kanzi and Mulika, use partial or complete repetition of others' symbols, as children do: they do not produce rote imitations, but rather use repetition to fulfil a variety of pragmatic functions in discourse. Indeed, and most important, through their repetitions, they display conversational competence. In this conclusion, we support the work of Van Cantfort & Rimpau (1982) and Drumm, Gardner & Gardner (1986), while diverging from the assessment of Terrace and colleagues.

PRAGMATIC FUNCTIONS OF REPETITION IN HUMAN CHILDREN

Our method of analysis is based on Ochs Keenan's (1977) method of discourse analysis used with children to identify the pragmatic function of the repetition in each case.

Examples of pragmatic functions are CONFIRMING THE PRECEDING UTTERANCE, MAKING A COUNTER-CLAIM, REQUEST, and CHOOSING BETWEEN TWO ALTERNATIVES. Some examples from human children are presented in Table 1.

TABLE 1. *Uses of repetition by human children and their caregivers*[a]

CONFIRM/AGREE
(I) Twins, Toby and David, 2;9, with their nanny, Jill
Jill: And we're gonna build a fire.
David: Mmm.
Toby: Oh yeah, build fire (Ochs Keenan, 1977: 130).

(II) Child, 2;1
Researcher: (*to child*) Is the baby sitting down?
Child: Uhhuh, baby down. (Rodd & Braine, 1971)

(III) Matthew, 1;0
Mother: Is that the birdie?
Matthew: dird [bird] (*pointing to it.*)
(Greenfield, unpublished data)

EXCITEMENT
(IV) Twins, Toby and David, 2;9, with their nanny, Jill
Jill: And we're going to have hot dogs.
Toby: Hot dogs! (*excitedly*)
Jill: And soup.
David: Mmm soup! (Ochs Keenan, 1977)

CHOOSE ALTERNATIVE
(V) Katie, 1;2, with caregiver at infant daycare center.
(*Caregiver pretends to pour tea for both of them, and they pretend to drink it.*)
Caregiver: Are you full, or do you want some more?
Katie: More.
(Leddick, 1989)

COUNTERCLAIM
(VI) Twins, Toby and David, 2;9
David, You SILLY/ you SILLY/ you SILLY/ you SILLY/you SILLY/
Toby: YOU/ YOU silly/ YOU silly/ YOU silly/ NO YOU silly/ (Ochs Keenan, 1977; 131)

(VII) Twins, Toby and David, 2;10, at lunch
Toby: Piece bread then.
David: No piece bread/ piece bread/ it's gone. (Ochs Keenan, 1977: 136)

QUERY
(VIII) Twins, Toby and David, 2;11
David: My hands are cold.
Toby: Cold? (Ochs Keenan, 1977; 131)

DENIAL
(IX) Siobhan, 3;0
Father: You're going up to bed now.
Siobhan: I not going up to bed (McTear, 1978: 299).

SELF-REFERENCE
(X) Siobhan, 3;0
Father: And he's kicking the ball.
It's a big red ball.
Siobhan: I got a big ball (McTear, 1978:297)

MATCHING A CLAIM/VERBAL PLAY
(XI) Siobhan, 3;0
Father (*jocularly*): You're a wee tough/a nice wee girl/a wee scruff.
Siobhan: *You* a wee tough/a nice wee girl/a wee scruff (McTear, 1978: 299)

TABLE 1. (*cont.*)

IMITATION
(XII) Twins, Toby and David, 2;9, with their nanny, Jill
Jill: Aren't I a good cook? Say 'Yes, the greatest!'
Toby: Yes the greatest. (*Softly*)
Jill: That's right.
David: The greatest! (*loudly*) (Ochs Keenan, 1977:131)

ADULT REPETITION/CHILD CORRECTION
(XIII) Twins, Toby and David, 2;10, with their nanny, Jill
Toby: Put it Toby's room.
Jill: Toby's got a worm?
Toby: No/ put it Toby's room.
Jill: Toby's what?
Toby: Toby's room
David: Room (*simultaneous with Toby, above*) (Ochs Keenan, 1977: 134)

[a] Although McTear (1978) lists REQUEST as an important communicative function of repetition, particularly at the early stages of language development, neither he nor any other author supplies an example from child language. The same holds true for PERFORMATIVE PLAY. See examples (8) and (9) below for VERBAL PLAY and DENIAL.

Only in example XII is the purpose of the repetition to imitate. Even there, however, imitation is not rote or mechanical. Instead it is selective in a meaningful way. Whereas imitation was the least frequent use of repetition for Ochs Keenan's two children, it was the most frequent for Casby's (1986) subject. However, Casby may have had a more inclusive definition of imitation than Ochs Keenan. On the other hand, individual differences in the frequency of various USES of imitation may be as striking as the individual differences in the RATES of imitation, pointed out by Bloom *et al.* (1974).

Note that repetitions can be complete (as in example VI), partial (as in example VIII), or partial with expansion (as in example VII). The same is true for the chimps.

EXPLORATORY STUDY: REPETITION IN TWO *PAN TROGLODYTES* CHIMPANZEES

METHOD

Subjects and setting

The subjects were Austin and Sherman, two symbol-trained *Pan troglodytes*. At the time these data were collected, they were seven and eight years old. Their symbol system consisted of lexigrams – arbitrary geometric symbols. The symbols were produced as a visual video display by depressing keys on a vertically mounted keyboard. Names of a few researcher–caregivers were represented on two keys each, one a lexigram, the other a photo. The keys were linked to a computer which produced a printout of all symbol use. This record was supplemented by a data-coding device through which the 'speaker' was identified; certain other contextual notes were made by

the researcher-caregiver as the utterances occurred. In the present study, the records consisted of this computer printout, supplemented by detailed contextual notes made by the researcher.

Each chimpanzee had constantly available, on the keyboard, 100 lexigrams. The lexigrams stood for foods, other objects, locations, activities, and people. The chimpanzee could use any lexigram at any time, and the researcher-caregiver would comply with any request, if possible. In addition, the chimpanzee often used non-verbal means of requesting things that were not encoded on the keyboard. The researcher-caregiver was also sensitive to these requests and would honour them if possible.

Analysis

Ochs Keenan's analysis is well accepted in the field of child language. We shall now apply the same criteria and operational definitions to chimpanzee data. If this methodology is accepted in the case of children, it should also be acceptable for chimpanzees. However, this point needs to be stressed, as there has historically tended to be a double standard for assessing linguistic competence for children and chimpanzees. Recognizing this tendency, we have used more stringent methodological standards than have child language researchers. In addition to using symbolic discourse as evidence for intent, we also use the subsequent unfolding of the chimp's non-verbal behaviour to confirm the communicative intent being inferred. (Only repetitions with concordance between behaviour and the interpretation of pragmatic intention have been used in the data analysis.)

The data selected for the following analysis were collected before the analysis was conceived. The analysis itself was performed primarily by the first author, who was not present at, and played no part in, the teaching of the chimpanzees or the collection of the data. The data themselves were collected by the second author, who provided both the contextual descriptions of the events that co-occurred with word usage and the history of the subjects. At the period of these data, the second author was attempting to expand Sherman's and Austin's tool-use skills and vocabulary. The data centre on typical training sessions, and no attempt was made by the second author during these sessions to encourage the chimpanzees to encode anything other than tool names. The remainder of the symbolic events reflect the chimpanzees' own judgements about when to use symbols. In no case was any constraint placed on the chimpanzees' length of symbol strings.

Because the analysis presented here had not been developed at the time the data were collected, trainer bias, a pervasive suspicion concerning chimp language research, was, in the present study, totally absent. The interpretive categories used in the analysis were developed from the data themselves and formed the basis for the more formal coding system used in the main study. The system, as applied to Kanzi and Mulika's data in the main study, yielded

high reliability, to be reported later. The two authors, although not coding independently, were in agreement concerning all interpretations of Sherman and Austin's data presented here.

The specific days' data used in the analysis of repetition were randomly selected for a study of perceived variability and language use (Greenfield & Savage-Rumbaugh, 1984) according to the following constraints: (*a*) that the principal teacher-caregiver (the second author) be present almost all the time; and (*b*) that the data centre on the tool-use task. The data in this period included instances of unanticipated spontaneous symbol usage by the chimpanzee, and these occurrences were noted by the principal teacher in the daily records. The particular data selected for analysis of repetition were two sessions that were the focus of Greenfield & Savage-Rumbaugh (1984). Transcripts of most of each session were published in that article. For both Sherman and Austin, the data were recorded on 18 September 1981 and 27 October 1981. Most of Sherman's data came from the September session, most of Austin's data came from the October session.

When a chimpanzee repeated at least one lexigram symbol from the immediately preceding lexigram string addressed to him by a person or another chimpanzee, the utterance was counted as a repetition. Because all lexigrams were lexical rather than grammatical words and most lexigram utterances were very short, this definition was at an appropriate level of inclusiveness.

RESULTS

Data from Sherman and Austin revealed many of the same functions of repetition observed in children. These are summarized in Table 2.

TABLE 2. *Distribution of pragmatic functions of repetition in two chimpanzees* (Pan troglodytes) *during two observation sessions*

	Austin (age 7) (2 hr, 7 min)	Sherman (age 8) (2 hr, 18 min)
CONFIRM/AGREE	5	9
CONFIRM WITH SPECIFICATION	0	3
COUNTERCLAIM	0	5
CHOOSE ALTERNATIVE	1	0
COMMENT	1	0
REQUEST (or DESIRE)	6	0
IMITATION	0	0

Indeed, despite implications of rote imitation in the writing of Terrace *et al.*, it never seemed as though the function of a repetition was to copy, to imitate for its own sake. There was not one example of an imitative function in the sessions selected for Sherman and Austin.

The function of confirm/agree includes answering *yes–no* questions. Human children's use of repetition to respond to *yes–no* questions is shown in examples II and III in Table 1. In Sherman's data, for example, we find instances of using partial repetition to answer a *yes–no* question, just as children do. Example (1) illustrates this function. (In this example, as in the others, (QUESTION) indicates a lexigram symbol used to signal a *yes–no* question; hyphenated words indicate a single lexigram. Each example includes all of the conversational turns on a single topic.)

(1) Sherman: M&M.
Researcher: (QUESTION) GO SINK-ROOM M&M.
Sherman: SINK-ROOM M&M.
Researcher: YES
(*They go to get peanut m&ms, small, round chocolate-plus-peanut candies with a hard, coloured coating.*)

In this example, note how the human researcher is using repetition to make a communication check, just as the human adult did with the young child in example XIII of Table 1.

From a comparative perspective, it is quite significant that the method of partial repetition to answer *yes–no* questions is a definite stage (although not the final one) in human children's developing linguistic ability to answer such questions (Greenfield & Smith, 1976). If we consider only linguistic means of affirming, affirmation by repetition precedes affirmation by the use of '*yes*' in child language. (See example III in Table 1.) Sherman answered every one of the twelve *yes–no* questions posed by his teacher with a partial or complete repetition. In no case did he produce the 'yes' lexigram; this absence of 'yes' was typical for Sherman. In Austin's transcript, the teacher asked only two *yes–no* questions, and Austin answered each with an appropriate repetition. The informative quality of Austin's repetition is shown by the conversation in example (2):

(2) Austin: ORANGE-DRINK.
Researcher: ORANGE-DRINK GONE NO.
(QUESTION) STRAWBERRY-DRINK.
Austin: STRAWBERRY-DRINK.
(*The teacher then agrees that they will get strawberry drink and peanut butter in the sink-room.*)

Although Austin does use the 'yes' lexigram, he does not use it to answer *yes–no* questions. Indeed, he does not use 'yes' as a reply at all; instead he uses it to initiate a new topic. As observed over a period of time extending beyond this one session, 'yes' for Austin seemed to indicate he wanted agreement from his teacher concerning the fulfilment of a request.

Therefore, we can conclude that both Sherman and Austin repeat what is being queried in order to give an affirmative reply to a *yes-no* question. Like children, they do so at a point in their development when neither of them has begun to use 'yes' to serve this function. In other words, they do not SELECT repetition as a device to indicate agreement. It is their only possibility: repetition makes conversational agreement possible.

In example (3), Sherman uses repetition to both agree with and add specificity to the preceding utterance:

(3) (*In tool room*)
Researcher: (QUESTION) GO SINK-ROOM FOOD.
Sherman: GO M&M.
Researcher: YES.

In (4) below, the adult human teacher uses repetition to make a counter-claim, similar to the function repetition served for the child in example VII in Table 1. The chimpanzee Sherman also uses repetition in this way, as in (4):

(4) (*In tool room*)
Sherman: M&M.
Researcher: M&M GONE GONE GONE.
Sherman: SINK-ROOM FOOD M&M.
(*Suggesting they look in a different room, where M&Ms were usually found*)
Researcher: M&M GONE
(*Showing him the empty M&M bag*)

This example also illustrates the capacity of the chimpanzee to use repetition to specify a topic (old information) to which he adds a comment (new information). Indeed, in the above dialogue, both human and chimpanzee use this discourse strategy. Sherman first introduces the topic of M&M. In the next turn, the researcher ratifies this topic by repeating it and then adds new information (GONE). Sherman applies the same strategy in his next turn, once again using repetition to continue the M&M topic, but adding additional new information (SINK-ROOM).

Looking at the above dialogue from a formal perspective, we find a second stage of development beyond simple repetition: paradigmatic substitution (Garvey, 1974). In paradigmatic substitution, the speaker goes beyond simple repetition to replace a part of the partner's utterance with parallel new information. In the above example, Sherman replaces the researcher's comment or predicate (GONE) with his own (SINK-ROOM).

Looking at all repetition examples (not merely paradigmatic substitution) in which a REPEAT-ADD strategy was used (Bloom *et al.* 1976), we find that 63% of Sherman's and 62% of Austin's repetitions were instances of repeat-add; simple repetitions were in the minority for both.

The next example illustrates the use of repetition to make a comment:

(5) (*Austin is with two researchers, Sue and Liz*)
Sue: (GROOM. (*Austin is grooming himself.*)
(9 seconds elapse.)
Austin: GROOM. (*Sue is grooming him.*)
(14 seconds elapse.)
GROOM. (*Liz is grooming him.*)
(36 seconds elapse.)
GROOM. (*He is grooming himself.*)

Because the contextual notes indicate that grooming is already taking place when Austin produces GROOM, we infer that he is making a statement or comment, rather than formulating a request. From the comparative perspective, Ochs Keenan (1977) reports that she has found the commenting function in both children and adults.

Austin uses repetition to make a request, as in the following example:

(6) (*Sherman and Austin are in toolroom with two researchers, Sue and Liz*)
Sherman: SUE (*photo*) SINK-ROOM. (*He takes Sue's hand*).
Austin: SINK-ROOM OUT.
Liz: YES GO SINK-ROOM OUT LIZ AUSTIN.

As we shall see with the bonobos (*Pan paniscus*) in the main study, Austin uses repetition to choose from among several alternatives. This is illustrated by the following example. (The brackets indicate a probable 'slip of the hand'.)

(7) Austin: ORANGE-DRINK
Researcher: ORANGE-DRINK [SCARE] GONE
ORANGE-DRINK GONE
COKE
COKE
LEMONADE
Austin: AUSTIN LEMONADE
Researcher: YES SINK-ROOM GO GET LEMONADE

In response to Austin's request for orange-drink, the teacher states that the orange-drink is gone and then suggests two other possibilities. Austin uses partial imitation to select one of these alternatives, the lemonade.

This example also illustrates a function of repetition identified by McTear (1978) in child language: the introduction of self-reference (example X, Table 1). In the above example, Austin uses expanded repetition to relate lemonade, introduced by his conversational partner, to himself.

In sum, Sherman and Austin indicated that chimpanzees (*Pan troglodytes*) use repetition to achieve many of the same functions as children do. These findings became the background for a more extensive study of the pragmatics of repetition in two bonobos or pygmy chimpanzees (*Pan paniscus*), Kanzi and Mulika.

MAIN STUDY: REPETITION IN TWO *PAN PANISCUS* CHIMPANZEES

METHOD

Subjects and setting

Our subjects were two *Pan paniscus* chimpanzees, Kanzi and Mulika. Both were born in captivity and were raised by and with their wild-born mother in a physical setting which gave them access to 55 acres of forest. In contrast to Sherman and Austin, Kanzi and Mulika were not given structured, reward-based lexigram training. Instead, they were provided with a communicative environment similar to what children experience, with the addition of lexigram boards. A board was available at every location the chimpanzees frequented. Indoors, the keyboards were equipped with a speech synthesizer that produced the English gloss of the lexigram. Outdoors, the visual symbols were mounted on a portable board and were silent. Kanzi produced his first lexigram at age 2;6, Mulika at 1;0. At the time of the study, Kanzi was five years old, Mulika almost two.

Data base

The analysis was based on every lexigram the two bonobos produced during one month, that was either available in the written observational record or in written transcripts of the video record. If an animal used one or more lexigrams employed by the human (or chimpanzee) companion in the previous utterance, we scored it as a repetition. Approximately 2 1/2 hours of videotape recorded on three different days was used to test the reliability of the observational records. There was no significant difference in the rate of repetition between video or real-time observation, thus indicating that real-time coding of repetitions does not underestimate their rate.

As before, the method of analysis was based on Ochs Keenan's (1977) method of discourse analysis to identify the pragmatic function of the repetition in each case. As a reliability check, the two authors each coded 15 randomly selected repetitions according to the categories shown in Table 3. They agreed on 14 out of 15, or 93% of the category assignments.

RESULTS

Table 3 presents qualitative examples of each function which repetition served for Kanzi and Mulika.

TABLE 3. *Uses of repetition by pygmy chimpanzees* (Pan paniscus)[a]

(In the dialogues, small capital letters indicate lexigrams for the chimps, lexigrams plus spoken English for the humans; lower case letters indicate spoken English.)

CONFIRM/AGREE
Kanzi, age 5, with Kelly
(*With Kanzi on her shoulders, Kelly stops at the door leading outside to comment at the lexigram board.*)
Kelly: We are GOing to see the GIBBONS (*as per Kanzi's earlier request*).
Kanzi: GIBBON (*vocalizing* eh-uh *in agreement.*)

Mulika, age 2, with human caregiver/researcher, Kelly
Kelly: Let's see what's on TELEVISION.
Mulika: TELEVISION (*Then Mulika goes to the video deck and gestures to it, ready for Kelly to put a tape in.*)

Kanzi, age 5, with human caregiver/researcher, Rose
(*Kanzi has indicated that he is interested in looking in the refrigerator. Rose opens it and Kanzi points to a bowl of raspberries. Rose takes out the raspberries and uses the keyboard.*)
Rose: We will call these FOOD. (*This is because there is not a symbol for raspberries on the keyboard.*)
Kanzi: FOOD (*He does not indicate any desire to have the raspberries, however, but goes over and looks out of the window.*)

EXCITEMENT
Mulika, age 2, with human caregiver/researcher, Kelly
Kelly: GO A-FRAME (*informing Mulika of destination verbally and with lexigrams*)
Mulika: GO (*vocalizing excitedly*)

CHOOSE ALTERNATIVE
Kanzi, age 5, with human caregiver/researcher, Rose
Rose: You can either PLAY or watch TV.
Kanzi: TV (*Kanzi watches after Rose turns it on.*)

PROMISE
Kanzi, age 5, with human caregiver/researcher, Phil
You must be very GOOD when we GO OUTDOORS.
Kanzi: GOOD (*whimpering*) (*Then he hugs Phil to seal his promise*)

REQUEST
Mulika, age 2, with human caregiver/researcher, Sue
Sue: Look here Muli, look here! Look Muli I found PRIVET-BERRYs in our REFRIGERATOR.
Mulika: PRIVET-BERRY. (*Sue takes berries out of refrigerator freezer and offers Mulika one; she reaches out for it.*)

IMITATION/REQUEST[b]
Mulika, age 2, with human caregiver/researcher, Karen
(*Mulika reaches for Karen's coke*)
Karen: COKE (*showing Mulika the lexigram*)
Mulika: COKE

HUMAN REPETITION/CHIMP CORRECTION
Kanzi, aged 5, with human caregivers/researchers Mel and Karen
Kanzi: CHASE TICKLE (*gesturing to Mel*)
Mel: Should I CHASE and TICKLE Karen? (*gesturing to her*) (*communication check*)

TABLE 3. (*cont.*)

Kanzi: TICKLE CHASE, (*pulling Karen to Mel: indicating that he wants Karen to tickle and chase Mel, not vice versa*) (*correction*)

[a] As with human children (Table 1), repetition can occur with reduction (EXCITEMENT, CHOOSE ALTERNATIVE, PROMISE), with expansion (Kanzi uses gesture to expand the CORRECTION portion of last example and vocalization to expand the first CONFIRM/AGREE) or with no change (second and third CONFIRM/AGREE, REQUEST, IMITATION/REQUEST), relative to the lexigram (or lexigram plus gesture) model. Note, too, that Kanzi's human caregivers use repetition in the service of a communication check, as caregivers do with human children (Table 1, example XIII) (Brown & Bellugi, 1964).

[b] IMITATION/REQUEST differs from REQUEST in that the chimp's conversational partner deliberately elicits an imitated lexigram to elaborate upon a non-verbal request spontaneously initiated by the chimpanzee. In REQUEST, the repeated lexigram that functions to express a request is produced spontaneously, without any invitation to imitate from the conversational partner. REQUEST was less reliably coded than other categories.

Many of the functions are the same as those presented in Table 1 for human children (and their caregivers). CONFIRM, EXCITEMENT, CHOOSE ALTERNATIVE, IMITATION, and REPETITION/CORRECTION were also found in Table 1. An important point is that these functions do not occur exclusively in request or instrumental situations; in the last CONFIRM/AGREE example, Kanzi confirms an identification, without wanting the identified item (food).

It is interesting to note that the bonobos' vocalizations are interpreted by the researchers as illocutionary modulation of the message (see the first CONFIRM/AGREE, EXCITEMENT, and PROMISE). In this way they seem to serve the function of intonation or other paralinguistic features in human speech. Drumm *et al.* (1986) have established the use of specific *Pan troglodytes* vocalizations as differentiated responses to situations with positive or negative valencies. In Table 1, the children's intonation helps specify a particular communicative function in examples IV, VI, and VIII. The bonobo vocalizations have clearly become part of the interspecies communication process and surely deserve study in their own right.

Kanzi and Mulika show parallels with children's pragmatic uses of repetition beyond the examples in Table 1. Casby (1986) has identified request as one of the communicative functions served by children's repetitions (although he provides no examples); both Kanzi and Mulika often use repetition to accomplish a REQUEST function (see Tables 3 and 4). In addition, Kanzi and Mulika use one function of repetition, PROMISE, that is not mentioned in the child literature. However, PROMISE occurs only once for Kanzi and never for Mulika, so it may occur, but rarely, for human children as well.

However, there is a group of pragmatic functions of repetition that occur in children, but not in chimpanzees. Most of the group involves functions whose purpose is to elicit further verbalization or simply play with words. This is exemplified by the QUERY function (example VIII, Table 1). It also

includes GREETING (A: 'Hello.' B: 'Hello.') and REVERSING THE DIRECTION OF QUESTION (A: 'Well?' B: 'Well?') (Ochs Keenan, 1977). Other such functions are VERBAL PLAY (Father: (*feigned surprise*) 'You've got a banana.' Siobhan: 'You got a nana.' (*not true*); McTear, 1978) and PERFORMATIVE PLAY (repetitions of a series or parts of stories or rhymes, onomatopoetic repetitions; Casby, 1986). The following example from McTear (1978:300–1) illustrates how a child uses repetition in verbal play to keep a conversation going for its own sake:

(8) Siobhan: You.
Grandmother: You.
Siobhan: You. You bad girl. You bad girl.
Grandfather: You're a funny girl.
Siobhan: You funny girl.
Grandfather: You're a funny granddaughter.
Siobhan: (*laughs*)

A last function seen in children, but not chimpanzees is DENIAL:

(9) Mother: The driver's getting out.
Child: Out (*shaking head 'no'*).
Mother: They're not getting out? (Casby, 1986:133)

Table 4 presents a quantitative distribution of each function for each chimpanzee. The figures indicate that the quantitative results are quite similar for both animals. The only real difference is that Mulika imitated more in response to coaching from her caregivers in a request situation. The reason for this difference is that Mulika was younger and there was therefore more explicit teaching going on. When she wanted something and indicated it non-verbally, she would often be asked to imitate a lexigram to get it.

TABLE 4. *Distribution of pragmatic functions of repetition in two bonobo chimpanzees during one month*

	Mulika (age 2)	Kanzi (age 5)
CONFIRM/AGREE	37	46
EXCITEMENT	2	0
CHOOSE ALTERNATIVE	2	4
PROMISE	0	1
REQUEST (or DESIRE)	10	7
IMITATE/REQUEST	36	3
CORRECTION	0	1

Let us now consider the proportion of repetition that has a purely imitative function – that is, its purpose is simply to mimic the model. This is an important point of comparison because an assumption behind the critique

formulated by Terrace *et al.* (1979) and Sanders (1985) is that the sole function of a repetition is to imitate.

The only researcher to provide quantitative data on the distribution of various functions of repetition in a human child is Casby (1986). Based on longitudinal examination of one child, Casby found that the proportion of imitative repetitions at Stage I, the closest stage to Kanzi and Mulika, was 38%; her range at various stages was from 26 to 49%. Kanzi's proportion of imitative repetitions was much lower: 5%. Mulika's proportion of 41% was in the same range as Casby's (1986) subject. As mentioned earlier, in the much smaller sample for Sherman and Austin, they produced no imitative repetitions at all.

Almost all of the repetitions in Table 3 are single lexigrams. In some cases, they are exact repetitions of the researcher's lexigram (second and third examples of CONFIRM/AGREE, REQUEST, IMITATION). In other cases, they are reductions of a more complex lexigram utterance produced by the researcher. Clearly, the function of CHOOSE ALTERNATIVE intrinsically requires imitation with reduction. In one case (CHIMP CORRECTION), the chimpanzee imitated two lexigrams, but changed their order.

That example is particularly interesting because Kanzi also added new information to his repetition through paradigmatic substitution on the level of gesture. (His substitution involved the reversal of agent and object.)

In one other case, Kanzi utilized a more advanced discourse strategy; he not only repeated, but he also added new information. This example is particularly interesting because it involves conversation between the two chimpanzees, Kanzi and Mulika.

(10) Mulika: MILK (*request*)
Kanzi: MILK PEANUTS (*expanded request*).

None of Mulika's repetitions (out of a total of 87, see Table 4) involved lexigram expansion; only one of Kanzi's 62 repetitions (shown in Table 4) involved lexigram expansion. Sherman and Austin more frequently (63% and 62%, respectively) utilized more complex repetitions, expanding as well as reducing the model. Examples 3 and 4, above, are partial repetitions with both reduction and expansion.

In terms of the quantitative aspects of repetition, Mulika's repetition rate of 21% is well within the range of children between one and two just starting to talk (Goldin-Meadow & Mylander, 1984). Kanzi's rate of 6% for the period under study is similar to the figures of Bloom, Lightbown & Hood (1974) for children up to age three. Sherman's repetition rate of 17% and Austin's of 10% for a six-week period fall in between Mulika and Kanzi's rates of repetition. In line with the previously observed variations in rates of linguistic repetition (Patterson, 1981; Yeager, O'Sullivan, Autry & Ingersoll, 1981; Miles, 1983; Greenfield & Savage-Rumbaugh, 1984; Sanders 1985),

ape training and testing conditions – not differences between humans and chimpanzees – seem the most important factor in causing elevated rates of repetition.

GENERAL DISCUSSION

For the very young human child who still lacks complex syntax, repetition enables the learner of either a first or second language (Keller-Cohen, 1979) to take part in the conversation (McTear, 1978; Casby, 1986), perform different speech acts (McTear, 1978), participate in contingent turn-taking (Casby, 1986), establish and add to a shared topic (Ochs Keenan & Klein, 1975; Bloom, Rocissano & Hood, 1976; Ochs Keenan, 1977; McTear, 1978). Our analysis indicates that the same conclusion applies to chimpanzees trying to learn the language of another species. Repetition provides a way for a creature with limited linguistic means to carry on rather sophisticated conversational interaction (for example, see Sherman's negotiation, example 4 above).

The implication for the evolution of human language is that this process of using repetition and turn-taking to establish a joint focus of attention as the basis for communicative interaction is likely to have had an ancient evolutionary history, dating back at least to the common ancestor of *Homo sapiens*, *Pan troglodytes*, and *Pan paniscus*. It is likely to have appeared early in phylogenetic history, just as it appears early in the ontogeny of language.

Given that repetition has an important functional role in the development of discourse structure, a formal progression has been identified for children: from single repetition to repetition plus new information (Garvey, 1974; Ochs Keenan & Klein, 1975; Halliday & Hassan, 1976; Keller-Cohen, 1979). (In the study of discourse structure, the latter sort of repetition is considered to unify a text through the repetition of a key lexical item; this device is termed LEXICAL COHESION by Halliday & Hassan (1976), REPEAT/ADD by Bloom *et al.* (1976).) For the bonobos, Mulika and Kanzi, the more primitive simple repetition predominates. For the *Pan troglodytes*, Sherman and Austin, the addition of new information to the repeated lexical item or items is predominant.

Although Drumm, Gardner & Gardner (1986) do not present many examples, partial imitation with expansion seems to have been the norm for Tatu (age 5) and Dar (aged 4), both *Pan troglodytes*. This difference between the *troglodytes* and the *paniscus* could have been either because of a species difference or because there were more variables in the contextual situation, leading to longer utterances (Greenfield & Savage-Rumbaugh, 1984). Indeed, our earlier study (Greenfield & Savage-Rumbaugh, 1984) demonstrated that Sherman and Austin emphasized informative elements in their symbol use, and this principle applied to both repetitive and spontaneous utterances.

However, the more limited sample of *Pan troglodytes*' conversation, the stimulation to communicate new information provided by caregivers to Sherman and Austin, but not to Mulika and Kanzi, as well as possible species differences, make it difficult to evaluate the reliability or cause of this apparent difference. In any case, the greater use of lexical cohesion by the *Pan troglodytes* was not associated with more sophisticated grammatical competence. Indeed, Kanzi, a *Pan paniscus*, has shown the most sophisticated syntactic skills of any primate so far (Greenfield & Savage-Rumbaugh, 1990). Probably the most important point is that both simple repetition and lexical cohesion are discourse strategies that are present in closely related primate species. The capacity for the strategies, then, is likely to have an evolutionary history stretching back to before the first hominids. While such a capacity was clearly not actualized in lexigram conversation at that point in evolutionary time, other possible manifestations in our primate ancestors will be discussed later.

We found differences, as well as similarities, between children and chimpanzees in the arena of symbolic repetition. A principal difference was that repetitions were used by children, but not chimpanzees, to keep conversation going, to elicit further verbalization. This could be for purposes of obtaining information, as in a query, or for its own sake, as in verbal play. There is, however, more than one possible interpretation of this difference. Given a similar communicative environment, this difference could reflect the lesser tendency for chimpanzees to use symbols for their own sake, as opposed to using them to gain a practical objective (Greenfield, 1978; Terrace, 1985; Greenfield & Savage-Rumbaugh, 1990). This difference would make evolutionary sense, for human beings evolved human language on their own, whereas chimpanzees did not. This difference, in the context of so many conversational similarities, could show that motivation to keep a conversation going and to use language for its own sake is, among the primates, unique to the human species. On the other hand, informal observation has indicated that the bonobos do use their own vocalizations to keep conversations going. Therefore, the apparent species difference may simply be a function of the limitations of the visual lexigram modality used by the chimpanzees.

For chimpanzees, as for human children, repetition provides the first way to use symbolic means to express conversational functions. Where children later develop lexical and syntactic means for expressing pragmatic functions such as agreement (e.g. 'Yes, I agree'), the chimpanzees in this study did not. That is, they used symbolic means to RELATE to the conversational turn of a partner, but did not use symbolic means to REFER TO AND DESCRIBE this relationship (e.g. 'I agree'). This ability to use language to describe the relationship between speaker and conversational turn of another could be considered the most primitive level of metacommunicative functioning.

The most likely candidate for a true species difference in our data is a limitation on sentence length. Even with expanded repetitions, no chimp 'utterance' in our data approached the maximum length of the lexigram expressions of the human caregivers or, more important, the spoken repetitions of two- or three-year-old children (Table 1). Although previous analysis had indicated that the lexigram board constrained the length of lexigram combinations for the human caregivers, relative to spoken sentences (Greenfield & Savage-Rumbaugh, 1990), the human 'utterances' were still longer than the chimpanzee repetitions. As an example, Sherman and Austin used a maximum length of three lexigrams in the examples given; in the same dialogue, the maximum length used by the human caregiver/researchers was six lexigrams. The maximum length for a child shown in Table 1 is seven morphemes (example IX).

This species difference in utterance length occurred despite the fact that all of the chimpanzee subjects except Mulika were older and had been using symbols longer than the children who produced the longer sentences in Table 1. It has previously been observed that chimpanzee utterance length is more limited than that of developing children (Terrace *et al.*, 1979; Greenfield & Savage-Rumbaugh, 1990). A constraint on the development of increasing utterance length was seen within our own study in the fact that Kanzi, having used symbols for about one and a half years longer than Mulika, still produced repetitions that were primarily one lexigram long. Our best guess is that this difference reflects an overall difference between human and chimpanzee memory capacity, most likely due to a smaller brain in the chimpanzee.

As a totality, these differences – (1) the use of language to elicit a linguistic response, (2) the use of language to describe the relationship of self to the previous conversational turn of another, and (3) a developmental increase in utterance length – make us aware of significant features of child language we may often take for granted. These features make an important contribution to the communicative and linguistic power of mature human language.

In the words of Ochs Keenan (1977:133):

> We can say that in repeating the child is learning to communicate. He is learning not to construct sentences at random, but to construct them to meet specific communicative needs. He is learning to query, comment, confirm, match a claim and counterclaim, answer a question, respond to a demand, and so on. In short, he is learning the human uses of language, what Dell Hymes has called 'communicative competence (1972)'.

With the exception of the query, Ochs Keenan's conclusions hold for symbol-trained chimpanzees as well.

Amongst chimpanzees trained to use humanly-devised symbol systems, the presence of repetition in their symbol use has been used (especially by

Terrace *et al.* 1979) to argue that chimpanzees are quite different from human children in their ability to learn language. While differences between the symbol use of apes and humans certainly exist, our data indicate that repetition is an area where similarity outweighs difference. Through our analysis of chimpanzee–human discourse, we have shown that two *Pan troglodytes*, Sherman and Austin, and two *Pan paniscus*, Kanzi and Mulika, use partial or complete repetition of others' symbols, as children do: they do not produce rote imitations, but rather use repetition to fulfil a variety of pragmatic functions in discourse. Indeed, and most important, through their repetitions, they display conversational competence. Thus, the conversational competence of children just learning to talk reflects most clearly the phylogenetic history of conversational competence that is fundamental to mature human linguistic communication.

These findings demonstrate that researchers CANNOT use repetition to draw the line between human and chimpanzee capacities for language. If we apply the same operational definitions to the discourse of child and chimp, we find that the area of linguistic repetition is one in which continuity between the species is far more striking than discontinuity. Most important to understanding the evolution of human language, we conclude that the potential for conversational functions such as agreement, promise, and correction are an ancient part of the phylogenetic history of *Homo sapiens*, probably going back at least to the ancestral species shared by human beings and chimpanzees.

Perhaps most important, the chimpanzees use the various pragmatic functions of repetition as a tool to co-ordinate joint action, whether it be a travel route or an activity (as in the first two examples of Table 3). This function of conversational repetition illuminates still further the evolution of human language, for, as Bruner (1975) points out, the very evolution of language probably reflects the requirements of joint action.

Was the potential for the communicative use of repetition to co-ordinate joint action employed by our primate ancestors? Or was this capacity an evolutionary by-product of selection for some other characteristic (cf. Pinker & Bloom, 1990)? Observations of contemporary chimpanzees living in a communicative environment of conspecifics suggest the former conclusion. As mentioned earlier, Goodall (1986) describes repetitive dialogues of pant-hoots by chimpanzees (*Pan troglodytes*) in the wild; such sequences of call and repetition are used to locate and identify other chimpanzees at a distance. The animals use these exchanges to plan their direction of travel so as to join – or avoid – particular other individuals. Thus, repetitive dialogue in the vocal modality is indeed used by chimpanzees to co-ordinate joint action in the wild.

We may also consider our findings in the context of the role of imitation in the transmission of gestural communication in a captive chimpanzee

colony (Tomasello *et al.* 1989). When we do, parallels appear. Tomasello (1990) hypothesizes that emulation, the intentional copying of a goal or result, is more common in the social transmission of communicative signals from chimpanzee to chimpanzee than is pure imitation, the intentional copying of behaviour. For example, when chimpanzees learn to use leaf-clipping as an attention-getter from a conspecific, they emulate the goal of using leaves to make noise, but do not imitate the manner in which this is accomplished. Similarly, we have found the use of repetition to achieve a pragmatic goal in the conversation is more common than the use of repetition to copy behaviour. It may be that repetitive pant-hoot dialogues in the wild also involve emulation to achieve a pragmatic goal, rather than an intention to produce an exact copy.

While captive chimpanzees who have been raised without the stimulus of human enculturation and linguistic communication imitate results but not behavioral means, this is not true of Kanzi and other chimpanzees (both *Pan paniscus* and *Pan troglodytes*) who have been part of a language-rich human social system. Tomasello, Savage-Rumbaugh & Kruger (in unpublished work) find that chimpanzees who have received human acculturation, including competence in a humanly devised symbol system, are able to imitate as well as emulate; that is, they do not only copy ends, but also copy means in Tomasello *et al.*'s nonverbal problem-solving tasks. Similarly, in the symbolic repetition reported here, the animals, both *Pan troglodytes* and *Pan paniscus*, show themselves able to produce exact lexigram copies, as well as to reduce or expand a partner's previous lexigram utterance, in order to achieve a particular pragmatic result.

As for *Pan paniscus* in a captive colony, De Waal (1989) describes repetitive echoing in the use of high hoots among bonobos in a social group at the San Diego Zoo. Hence, the spontaneous vocal communication of both species of chimpanzee (*Pan paniscus* and *Pan troglodytes*) indicates that repetition plays a role. Another relevant piece of the evolutionary puzzle is evidence from biological anthropology that the modern bonobo may be a reasonable prototype for the common ancestor of humans, chimpanzees, and bonobos (Zihlman, Cronin, Cramer & Sarich, 1978). It is therefore not too hard to imagine that the genetic potential for expressing communicative functions by repetition was to some degree phenotypically realized in the ancestral species from which human beings and their language evolved.

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