

Experimental Conversations: Sign Language Studies with Chimpanzees

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Abstract Sign language studies of chimpanzees are a tool for studying the continuity between human behavior and behavior of other animals and between verbal behavior and other intelligent behavior. Cross-fostered chimpanzees paralleled children in their acquisition and use of signs and phrases. These procedures occurred under rigorous and systematic record keeping and experimental paradigms. The study of Wh-questions and the use of remote videotaping (RVT) are examples of experimental procedures. These revealed chimpanzee-to-chimpanzee signing and private signing. Face-to-face interactions between the chimpanzees and an interlocutor who presented various systematic probes is another experimental procedure. The chimpanzees adjusted to the interlocutor with revisions, new signs, or no response when appropriate. The hallmark of the sign language studies is that caregivers treated the chimpanzees as conversational partners socially motivated rather than experimental subjects bribed or forced into participation. These findings confirm continuity with differences of degree among species.

Keywords Sign language experiments • Project Washoe • Chimpanzees • Immersion learning

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1 Cross-Fostering

Nearly 40 years of research using various methodologies in a group of chimpanzees reveals discoveries about the remarkable capacities of this species. In these studies, creating comparable conditions between chimpanzees and humans has allowed valid comparisons between the two species.

Sign language studies of chimpanzees are a tool for studying the continuity between human behavior and behavior of other animals and between verbal behavior and other intelligent behavior. Gardner and Gardner used cross-fostering to study infant chimpanzees' acquisition of signs (Gardner & Gardner 1969). Cross-fostering is a procedure to study the interaction between environmental and genetic factors by having parents of one genetic stock rear the young of a different genetic stock. It seems as if no form of behavior is so fundamental or so distinctively species-specific that it is not deeply sensitive to the effects of early experience (Stamps 2003). Ducklings, goslings, lambs, and many other young animals learn to follow the first moving object that they see, whether it is their own mother, a female of another species, or a shoebox. The mating calls of many birds are so species-specific that an ornithologist can identify them by their calls alone without seeing a single feather. Distinctive and species-specific as these calls may be, they, too, depend upon early experience (Slater and Williams 1994; West et al. 1997). The development of the individual is dependent upon the interaction between both genes and environment.

How about our own species? How much does our common humanity depend on our common human genetic heritage and how much on the equally species-specific character of a human childhood? The question is as traditional as the story of Romulus and Remus and so tantalizing that even alleged but unverified cases of human cross-fostering, such as the wolf children of India (Singh and Zingg 1942) and the monkey boy of Burundi (Lane and Pillard 1978) attract serious scholarly attention. An experimental case of a human infant cross-fostered by nonhuman parents would require an unlikely level of cooperation from both sets of parents. In a few cases, however, chimpanzees have been cross-fostered by human parents (Kellogg and Kellogg 1933; Hayes and Hayes 1951).

2 A Conversational Laboratory

2.1 *Chimpanzees as Cross-Fosterlings*

In making discoveries about human behaviors, chimpanzees are an obvious first choice for cross-fostering, as they look and act remarkably like human beings and recent research reveals close and deep biological similarities of all kinds (Goodall 1986). In blood chemistry, for example, chimpanzees are not only the closest species to humans, but chimpanzees are closer to humans than chimpanzees are to

gorillas or to orangutans (Stanyon et al. 1986; Ruvolo 1994) and 98 % of human and chimpanzee DNA shares the same structure (Sibley and Ahlquist 1984; The Chimpanzee Sequencing and Analysis Consortium 2005). Cross-fostering a chimpanzee is very different from keeping one in a home as a pet. Many people keep pets in their homes. They may treat their pets very well, and they may love them dearly, but they do not treat them like children. True cross-fostering—treating the chimpanzee infant like a human child in all respects, in all living arrangements, 24 h a day every day of the year—requires a rigorous experimental regime that has rarely been attempted.

2.2 *Sign Language Immersion*

Allen and Beatrix Gardner reared the infant chimpanzees, Washoe, Moja, Tatu, Dar, and Pili, in a cross-fostering laboratory at the University of Nevada Reno. With the similarities between chimpanzees and humans, the Gardners hypothesized that the chimpanzees would acquire aspects of human culture if immersed in those aspects.

Washoe at about 9-months, followed by Moja, Pili, Tatu, and Dar within days of birth, entered a laboratory of rigorous cross-fostering. They had all the usual toys, games, and picture books that human infants get. They lived in quarters in which humans had lived, ate human food at tables from dishes with forks and spoons, and drank from cups. They also helped set and clear their tables, clean their quarters, and put away their playthings. They dressed and undressed themselves and used human toilets, wiping themselves, flushing, even asking to go potty during lessons and naptimes. Most important, at least one human member of their foster families stayed in close attendance throughout their waking hours. Never caged, they were as free as human infants to move about the world with supervision. When they slept, human family members listened on intercoms to comfort troubled infants during the night. (Gardner 2002: 624)

Caregivers integrated American Sign Language (ASL) into the procedure so that the chimpanzees were immersed in a sign language environment much like a human child is immersed in a speech environment. In teaching sign language to Washoe, Moja, Pili, Tatu, and Dar, caregivers imitated human parents teaching young children in a human home. They called attention to everyday events and objects that might interest the young chimpanzees, e.g., THAT CHAIR, SEE PRETTY BIRD, and MY HAT. Caregivers often molded the chimpanzees' hands in the shape of new signs as deaf parents do (Maestas and Moores 1980). The cross-fosterlings learned many signs by watching adults sign about interesting objects and activities (Gardner and Gardner 1989: 17–19). Caregivers asked probing questions to check on communication, and they always tried to answer questions and to comply with requests. They expanded on fragmentary utterances using the fragments to teach and to probe. They also followed the parents of deaf children by using an especially simple and repetitious register of ASL and by making signs on the youngsters' bodies to capture their attention (Maestas and Moores 1980; Marschark 1993; Schlesinger and Meadow 1972; Gardner et al. 1989a).

2.3 Deleterious Effect of Operant Techniques

While many experimental psychologists were putting rats and rewards in boxes to study learning, Gardner and Gardner discovered that operant techniques had detrimental effects on the desired behavior and often interfered with the task at hand (Gardner and Gardner 1989, p. 20).

... Washoe, Moja, Pili, Tatu, and Dar both learned and used the signs of ASL in an environment modelled after the living and learning conditions of a human household. We did not have to tempt them with treats or ply them with questions to get them to sign to us. They initiated conversations on their own, and they commonly named objects and pictures of objects in situations in which we were unlikely to reward them. (Gardner et al. 1989b: 23)

Rewards have a negative effect on children's behavior as well. For example, rewards suppress drawing in a classroom setting (Lepper et al. 1973).

2.4 Acquisition of Signs

Size of vocabulary, appropriate use of sentence constituents, number of utterances, proportion of phrases, and inflection all grew robustly throughout five years of cross-fostering. The growth was patterned growth and the patterns were consistent across chimpanzees. Wherever there are comparable measurements, the patterns of growth for cross-fostered chimpanzees paralleled the characteristic patterns reported for human infants (Gardner and Gardner 1994, 1998). Both chimpanzees and children used immature forms of the signs, generalized the early meaning of the signs, used negation (Gardner et al. 1989a), and inflected signs in questions and expression of person, place, and instrument (Chalcraft and Gardner 2005; Gardner and Gardner 1974, 1978; Rimpau et al. 1989).

3 Systematic Records

These procedures occurred under rigorous and systematic record keeping and experimental paradigms. The caregivers doubled as human observers and made systematic records of the chimpanzees' development in the form of diary records, inventories of phrases, and samples of utterances. There was rigor in these records; for example, signs were recorded with descriptions of their shape and use, each sign in the chimpanzees' vocabulary had to meet a criteria to be included, and periodically old signs were reassessed to make sure they were still part of the vocabulary (see Gardner et al. 1989a for review). Under meticulous conditions, Gardner and Gardner video recorded conversations between the chimpanzees and caregivers for later analysis (Gardner and Gardner 1973; Chalcraft and Gardner 2005).

Besides naturalistic observation, Gardner and Gardner also used systematic experiments (Gardner and Gardner 1984; Gardner et al. 1989b, 1992). These procedures including systematic controlled manipulation of independent variables were embedded in the daily routine making the chimpanzees' participation in the experiment no more forced than American children saying "trick-or-treat" on Halloween.

3.1 Wh-Questions

The study of Wh-questions is an example of an experiment in the cross-fostering laboratory. In Wh-questions, the critical word begins with wh such as whose, where, who, what, and why. "...in English, questions of this type correspond with individual declarative sentences in which there is one unknown, or *x* element, corresponding to some major grammatical constituent" (Brown 1973: 14). Wh-questions are used to study grammatical structure in the early linguistic development of children. Periodically throughout the cross-fostering project, systematic samples of replies to Wh-questions were recorded.

We embedded the sample of questions and replies into the normal stream of everyday conversation.... We avoided concentrated series of questions, as in a battery of tests. Sometimes, of course, a series of questions of different types fitted unobtrusively into the normal conversational context. (Gardner et al. 1992: 33)

Later analysis of these questions and responses revealed that the Washoe, Moja, Tatu, Dar, and Pili replied to Wh-questions with appropriate sentence constituents (Gardner and Gardner 1975; Gardner et al. 1992). Longitudinally, Moja, Tatu, and Dar followed the same developmental sequence in their responses to Wh-questions as human children (Van Cantfort et al. 1989). The Gardners made no sacrifice in rigor while testing grammatical skill in the chimpanzees.

3.2 Vocabulary Test of Communication

Since the chimpanzees frequently named objects, in another experiment Gardner and Gardner (1984) used naming to test whether the chimpanzees could communicate information otherwise unknown to a human observer. A hidden experimenter projected slides onto a screen that only the chimpanzee could see. There were two human observers: one with the chimpanzee and another hidden in a room with a view of the chimpanzee. The human observers could only see the chimpanzee signing and could not see the screen. The chimpanzee began a trial by sliding open a door or pressing a button, which made the slide appear. If the chimpanzee failed to sign, then the observer asked him or her to sign again. Gardner and Gardner (1984) described how the cross-fosterlings participated in the test.

Washoe, Moja, Tatu, and Dar were awake and accompanied by a human member of their foster family approximately 70 hr a week. During those 70 hr, the exposure to objects and the ASL names for objects was very great compared with the brief periods spent in vocabulary tests. Moreover, these tests were as different from the routines of the rest of their daily lives as similar testing would be for young children. For caged subjects, a session of testing is probably the most interesting thing that happens in the course of a laboratory day. For Washoe, Moja, Tatu, and Dar, most of the activities of daily life were more attractive than their formal tests. Nor could we starve them like rats or pigeons and make them earn their daily rations by taking test. Getting free-living, cross-fostered chimpanzees to do their best under the stringent conditions of these test required a great deal of ingenuity and patience. The basic strategy was to establish the testing routine, by a regular program of pretests that were kept short, usually less than 30 min, and infrequent, rarely more than two sessions per week. (Gardner and Gardner 1984: 385)

The agreements between the two observers and between the signs reported by the two observers and the correct name of the slide were high ranging from 70 to 95 %. Using a procedure that required voluntary chimpanzee participation, Gardner and Gardner showed that the chimpanzees could communicate novel information and that their signs were distinct and intelligible. Additionally, this procedure provided a control for cuing. Interlocutors can unwittingly lead subjects to correct or incorrect responses as the horse Clever Hans famously demonstrated (Gardner et al. 2011 for review). Controls for cueing are essential in tests of language and intelligence, and this study provided such a control.

4 Signing Among Chimpanzees

4.1 Leaving Reno

In 1970, Washoe left Reno with Roger and Deborah Fouts for the Institute of Primate Studies (IPS) at the University of Oklahoma. While Washoe was wild-caught by the US Air Force and arrived in the cross-fostering laboratory at about 9 months of age, Moja, Pili, Tatu, and Dar were born in American laboratories and each arrived in Reno within a few days of birth. Moja arrived in November 1972 and cross-fostering continued for her until winter 1979 when she left for IPS. In 1980, Washoe and Moja moved with the Fouts to the Chimpanzee and Human Communication Institute (CHCI) on the campus of Central Washington University in Ellensburg, WA. Tatu arrived in Reno in January 1976 and Dar in August 1976. Cross-fostering continued for Tatu and Dar until May 1981 when they left to join Washoe and Moja in Ellensburg. Pili arrived in Reno in November 1973, and he died of leukemia in October 1975.

4.2 Project Loulis: A Case of Transmission

The Gardners' studies utilized naturally occurring behaviors, which eliminated any need to coerce the chimpanzees into participation. These principles and procedures continued after the chimpanzees left Reno. The first of these studies began in 1979

at IPS in Oklahoma when Washoe adopted a 10-month-old son, Loulis. To show that Loulis would learn signs from Washoe and other signing chimpanzees without human intervention, experimenters restricted human signing when Loulis was present except for seven specific signs, WHO, WHAT, WHERE, WHICH, WANT, SIGN, and NAME. Humans instead used vocal English to communicate in his presence. Loulis began to sign in 7 days and at 73 months of age his vocabulary consisted of 51 signs (Fouts 1994b; Fouts et al. 1982, 1989b). At 15 months of age, he combined signs and the development of his phrases paralleled the cross-fostered chimpanzees and children (Fouts et al. 2002). In June 1984, the signing restriction around Loulis ended. The control showed ASL was easily acquired from other chimpanzees.

5 Remote Videotaping: A Method to Record

RVT was an observational technique used to record the behaviors of the chimpanzees with no humans present at CHCI. Initially, three cameras were mounted in a chimpanzee enclosure and focused on the chimpanzees' enclosure. Later, a fourth camera was added. The cameras were attached to television monitors and a VCR in another room away from the chimpanzees. Only one camera recorded at a time and the VCR operator could control which camera recorded. During recording sessions, no one entered the chimpanzee quarters, surrounding hallways, and adjacent rooms. All humans stayed out of view and kept silent, and all activities in the laboratory that might be a distraction ceased.

5.1 Chimpanzee-to-Chimpanzee Conversations

Data collection with RVT initially occurred during a 15-day period at the end of July and the beginning of August 1983 in a study that focused on Loulis' use of signs with Washoe, Moja, Tatu, and Dar. Every day during the 15-day period, the video cameras were turned on for two 20-min recording periods between the hours of 9:00 a.m. and 5:00 p.m. There were 45 recording periods so that each hour of the day was sampled randomly without replacement either five or six times. On the videotapes, there were 189 chimpanzee-to-chimpanzee signed interactions. Dar and Loulis were the most frequent dyad with 167 signed interactions, and Loulis and Tatu were the second most frequent dyad with 76 signed interactions. Most of the interactions occurred in the Affinitive Social (33 %) and Play (38 %) contexts (Jensvold and Gardner 2000; Jensvold et al. 2014).

5.2 Private Signing

In the 45 h of videotape, Fouts (1994a) reported 115 private signs that Loulis made when his face and body were not oriented toward another chimpanzee. In

a second analysis of the videotapes, Bodamer (1987) found 90 instances of private signing by the other chimpanzees. These were signs made in the absence of interactive behaviors such as looking toward another individual. Bodamer classified these into categories of private speech that humans use (Furrow 1984). A later study recorded 56 more hours of RVT and found 368 instances of private signing (Bodamer et al. 1994). In both samples, one of the most common categories of signing was Referential (59 % in the 56 h sample). In this category, the chimpanzee signed about something present in the room for example naming the pictures in a magazine. The informative category, an utterance that refers to an object or event that is not present, accounted for 12 % in the 56 h sample and 14 % in the 45 h sample. An example of this category was when Washoe signed DEBBI to herself when Debbi was not present.

One category of private signing was imaginative (Furrow 1984) and accounted for 17 instances in the 56 h of RVT. A later study recorded 15 h of RVT while the chimpanzees' enclosure was filled with toys. There were six instances of imaginary play classified into categories of imaginary play that human children use (Matthews 1977). There were four instances of Animation in which the chimpanzee treated an object as if it was alive. For example Dar signed PEEKABOO to a stuffed bear. There were four instances of substitution in which the chimpanzee treated one object as if it were another. For example, Moja wore a shoe and signed SHOE. She then removed the shoe, put a purse on her foot, and zipped it up (Jensvold and Fouts 1993).

RVT was a systematic data collection technique that controlled for cuing and provided a way to discover what the chimpanzees did without any human influence. It revealed various functional uses of signs, socially between chimpanzees, privately, and creatively. Other research manipulated independent variables within the context of the chimpanzees' typical daily signed interactions with their human caregivers.

6 Systematic Interactions with Human Interlocutors

6.1 *A Bottom-up Approach to Linguistics*

The tradition in theoretical linguistics is to examine syntax and semantics using a top down approach. Yet successful face-to-face interactions involve the orchestration of pragmatics and context as well as syntax and semantics evoking a bottom-up approach to questions in linguistics. More recent research in human adults and children systematically explores pragmatic and contextual appropriateness during the stream of conversation in a variety of ways including initiation of conversation, topic introduction and maintenance, turn taking, responses to questions, conversational repair and changes in conversational register (Abbeduto and Hesketh 1997; Ferguson 1998; Galski et al. 1998; Ripich et al. 2000; Duncan 2000; Pickering and Garrod 2004; Mol et al. 2012; Benus et al.

2012). Interlocutors systematically vary input in conversations to examine conversational skill in children.

6.2 *Experimental Conversational Breakdowns: Human Studies*

Communication depends on the interaction between two speakers or signers. In the give-and-take of conversation, conversational partners must respond appropriately to the communicative actions of each other. However, communication breakdown between partners is not uncommon and partners must make contingent adjustments in their responses for the conversation to continue. Conversational contingency is evident in behaviors of very young human children and develops gradually and systematically on into adulthood (Wilcox and Webster 1980; Golinkoff 1986; Wootton 1994; King and Gallegos-Santillan 1999; Most 2003). Systematic studies of children's early responses to conversational breakdown show they initially repeat their original utterance (Gallagher 1977). Later, they begin to add more information by revising the original utterance and adding new words (Brinton et al. 1986a). Researchers have examined this during natural conversations (Garvey 1977; Golinkoff 1993; King and Gallegos-Santillan 1999) and in paradigms where the interlocutor presents systematic probes in response to a child's utterance (Brinton et al. 1986a, b; Ciocci and Baran 1998; Most 2003; Wilcox and Webster 1980; Wootton 1994) or request (Marcos 1991; Marcos and Knnrnhaber-le Chanu 1992; Ryckebusch and Marcos 2004).

Anselmi et al. (1986) examined responses of children to general questions such as "What?" versus specific questions such as "What banana?" Wilcox and Webster (1980) presented questions versus statements to children. They found that children were more responsive to questions than statements. Brinton et al. (1986a) presented a succession of general questions to children 2–7 years old. In the succession, the interlocutor followed the child's response to the first general question with a second general question for a total of three questions. For example,

Child: Gimme ball.

Probe 1: Huh?

Child: Gimme ball.

Probe 2: What?

Child: Gimme that ball.

Probe 3: I don't understand.

Child: That ball there, gimme it.

Younger children had more difficulty responding to questions occurring later in the series than older children. Older children provided more information to the interlocutor than the younger children. General question series shows differences between normal versus language impaired children (Brinton et al. 1986b) and among developmentally disabled adults (Brinton and Fujiki 1991). By systematically varying the response of the interlocutor, research showed that responses of children were contingent on the questions of the interlocutor.

6.3 Systematic Conversational Experiments with Chimpanzees

In a study with the chimpanzees, the interlocutor systematically varied her input during casual interactions with the chimpanzees. A single interlocutor presented one of four types of probes: general requests for more information, on-topic questions, off-topic questions, or negative statements. At the time of data collection, she had 8 years of experience caring for and interacting with this group of chimpanzees and 10 years of experience communicating in ASL.

When she arrived at the interaction area MLJ either approached a chimpanzee or waited for a chimpanzee to approach her as she normally did in the course of a day. The interlocutor then attempted to engage the chimpanzee in a typical conversational interaction on a subject such as looking at a book, eating a meal, playing a game, or some other common activity (Fouts et al. 1989a). When ready, the camera operator signaled that the camera was ready and prompted the interlocutor by indicating which condition to present on that trial. The next time that the chimpanzee signed to the interlocutor, she replied with the first probe in the series specified by the condition for that trial. When the chimpanzee signed in response to the first probe, the interlocutor probed again, and so on until the interlocutor completed the series of three planned probes specified for that trial. The chimpanzees were free to interact with the interlocutor or to ignore her. After each probe, the chimpanzee was free to answer with any signs or phrases in his or her vocabulary, to continue to face the interlocutor, to look away, or to leave the scene entirely.

6.4 Conditions

There were four conditions of probes. The general conditions were questions such as HUH? And WHAT? indicating a general misunderstanding. The on-topic condition was Wh-questions that were related to the chimpanzee's previous utterance. For example when Washoe signed THAT the interlocutor asked WHO WANT THAT? The off-topic condition was Wh-questions that were unrelated to the chimpanzee's previous utterance. For example, when Washoe signed RED THERE, the interlocutor asked WHO FUNNY? The negative condition was three statements indicating the interlocutor could not comply with probes such as CAN'T, SORRY CAN'T and I MUST GO.

An experimenter transcribed the signs on the videotape. She then categorized replies in relationship to the chimpanzees' previous utterance and again in relationship to the interlocutor's previous utterance. Reliability scores ranged from 87 to 93 %.

6.5 Results

Like older children (Brinton et al. 1986a), the chimpanzees were as responsive to the later probes as they were to the initial probes with in a trial. This was the result in all four conditions.

Human children react to general probes by expanding across turns as in Brinton et al. (1986a: 77).

Child: A girl's playing on the swing

Adult: Huh?

Child: A girl and boy are playing on the swing.

Expanding across turns maintains the topic (Garvey 1977; Wilcox and Webster 1980) and also adds information. As human children develop, they are more likely to expand across turns (Brinton et al. 1986a; Anselmi et al. 1986). The cross-fostered chimpanzees often reacted to probes by expanding across turns. This maintained their original topic while adding more information.

Trial # 3/1:04:40

1:04:51 Washoe: ME GIMME (toward edible plants beyond her reach)/

1:04:54 Probe: NOT UNDERSTAND/

1:04:56 Washoe: FOOD GIMME/

It was also appropriate to react to a general probe by repeating the signs in the chimpanzee's previous utterance, thus emphasizing or clarifying something that the interlocutor may have missed.

Trial # 4/0:22:27

0:22:28 Dar: FLOWER THERE/

0:22:29 Probe: WHAT?/

0:22:30 Dar: FLOWER THERE/

Yet Washoe, Moja, Tatu, and Dar were more likely to expand across turns to general probes.

Incorporation was a category of response in which the chimpanzee used some of the signs in the interlocutor's previous utterance. Expansion was a category in which the chimpanzee used some signs from the interlocutor's previous utterance and added new signs. When the interlocutor asked relevant on-topic questions, the chimpanzees responded with many incorporations and expansions. These were absent in the general condition. In conversation, both human adults and human children often incorporate all or part of the utterance of a partner into their own next rejoinder. Keenan (1977), Keenan and Klein (1975), and Wilbur and Petitto (1981) suggest that incorporation indicates assent in the utterances of children. They interpreted examples of incorporation as a pragmatic device indicating positive response as in Keenan (1977: 130):

Adult: And we're going to have hot dogs.

Child: Hot dogs! (excitedly)

In Reno, Tatu and Dar incorporated signs from the interlocutor's previous utterance and incorporations were more likely to occur in response to announcements of positive events than to neutral or negative announcements. For example, "in response to the statement TIME ICECREAM NOW, Tatu signed ICECREAM ICECREAM ICECREAM ICECREAM ICECREAM ICECREAM ICECREAM ICECREAM" (Gardner et al. 1989b: 47).

Adults and older children interact in conversation by expanding as well as incorporating while younger children tend to incorporate without expanding (Bloom et al. 1976; Keenan 1977), as in Bloom et al. (1976: 528).

Adult: Take your shirt off.

Child: Shirt off

In this experiment, Washoe, Moja, Tatu, and Dar often expanded on the interlocutor's utterance when they responded to probes adding information to the interlocutor's previous utterance as in the following example:

Trial # 2/0:19:23.

0:19:24 Tatu: SMELL/

0:19:26 Probe: WHO SMELL?/

0:19:27 Tatu: TATU SMELL YOU/

As cross-fosterlings in Reno, Washoe, Moja, Tatu, and Dar replied to Wh-questions with expansions (Van Cantfort et al. 1989: 210). In Reno as in Ellensburg, the conversation of these chimpanzees resembled older children rather than younger children.

When the interlocutor asked off-topic questions, the chimpanzees often failed to respond and when they did respond they used few incorporations and expansions. On-topic and off-topic probes had the same Wh-signs combined with signs that were either contingent on or irrelevant to the signs in the previous utterance of the chimpanzee.

On-topic Trial # 2/1:39:59

1:39:57 Moja: EAT/

1:39:59 Probe: WHO EAT?/

Off-topic Trial # 3/0:30:15

0:30:12 Moja: FLOWER/

0:30:15 Probe: WHO IN THERE?/

With on-topic probes, the interlocutor followed the conversational lead of the chimpanzee. Off-topic probes created a situation like a dual monologue; the interlocutor's responses ignored the conversational utterances of the chimpanzee.

The cannot condition evoked the least response of all the conditions of this experiment. Moja and Tatu responded slightly more often than Washoe and Dar showing more persistence since they also expanded on their previous utterances, thus staying with their original topic. Marcos and Bernicot (1994) examined reactions of 18- to 30-month-old human children to an interlocutor who refused to cooperate with requests for objects. Like the chimpanzees in this experiment, the children sometimes persisted in their original request; sometimes, they switched to a different topic, but more often, they failed to respond.

6.6 Systematic Responses to Chimpanzee Requests

Interlocutor nonverbal behavioral responses to chimpanzees' utterances are another type of independent variable. The chimpanzees depended on their caregivers to fulfill many of their needs, and often used signs to request objects and activities of

humans. Typical interactions between caregivers and the chimpanzees included games, such as chase and peek-a-boo; activities, such as coloring and looking at books; chores, such as cleaning; and meals (Fouts et al. 1989a). The objective of Leitten et al. (2012) was to experimentally manipulate caregiver responses to the chimpanzees' requests and determine whether changes in the chimpanzees' signing were contingent upon this interlocutor input. Following the chimpanzee's request, a human interlocutor responded systematically.

The daily activity of the chimpanzees contained a wide spectrum of events. A master list of potential requests was created before data collection began. Three of the chimpanzees' longtime caregivers compiled a list of 18 object signs or action signs that the chimpanzees often requested. Then, nine other longtime caregivers ranked each chimpanzee's preference for each object or action (after Gardner et al. 1989b). The five objects or actions that caregivers ranked as the least preferred for each chimpanzee were those offered during the misunderstand condition, described below.

6.7 Trials

On experimental days, the interlocutor entered the chimpanzee–human interaction area with a camera operator and waited for a chimpanzee to initiate a conversation. A trial began, when the chimpanzee signed for an object on the list. GIMME and THERE could also begin a trial if the referent of the sign was visible and was included on the list. The interlocutor then responded to the chimpanzee's request with a probe from one of four conditions, described below. Trials concluded either after the chimpanzee signed in response or after 30 s.

6.8 Conditions

There were four conditions of interlocutor probes in this study: comply, misunderstand, refuse, and unresponsive. The probe in the comply condition was when the interlocutor offered the chimpanzee the requested object or performed the requested action. Requested objects were readily available in a nearby area, but often not visible to the chimpanzees. For example, if Tatu requested MASK, the interlocutor would enter the adjacent enrichment room and return to Tatu with a mask. As per typical daily protocol, if the chimpanzee requested gum, toothbrushes, snacks, or other items, the interlocutor offered the item to all of the chimpanzees regardless of whether they had participated in a trial.

The probe in the misunderstand condition was when the interlocutor offered an object or activity that was not part of the initial request. For example, if Tatu requested MASK, the interlocutor would enter the adjacent enrichment room and return to Tatu with a brush. The interlocutor used a list of objects to determine which requests were candidates for misunderstand trials and what objects to offer

in the misunderstand condition. The interlocutor only presented a probe to utterances that contained a sign for an object or action that was on the list for that chimpanzee.

The probe in the refuse condition was when the interlocutor refused to comply with the chimpanzee's request, with signs such as CAN'T. For example, if Tatu requested MASK, the interlocutor would respond by signing SORRY CAN'T. The refusals in this condition were like the refusals that typically occur in interactions between caregivers and their charges, be they children (Marcos and Bernicot 1994) or chimpanzees.

The probe in the unresponsive condition was when the interlocutor made no signed response to the chimpanzee's request, but continued to face the chimpanzee. For example, if Tatu requested MASK, the interlocutor refrained from responding and ignored the request.

6.9 Transcription

An experimenter transcribed the trials and then classified each of the chimpanzees' responses by comparing them to the chimpanzees' initial requests. Interobserver reliability ranged from 82 to 95 %. In the category repetition, the signs in the chimpanzee's response were the same as the signs in the chimpanzee's initial request. An example of a repetition is as follows:

Trial #1

0:31:17 Tatu: TOOTHBRUSHx/

0:31:38 LL: Offers Tatu a glove

0:32:07 Tatu: TOOTHBRUSHx/

In the category revision, the signs in the chimpanzee's response contained more or fewer signs than the chimpanzee's initial request, or the response contained completely different signs than the initial request. Some examples of revisions are as follows:

Trial #140

0:31:56 Moja: FOODx GUMx/

0:32:16 LL: Gives Moja a string

0:32:18 Moja: FOOD THERE GUM/

Trial #48

1:37:25 Washoe: GIMMEx TOOTHBRUSHx/

1:37:44 LL: Offers Washoe a hammer

1:37:58 Washoe: TOOTHBRUSHx HURRYx/

Trial #33

1:19:24 Tatu: TOOTHBRUSHx/

1:19:58 LL: Offers Tatu a ball

1:20:28 Tatu: MASKx/

In the category nonsign, the chimpanzee failed to sign within 30 s after the probe (Brinton et al. 1986a, p. 377).

6.10 Results

For each chimpanzee, there were 10 trials in each of the four conditions, yielding a total of 40 responses per chimpanzee. The 3×4 FET tests indicated that for four of the five chimpanzees the distribution of response types differed significantly across the four conditions, Washoe, $p < .001$, Tatu, $p < .001$, Dar, $p = .002$, Loulis, $p = .03$. There was no evidence that Moja's response types differed across the conditions, $p = .28$, FET.

Systematic differences in nonsigning contributed to the significance of the omnibus tests. Each chimpanzee ceased signing in the comply condition significantly more often than would be expected given the null hypothesis, Washoe, APR = 3.7, $p < .001$, Tatu, APR = 5.90, $p < .001$, Dar, APR = 3.70, $p < .001$, and Loulis, APR = 2.51, $p = .01$.

In the comply condition, Washoe, Tatu, and Dar used revisions significantly less often than expected, Washoe, APR = -2.01, $p = .04$, Tatu, APR = -2.53, $p = .01$, and Dar, APR = -2.25, $p = .02$. Also in the comply condition, Loulis exhibited less repetition than would be expected as indicated, APR = -2.68, $p = .007$. Finally, in the unresponsive condition, Washoe used significantly more repetitions than would be expected, APR = 3.65, $p < .001$.

Like human children (Brinton et al. 1986a, b; Wilcox and Webster 1980), the chimpanzees repeated their initial request more often in the refuse and unresponsive conditions than in either of the other conditions. For example,

Trial #182

0:34:05 Washoe: HUG x/

LL: No response

0:34:07 Washoe: HUG x/

Repetitions add no new information. In contrast the other category of response, revisions (also termed modifications) contain addition, deletion, or substitution of words or signs that change the original message (Halle et al. 2004). As described by Halle et al. (2004: 45):

Whereas both repetitions and modifications can be effective from the child's point of view... modifications have been viewed as important indicators of children's development in perspective-taking skills needed for conversation. Modifications have obvious practical advantages as well. If a child's communication is not successful, then producing an alternative communication act that matches environmental conditions and partner behavior would seem to have adaptive value.

Revisions require persistence and elaboration which are indicators of intentionality (Bates et al. 1979; Golinkoff 1986, 1993). Golinkoff states that these behaviors in young children "indeed reveal an understanding ... of the mind of another"

(p. 203). Adjusting responses to conversational partners is part of the shared negotiation and give-and-take of conversation. The chimpanzees in this study used revisions often when the interlocutor misunderstood the request, for example,

Trial #140

0:34:05 Moja: EATx GUMx/

LL: Gives Moja string

0:34:07 Moja: EAT THAT GUM/

If revisions are indicators of intentionality in human children, then the same can be said for chimpanzees.

6.11 Chimpanzees Initiate Conversations

In similar procedures, Bodamer and Gardner (2002) explored initiation of interactions. At the original CHCI facility, the chimpanzees had access to a suite of enclosures. One of the enclosures was across the hall from a human work room. When a caregiver was in the workroom, the chimpanzees often came to the nearby enclosure to request objects or activities. They often made noises if the human was not looking at them. Bodamer and Gardner systematically studied these initiations. The interlocutor sat in the work room with his back toward the chimpanzees' enclosure. When the chimpanzee made a noise, the interlocutor turned and faced the chimpanzee immediately or after a 30-s delay. When the interlocutor was not facing the chimpanzees, they made noises, such as Bronx cheers, and rarely signed. The few times the chimpanzees signed they used signs that made noise, such as DIRTY where the back of the hand hits the bottom of the jaw. With force this sign is noisy. In the delay condition, the noises became louder and faster. Once the interlocutor faced the chimpanzees, signing began and noises ended. Using a naturally occurring situation, this experiment showed the chimpanzees initiate interactions and sign spontaneously.

Experimental conversations with chimpanzees using systematic probes show their linguistic skill. The chimpanzees initiate and maintain conversations contingent on and appropriate to the interlocutor's input.

7 Conversations Versus Drill

The discoveries about chimpanzee signing occur with experimental trials presented in conversational contexts. The opposite of a conversational context is a drill context, which is characterized by requests to name objects and lacks in the natural give-and-take of conversations. Gardner and Gardner commented that drill tended to reduce the amount and quality of signing by the cross-fosterlings (Gardner and Gardner 1971: 140–141). This was later demonstrated

experimentally when O'Sullivan and Yeager (1989) compared a conversational style of interaction to drill interactions with signing chimpanzee Nim (Terrace 1979). They found that in a conversational context, Nim interrupted less often and produced a high rate of spontaneous utterances. He behaved like a conversational partner when treated as one. Brown (1973: 178) noted children had deficient performance when mothers tried to elicit speech by asking their children to name things rather than interacting in a natural way.

The hallmark of the sign language studies is that caregivers treated the chimpanzees as conversational partners socially motivated rather than experimental subjects bribed or forced into participation. The chimpanzees were always free to leave the testing situation and free to respond to their world with their full repertoire of behaviors; these were often the dependent variables. Interlocutors nearly always doubled as chimpanzee caregivers. The tests were then embedded into the rich daily interactions that occurred between two friends. No rigor was lost, and an understanding of the remarkable similarities between human and chimpanzee behaviors is gained.

With comparable conditions, the research supports continuity with differences of degree among species as predicted by Darwin's theory of evolution.

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