

The communicative functions of five signing chimpanzees (*Pan troglodytes*)

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Speech act theory describes units of language as acts which function to change the behavior or beliefs of the partner. Therefore, with every utterance an individual seeks a communicative goal that is the underlying motive for the utterance's production; this is the utterance's function. Studies of deaf and hearing human children classify utterances into categories of communicative function. This study classified signing chimpanzees' utterances into the categories used in human studies. The chimpanzees utilized all seven categories of communicative functions and used them in ways that resembled human children. The chimpanzees' utterances functioned to answer questions, request objects and actions, describe objects and events, make statements about internal states, accomplish tasks such as initiating games, protest interlocutor behavior, and as conversational devices to maintain and initiate conversation.

Keywords: American Sign Language, Chimpanzee, communicative function, cross-fostered

1. Introduction

Jane: Pass the peas.
Bob: What do you say?
Jane: Please.
Bob: Ok. Here are the peas.
Jane: They are so green!

The utterances of the speakers in this dialogue have a variety of functions: requests, politeness markers, and declaratives. Speech act theory describes basic units of language as acts with a function to change the behavior or beliefs of the partner (Austin, 1962; Searle 1969). This theoretical work paved the way for the systematic analysis of speech acts, also known as communicative intentions (Carpenter, Mastergeorge, and Coggins 1983; Coggins, Olswang, and Guthrie 1987; Day 1986;

Dore 1977a, 1977b) and communicative functions (Barachetti and Lavelli 2010; Flax, Lahey, Harris, and Boothroyd 1991; Wetherby 1986). Though the terms are interchangeable, this study will utilize communicative function because the communicative behavior is coded by the social function it serves (Nicholas and Geers, 1997, 2003). Dore (1975) defined communicative functions as “the deliberate pursuit of a goal by means of instrumental behaviors subordinated to that goal” (p.36). Therefore, with every utterance an individual seeks a communicative goal that is the underlying motive for the utterance’s production; this is the utterance’s function.

The development and production of communicative functions have been studied in typically developing children (Aureli, Perucchini, and Genco 2009; Barachetti and LaVelli 2010; Carpenter et al. 1983; Coggins et al. 1987; Dore 1973, 1974, 1975, 1977a, 1977b; Ervin-Tripp 1977; Flax et al. 1991; Furrow 1984; Garvey 1975; Wetherby, Cain, Yonclas, and Walker 1988; Wetherby and Rodriguez 1992), deaf children (Day 1986; Jeanes, Nienhuys, and Rickards 2000; Nicholas and Geers 1997; Nicholas and Geers 2003), and in children with disabilities (Bruce, Godbold, and Naponelli-Gold 2004; John and Mervis 2010; Wetherby 1986; Wetherby, Yonclas, and Bryan 1989; Ziatas, Durkin, and Pratt 2003). Understanding a conversational partner’s communicative function is the most fundamental task of language, yet it can be the most difficult (Ninio, Snow, Pan, and Rollins 1994, p. 157). Becoming a competent conversationalist requires skill in the production and comprehension of the function of utterances because as social beings, one must be able to understand others as well as be understood themselves (Akhtar and Martinez-Sussman 2007; Aureli et al. 2009; Barachetti and LaVelli 2010; Jeanes et al. 2000; John and Mervis 2010). The study of communicative functions allows for a pragmatic analysis of an individual’s language and conversational competency.

Dore (1973, 1974, 1975, 1977a, 1977b) has extensively studied the communicative functions of children. Dore (1974) categorized 15-to-19-month-old children’s one-word utterances into nine categories of communicative function. Most often the utterances were a repetition of the adult’s previous utterance, yet they also often requested and labeled. Later, Dore (1977a, 1977b) categorized longer utterances of 34- to 39-month-old children into seven categories. These categories were Request, Response, Description, Statement, Conversational Device, Performative, and Uninterpretable. Children produced Requests and Descriptions most often. Day (1986) also classified single and multi-sign utterances of deaf 35-to 42-month-old children. Like the hearing children, their utterances most often were Descriptions and Requests. Furrow (1984) also found description was the most common communicative function in 2-year-old children’s speech. Though Dore’s categories of communicative function were developed in the 1970’s, they are still relevant and used in current communicative function research (MacRoy-Higgins and Kaufman 2012).

Conversational interaction is a fundamental characteristic of human face-to-face communication in words and signs and has always been a primary objective of sign language studies of cross-fostered chimpanzees:

At the outset we were quite sure that Washoe could learn to make various signs in order to obtain food, drink, and other things. For the project to be a success, we felt that something more must be developed. We wanted Washoe not only to ask for objects but to answer questions about them and also to ask us questions. We wanted to develop behavior that could be described as conversation. (R. A. Gardner and Gardner 1969, pp. 665–666).

Ethologists use the procedure called cross-fostering 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). 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 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, Chiarelli, Gottlieb, and Patton 1986; Ruvolo et al. 1994), and 98% of human and chimpanzee DNA share the same structure (Sibley and Ahlquist 1984; The Chimpanzee Sequencing and Analysis Consortium 2005).

Humans reared the infant chimpanzees Washoe, Moja, Tatu, and Dar in a cross-fostering laboratory at the University of Nevada-Reno, and raised the young chimpanzees as if they were deaf human children. Like human children, the cross-fosterlings wore clothes; used spoons, bowls and highchairs; played games; and helped with chores (R.A. Gardner and Gardner 1989). The human foster families used only American Sign Language (ASL) during everyday activities with the chimpanzees. They encouraged the cross-fosterlings to sign by expanding on fragmentary utterances and asking questions. Under these conditions, the cross-fosterlings acquired the signs of ASL in patterns similar to those of human children (R.A. Gardner, Gardner, and Van Cantfort 1989; B.T. Gardner and Gardner 1994).

As a young adult, Washoe adopted 10-month-old Loulis. To determine whether Loulis would acquire signs without human intervention, all human signing, except for seven signs, WHO, WHAT, WHERE, WHICH, WANT, SIGN, and NAME, were prohibited in his presence¹. Loulis spent all of his time with Washoe and other signing chimpanzees. He began to sign in seven days and combined signs into phrases in five months. In the 5-year-period of signing restriction, Loulis learned 51 signs (R.S. Fouts, Hirsch, and Fouts 1982; R. S. Fouts, Fouts, and Van Cantfort

1989). Like the cross-fostered chimpanzees and human children, Loulis acquired his signs in a conversational setting and later used his signs in conversations with human caregivers and the other chimpanzees (R.S. Fouts 1994).

As adults at the Chimpanzee and Human Communication Institute (CHCI) at Central Washington University in Ellensburg, the chimpanzees have continued to sign spontaneously and interactively about activities, meals, games, and events with each other as well as with human familiars (D. H. Fouts 1994; Bodamer and Gardner 2002; Hartmann 2011; Jensvold and Gardner 2000; Krause and Fouts 1997; Leitten, Jensvold, Fouts, and Wallin 2012). As in the Reno laboratory, human caregivers continue to ask questions of the chimpanzees and expand on fragmentary utterances.

It is during these ongoing casual conversations that interlocutors explore systematically the chimpanzees' conversational behaviors revealing the variety of functions of their utterances. The chimpanzees sign to initiate and maintain games and social activities with one another as well as to comment on their environment (Bodamer and Gardner 2002; Krause and Fouts 1997; R.S. Fouts 1994). They reiterate, adjust, and shift utterances in conversationally appropriate rejoinders (Bodamer and Gardner 2002; Jensvold and Gardner 2000). They also sign to themselves when alone (Bodamer, Fouts, Fouts, and Jensvold 1994). The chimpanzees depend on their caregivers to fulfill many of their needs, and often use signs to request objects and activities of humans (Leitten, Jensvold, Fouts, and Wallin 2012). Typical interactions between caregivers and the chimpanzees include games, such as chase and peek-a-boo; activities, such as coloring and looking at books; chores, such as cleaning; and meals (R.S. Fouts, Fouts, Jensvold, and Bodamer 1994; Leitten et al. 2012). Caregivers record detailed logs of the chimpanzees' signs and behaviors that occur in these interactions. These logs provide a rich record of the chimpanzees' signs and conversations across a wide variety of contexts.

The purpose of this study was to examine the communicative functions of Washoe, Tatu, Moja, Dar, and Loulis in unstructured interactions with each other and their human caregivers. It examined conversations arising from day-to-day interactions over a 4-year period to better understand the communicative functions of the chimpanzees' utterances.

2. Method

Participants

The participants in this study were five adult chimpanzees (*Pan troglodytes*) who lived at the Chimpanzee and Human Communication Institute (CHCI) located on the campus of Central Washington University in Ellensburg, WA, U.S.A.

Washoe, Tatu, Moja, and Dar were cross-fostered as if they were deaf human children (Gardner and Gardner 1989). They were raised in a human household and used ASL to communicate with their human caregivers and each other. Loulis was not cross-fostered but raised by cross-fosterling Washoe and acquired ASL from her and the other signing chimpanzees (R.S. Fouts and Fouts 1989). Table 1 gives other biographical information for the five chimpanzees participants.

CHCI consists of a large outdoor enclosure, two main indoor enclosures and an indoor night enclosure area. The indoor, outdoor, and night enclosure area total 4,417 m². The chimpanzees' daily object enrichment includes items such as shoes, magazines, clothes, mirrors, masks, plastic containers, and activities such as painting, food puzzles, food forages and signed interactions with human caregivers.

Table 1. *Chimpanzee biographical information.*

Name	Sex	Date of Birth	University of Reno	University of Oklahoma	Central Washington University
Washoe Pan Satyrus	Female	06/06/1966	06/1966–10/1970	10/1970–09/1980	09/1980–10/30/2007
Moja Lemsip	Female	11/18/1972	11/1972–12/1979	12/1979–10/1980	10/1980–06/06/2002
Oklahoma Tatu	Female	12/30/1975	01/1976–05/1981	Born 12/30/1975	05/1981–present
Dar es Salaam	Male	08/02/1976	08/1976–05/1981	N/A	05/1981–11/24/2012
Loulis Yerkes	Male	05/10/1978	N/A	03/1979–09/1980	09/1980–present

Sign logs

Sign logs are written records of the chimpanzees' interactions. The purpose of sign logs is to record the signed and non-signed behaviors of the chimpanzees including chimpanzee-to-human interactions, chimpanzee-to-chimpanzee interactions, private signing and other interesting interactions or behaviors. Caregivers fill out sign logs following the observation of the previously described behaviors. Caregivers are trained in ASL, including one course in ASL and a demonstration of proficiency in ASL by completing a video test of each individual chimpanzee's sign use with an accuracy of at least 85%.

Sign logs document each chimpanzee utterance during an interaction, along with the nonverbal behavior of the signer and conversation partner. The sign logs document the individual signs in each utterance, the placement, configuration and movement (PCM) of each sign, the hand used to sign each sign, and

utterance frequencies. The context of each participant is described by: social context (i.e., play, feeding, affiliative social, etc.), body orientation, physical location in the building, eye gaze, vocalizations, arousal, and any other nonverbal behaviors. Lastly, the sign log contains a written description of the signed interaction.

Experimenters categorized the utterances of the five signing chimpanzees from sign logs into categories of communicative function. Previous research into the communicative functions of nonhuman apes also used databased utterances from live data recorded by caregivers (Lyn, Greenfield, Savage-Rumbaugh, Gillespie-Lynch, Hopkins 2011).

Categories of communicative functions

An adapted version of Dore's (1977a, 1977b) categories of communicative functions was utilized for categorizing the chimpanzee utterances into communicative functions. Table 2 lists the categories of communicative functions utilized in this study.

Table 2.

Categories	All*		C-H*		C-C*	
	Freq.	%	Freq.	%	Freq.	%
<i>Locations</i> : represent location or direction of objects, events, etc.	27	2.6	27	2.7	0	0
STATEMENTS : express analytic and institutional facts, beliefs, attitudes, emotions, reasons, etc.	41	3.9	41	4.0	0	0
<i>Rules</i> : express conventional procedures, facts, definitions, etc.	0	0	0	0	0	0
<i>Evaluations</i> : express impressions, attitudes, judgments, etc.	33	3.1	33	3.2	0	0
<i>Internal reports</i> : express S's internal state (emotions, sentiments, sensations)	8	0.8	8	0.8	0	0
<i>Attributions</i> : express beliefs about another's internal state.	0	0	0	0	0	0
<i>Explanations</i> : report reasons, causes or motives for acts, or predict future states of affairs.	0	0	0	0	0	0
CONVERSATIONAL DEVICES : regulate contact and conversations.	10	0.9	10	1.0	0	0
<i>Boundary markers</i> : initiate or end contact or conversation.	0	0	0	0	0	0
<i>Calls</i> : make contact by soliciting attention.	4	0.4	4	0.4	0	0
<i>Accompaniments</i> : signal contact by accompanying S's action.	0	0	0	0	0	0

Table 2. (continued)

Categories	All*		C-H*		C-C*	
	Freq.	%	Freq	%	Freq	%
<i>Returns</i> : acknowledge, or fill in after, R's preceding U.	0	0	0	0	0	0
<i>Politeness markers</i> : make explicit S's politeness.	6	0.5	6	0.6	0	0
PERFORMATIVES : accomplish acts by being said.	83	7.9	54	5.3	29	65.9
<i>Role play</i> : establish fantasies.	0	0	0	0	0	0
<i>Protests</i> : object to R's previous behavior.	5	0.5	4	0.4	1	2.3
<i>Jokes</i> : produce humorous effects.	1	0.1	1	0.1	0	0
<i>Game markers</i> : initiate, continue or end a game.	59	5.6	45	4.4	14	31.8
<i>Claims</i> : establish rights for S by being signed.	3	0.3	3	0.3	0	0
<i>Warnings</i> : alert R of impending harm.	0	0	0	0	0	0
<i>Locations</i> : represent location or direction of objects, events, etc.	27	2.6	27	2.7	0	0
STATEMENTS : express analytic and institutional facts, beliefs, attitudes, emotions, reasons, etc.	41	3.9	41	4.0	0	0
<i>Rules</i> : express conventional procedures, facts, definitions, etc.	0	0	0	0	0	0
<i>Evaluations</i> : express impressions, attitudes, judgments, etc.	33	3.1	33	3.2	0	0
<i>Internal reports</i> : express S's internal state (emotions, sentiments, sensations)	8	0.8	8	0.8	0	0
<i>Attributions</i> : express beliefs about another's internal state.	0	0	0	0	0	0
<i>Explanations</i> : report reasons, causes or motives for acts, or predict future states of affairs.	0	0	0	0	0	0
CONVERSATIONAL DEVICES : regulate contact and conversations.	10	0.9	10	1.0	0	0
<i>Boundary markers</i> : initiate or end contact or conversation.	0	0	0	0	0	0
<i>Calls</i> : make contact by soliciting attention.	4	0.4	4	0.4	0	0
<i>Accompaniments</i> : signal contact by accompanying S's action.	0	0	0	0	0	0
<i>Returns</i> : acknowledge, or fill in after, R's preceding U.	0	0	0	0	0	0
<i>Politeness markers</i> : make explicit S's politeness.	6	0.5	6	0.6	0	0

Table 2. (continued)

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	Freq.	%	Freq	%	Freq	%
PERFORMATIVES: accomplish acts by being said.	83	7.9	54	5.3	29	65.9
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<i>Protests:</i> object to R's previous behavior.	5	0.5	4	0.4	1	2.3
<i>Jokes:</i> produce humorous effects.	1	0.1	1	0.1	0	0
<i>Game markers:</i> initiate, continue or end a game.	59	5.6	45	4.4	14	31.8
<i>Claims:</i> establish rights for S by being signed.	3	0.3	3	0.3	0	0
<i>Warnings:</i> alert R of impending harm.	0	0	0	0	0	0
<i>Teases:</i> annoy, taunt or provoke R.	0	0	0	0	0	0
<i>Reassurance:</i> calm, reassure or provide support to R.	15	1.4	1	0.1	14	31.8
UNINTERPRETABLE: are unintelligible, incomplete or otherwise incomprehensible utterances.	220	20.8	219	21.6	1	2.3
Total	1057	100	1013	99.8	44	100

Operational features for coding communicative functions

Previous studies on the communicative functions of chimpanzees and human children used operational features of an utterance to categorize its communicative function. The operational features used to categorize the chimpanzees' utterances into categories of communicative function were based off previous research on communicative functions (Dore, 1977a, 1977b; Day 1986; Rivas 2005) and were the semantic content of the chimpanzee's utterance, the grammatical and inflectional aspects of the chimpanzee's signed utterance, the accompanying nonverbal behavior of the chimpanzee, the behavioral and social context of the conversation, and the behavior of the conversational partner.

Categorizing and reliability

Sign logs from 2000 to 2003 totaling 1057 utterances were categorized. A total of 40 trained researchers composed of faculty, graduate students, and undergraduate students recorded the signs logs utilized in this study. Experimenters categorized each utterance that appeared on a log into a communicative function and communicative function subcategory. Those categories and definitions appear in Table 2. In determining the category, experimenters used the operational features of the utterance. Experimenters recorded each operational feature of the utterance in the spreadsheet.

Some utterances met the definition of more than one category. Dore (1977a) described the necessity to double code with the example: “Responses to Wh- questions, for example, are often also descriptions: a response to ‘Where’s John?’ was ‘He’s under the table’ which is both a Wh- answer and a location description” (p. 233).

To determine interobserver reliability, two experimenters categorized all 1,057 utterances for the communicative function of the utterance. Percent agreement between the two experimenters was calculated for all 1,057 utterances. Interobserver reliability for the categorization of communicative functions was 91.56%. The two experimenters discussed disagreements and decided on a category. Where no agreement could be made, the utterance was coded as Uninterpretable. To minimize coder fatigue, coding was done in 1-hour intervals.

3. Results

The chimpanzees produced all seven categories of communicative functions and 23 out of the 32 subcategories in 1,057 utterances. Table 2 lists the frequency and percentage of use for each category. The chimpanzees produced a variety of signs in each function, a list of which appears in Table 3.

Table 3. *Sign use in each category of communicative function.*

Communicative function	Sign’s used (frequency)
Request Yes-No Question	BLANKET (7), BANANA (2), CLOTHES (2), CRACKER (2), MORE (2), DRINK (2), FRUIT, FRIEND, HOT, POTATO, ICE CREAM, MILK, ONION, RED, SWEET, THAT
Request Wh- Question	ROGER, CLOTHES
Request Action Request	HURRY (23), GIMME (19), SMELL (17), YOU (13), THERE (12), GO (10), OUT (7), THAT (5), GROOM (5), COME (4), MASK (4), MORE (3), BRUSH (3) BERRY (2), HAIR (2), LISTEN (2), DAR (2), FOOD (2), CRACKER (2), LOTION (2), QUIET (2), SWALLOW (2), BLACK, BOOK, CLEAN, DRINK, GIRL, PEAR, POTATO, SORRY, CLOSE, SHOE, CHASE, FRIEND, OPEN, DIFFERENT, CAN’T, ME, GRASS, HUG/LOVE, PERSON
Request Permission	TOOTHBRUSH
Response Yes-No Answer	TEA (10), RICE (6), DRINK (4), HUNGRY (4), LIPSTICK (3), EAT (3), HURRY (3), MORE (2), WASHOE (2), BEAN (2), DOG (2), CLOTHES (2), OUT (2), BANANA (2), DAR (2), BLANKET (2), BRUSH (2), TOOTHBRUSH (2), BREAD, COFFEE, HOT, PAINT, LOTION, BIRD, BOOK, BOY, BLACK, CORN, FRUIT, POTATO, READY, POPCORN, BERRY, CRACKER, DR. G., GOOD, GUM, HEAR, LOULIS, MOJA, TREE, VEGETABLE, IN, GO

Table 3. (continued)

Communicative function	Sign's used (frequency)
Response Wh- Answer	RICE (14), RED (13), THERE (11), CLOTHES (10), BERRY (8), TATU (8), TEA (7), THAT (6), DRINK (5), COFFEE (5), DAR (5), GRAPE (4), MORE (4), BANANA (4), HURRY (3), FOOD (3), BABY (3), BOY (3), ICE CREAM (3), CAT (3), CEREAL (3), HURT (3), ME (3), BLACK (3), LIPSTICK (3), CRACKER (2), GIRL (2), IN (2), CHASE (2), DOG (2), MASK (2), TOOTHBRUSH (2), YOU (2), FUNNY (2), OUT (2), GUM (2), LOTION (2), APPLE (2), BUG (2), DEBBIE (2), ROGER (2), TREE (2), FRIEND (2), BREAD, DIRTY, VEGETABLE, BEAN, BED, HIEDI, SANTA CLAUSE, SODA POP, TEETH, SWALLOW, WANT, CHEESE, GREEN, ICE, LAUGH, MILK, ONION, ORANGE, SWEET, SORRY, FLOWER, BIRD, GROOM, MOJA, PAINT
Response Agreements	DRINK (4), RICE (4), TOOTHBRUSH (3), FRIEND (3), BERRY (2), BRUSH (2), COLD (2), DIRTY (2), EAT (2), GRAPE (2), GUM (2), HUNGRY (2), MARY LEE (2), NUT (2), RED (2), SLICE (2), SORRY (2), SWALLOW (2), SWEET (2), APPLE, BABY, BANANA, BED, BLACK, BLANKET, CLEAN, CLOTHES, COFFEE, CORN, DAR, DIFFERENT, DOG, EARRING, FRUIT, FUNNY, GIMME, GOOD, LIKE, MEAT, ONION, SLEEP, SMART, THERE, VEGETABLE, WEEK
Response Compliances	CLOTHES (25), TEA (12), RICE (4), HALLOWEEN (3), APPLE (2), BERRY (2), CAR (2), CHEESE (2), GIMME (2), GRASS (2), RED (2), TOOTHBRUSH (2), BED, BRUSH, CEREAL, COFFEE, COOKIE, CRACKER, DAR, DIFFERENT, DRINK, EGG, FLOWER, FRIEND, HIEDI, HUNGRY, HURRY, LIPSTICK, MEAT, ONION, OUT, READY, RING, ROGER, SANTA CLAUSE, SMELL, SWEET, THAT, THERE
Response Qualification	RICE (5), BERRY, BREAD, LIKE, TIME, CHASE, CAT, CRACKER
Description Identification	THAT (17), THERE (12), COFFEE (7), TATU (7), BOY (6), CAT (6), MASK (6), BABY (5), BERRY (5), CLOTHES (5), DAR (5), GIRL (5), GUM (5), YOU (5), DRINK (4), RED (4), TOOTHBRUSH (4), BLACK (3), BUG (3), DOG (3), FOOD (3), ME (3), PAINT (3), RICE (3), TEA (3), BANANA (2), BIRD (2), BLANKET (2), CHASE (2), FUNNY (2), HURT (2), ICE CREAM (2), LOTION (2), POTATO (2), SHOE (2), SWEET (2), TREE (2), APPLE, BEAN, CORN, COVER, DEBBI, FLOWER, GLASS, GRASS, GROOM, HIEDI, LAUGH, LIGHT, LIPSTICK, MOJA, NUT, ONION, ORANGE, OUT, PAPER, PERSON, POPCORN, RING, ROGER, SANTA CLAUSE, SEE, SLEEP, TEETH
Description Possessions	ME (3), THAT (2), LIPSTICK, YOU, GUM, SWALLOW

Table 3. (continued)

Communicative function	Sign's used (frequency)
Description Events	SWALLOW (4), CHASE (3), THERE (2), DAR (2), GUM (2), BABY, IN, HEAR, GIRL, BLANKET, RED, TIME, FUNNY, EAT, THAT, THERE, TOOTHBURSH, OUT
Description Properties	RED (4), BLACK (4), THAT (3), DRINK (2), HURT (2), PAINT (2), SHOES, SMELL, DIRTY, ORANGE, BANANA, CHEESE, COFFEE, HAIR, MILK, ONION, TOTHBRUSH
Description Locations	THERE (26), TREE (3), CAT (2), CLOTHES (2), DRINK (2), BRUSH (2), RED (2), POTATO (2), TOOTHBRUSH, HURT, RED, SWALLOW, GRAPE, ICE, TEA, FLOWER
Statements Evaluations	GOOD (13), FRIEND (8), STUPID (5), DAR (5), SORRY (4), BLACK (3), SWEET (2), YOU (2), BLANKET (2), FUNNY (2), CLEAN, TATU, HUNGRY, DRINK, BOY, ME
Statements Internal Reports	SORRY (4), HUNGRY (3), CRACKER, DAR, HURT, TATU
Conversational Device Calls	YOU (4), PERSON
Conversational Device Politeness Marker	SORRY (6), GO, THERE
Performative Protest	HURRY (2), DIRTY, GIRL, LOTION, STUPID, DAR, SWALLOW, CEREAL, MORE, PERSON, BRUSH, GO
Performative Jokes	LAUGH
Performative Claim	READY (2), GUM
Performative Game Markers	CHASE (52), PEEKABOO (5), BOY (2), GIRL (2), LIGHT (2), MARY LEE (2), HURRY, FRIEND, BRUSH, FUNNY, OUT, THERE, TICKLE, TATU, YOU
Performative Reassurance	HUG/LOVE (9), HURRY (8), PERSON, FRIEND, GOOD, GIMME
Statements Internal Reports	SORRY (4), HUNGRY (3), CRACKER, DAR, HURT, TATU
Conversational Device Calls	YOU (4), PERSON
Conversational Device Politeness Marker	SORRY (6), GO, THERE
Performative Protest	HURRY (2), DIRTY, GIRL, LOTION, STUPID, DAR, SWALLOW, CEREAL, MORE, PERSON, BRUSH, GO
Performative Jokes	LAUGH
Performative Claim	READY (2), GUM
Performative Game Markers	CHASE (52), PEEKABOO (5), BOY (2), GIRL (2), LIGHT (2), MARY LEE (2), HURRY, FRIEND, BRUSH, FUNNY, OUT, THERE, TICKLE, TATU, YOU

Table 3. (continued)

Communicative function	Sign's used (frequency)
Performative Reassurance	HUG/LOVE (9), HURRY (8), PERSON, FRIEND, GOOD, GIMME

The category Responses was the most frequent at 35%, followed by Uninterpretable (20.8%), Description (19%), Request (12.5%), Performative (7.9%), Statement (3.9%), and Conversational Device (0.9%). The two most frequent subcategories were Response Wh- answer (15%) and Description Identification (13.2%). The mean rank order for Request was 3.60, Response 1.00, Description 2.80, Statement 6.00, Conversational Device 6.60, Performative 4.80 and Uninterpretable 3.20. Following the methods of Day (1986), Kendall's Coefficient of Concordance rank order was utilized to establish if the chimpanzees as a group were producing their communicative functions similarly or dissimilarly to each other. Kendalls' coefficient was significant and highly correlated ($W=0.814$, $p<0.01$). Although there were some individual differences in use, the chimpanzees utilized the same communicative functions in similar frequencies to each other. Deaf children showed similar correlation in their use of communicative functions (Day 1986).

The chimpanzees produced three categories of communicative function and five subcategories in a total of 44 utterances in the chimpanzee-to-chimpanzee context (Table 2). The category Performative was the most frequent (65.9%), followed by Request (29.5%), and Description and Uninterpretable (2.3% each, respectively). Performative Reassurance, and Performative Game Marker were both utilized in 31.8% of utterances, followed by Request Action (29.5%) and Performative Protest and Description Identification (2.3% each, respectively).

The chimpanzees produced all seven categories of communicative function and 23 subcategories in a total of 1,013 utterances in the chimpanzee-to-human context (Table 2). The category Response was most frequent at 36.5% followed by Uninterpretable (21.6%), Description (19.7%), Request (11.7%), Performative (5.3%), Statement (4.0%), and Conversational Device (1.0%). The subcategory Response Wh- Answers were most frequent at 15.7%, followed by Description Identification (13.6%).

4. Discussion

The chimpanzees produced all seven of Dore's (1977a, 1977b) categories of communicative function. They primarily produced Response (35%) and Uninterpretable (20.8%), while producing Conversational Device (0.9%) the least. Request was

the fourth most frequently produced communicative function. Further the chimpanzees produced 23 of the 32 subcategories.

Hearing children produced Response in 18.5% of their utterances (Dore, 1977a, 1977b), while deaf children produced Response in 10.5% (Day 1986). Other language using apes produce a high frequency of responses to caregiver probes as well (Lyn et al. 2011; Miles 1975; Patterson, Tanner, and Mayer 1988). The frequent asking of questions, however, can influence the coding of communicative functions. A signing chimpanzee named Ally produced the communicative function Action Request in 46% of his utterances (Miles 1976). However, Ally's caregivers often initiated conversations by asking, "What do you want?" Thus an Action Request was an appropriate answer. Of his Action Requests, 28% were elicited by his caregivers. Brown (1973) reported that adults often ask continual questions to children, rather than allowing children to direct the conversation.

In their day-to-day life children are regularly asked questions by adults, the studies of which are relevant to understanding how children use language (Wedell-Monnig and Lumley 1980). On the cross-fostering project, caregivers asked the chimpanzees questions (Van Cantfort, Gardner, and Gardner 1989). In a systematic study, caregivers asked Washoe 10 Wh-question frames. These question frames were who pronoun, who action, who trait, whose demonstrative, what color, what demonstrative, what now, what want, where action and where object questions. Each question had a target category for response, for example, in response to Who pronoun, a proper name was the target response. At age five Washoe replied to Wh-questions with grammatically appropriate answers 84% of the time (B.T. Gardner and Gardner 1975). A second study examined Moja, Tatu, and Dar's responses to Wh-questions at 20–60 months of age. The number of grammatically appropriate responses to Wh-questions increased with age, ranging from 53% in the beginning of the study to 96% at the end of the study (Van Cantfort et al. 1989). In another test with questions, interlocutors asked the chimpanzees one of four types of probes: General questions, On Topic questions, Off Topic questions, or negative statements (Jensvold and Gardner 2000). The chimpanzees' responses were contingent and appropriate to the interlocutor's rejoinders and resembled patterns of conversation found in similar studies of human children.

The chimpanzees produced the communicative function Description in 19% of their utterances, including all five subcategories. Hearing children produced Description in 22.3% of their utterances (Dore, 1977a, 1977b), and deaf children produced Description in 28.6% of their utterances (Day 1986). Other language using apes commonly described objects, actions, and events in their surroundings as well (Lyn et al. 2011; Miles 1976; Patterson et al. 1988). The describing and naming of objects and individuals is a robust aspect of the cross-fostered chimpanzees language use. The chimpanzees produced the function Description Identification

most frequently, often to label colors, individuals, and food items. For example, a caregiver had dyed her hair black the night before. As the caregiver was cleaning enclosures Tatu sat and watched the caregiver signing to herself BLACK and PAINT. When done cleaning, the caregiver asked Tatu WHAT YOU SIGN? YOU WANT PAINT? Tatu replied BLACK HAIR PAINT (Sign Log #427, 09/19/2001). During an interaction with a caregiver, Dar pulled his lips apart and stuck out his tongue and signed FUNNY. The caregiver asked WHO FUNNY? Dar replied DAR FUNNY, and made the face again (Sign Log #226, 08/13/2001).

Human children produced this function similarly, for example, labeling objects by saying, "That's a train" (Dore 1977a, p. 238), and signing "points to picture and signs BIRD, touches pants and signs PANTS" (Day 1986, p. 374). Bodamer et al. (1994) examined the communicative functions of the chimpanzees' private signs. The chimpanzees produced referential utterances, which is describing present objects or events, most frequently. Human children also produced referential utterances most frequently when speaking to themselves (Furrow 1984).

The chimpanzees described activities with the function Description Event, for example, a caregiver was interacting with Dar, and Dar signed TIME CHASE (Sign Log #183, 08/08/2001). In another example, Dar was eating soup for lunch. He took a spoonful and signed SWALLOW (Sign Log #264, 05/02/2003). Human children produced this function similarly, for example, signing POUR while pointing to wet pants, and EAT while taking a bite of a sandwich (Day 1986, p. 374).

The chimpanzees described the locations of objects with the function Description Location. For example, on a snowy day a caregiver was interacting with the chimpanzees at the observation window that looks outside. Tatu signed TREE THERE, while oriented toward, pointing toward, and looking toward outside where there was a tree (Sign Log #29, 03/20/2002). Human children produced this function similarly, for example, signing DADDY and pointing to the other room (Day 1986, p. 376). The chimpanzees described the possession of objects with the function Description Possession. For example, a caregiver brought the chimpanzees gum, and Dar signed THAT ME GUM ME, while oriented toward and pointing toward the gum in the caregiver's hand (Sign Log #268, 03/05/2003). Human children produced Description Possession similarly, for example, signing, "PAM and SOCK, while pointing to a sock" (Day 1986, p. 376), and saying, "That's John's egg" (Dore 1977b, p. 146). The chimpanzees described the properties of objects with the function Description Property. For example, when interacting around the outside garden, a human caregiver asked Dar, WHAT THAT, toward the unripe tomato. Dar signed ORANGE (Sign Log #182, 08/23/2001). Human children produced this function similarly, for example, signing, "SAME while pointing to object 1 and object 2" (Day 1986, p. 376), and saying, "That's a red crayon" (Dore 1977b, p. 146).

The chimpanzees used 64 different signs in the production of the communicative function Description. Throughout these chimpanzees lives they have lived in a state-of-the-art environment, filled with complex enrichment and opportunities for social interaction. For instance, the chimpanzee's meals are varied and are served by good friends every day. The chimpanzees also receive daily play objects such as magazines, brushes, toys, stickers, mirrors, perfume samples, whistles, and cardboard, to name just a few. Furthermore, birthdays and all major holidays are celebrated, a garden is grown every spring and summer, and weekly caregiver meetings are held to ensure that new and exciting activities are continually being developed. Providing the chimpanzees with a diverse array of enrichment creates an environment that maintains interesting social interactions and allows for the diverse array of communicative functions and sign use observed by this study (R.S. Fouts, Abshire, Bodamer, and Fouts 1989, pp. 386–388).

The chimpanzees produced the communicative function Request in 12.5% of their utterances. Children produce requests in 20% to 50% of their utterances (Day 1986; Dore 1977a, 1977b; Ervin-Tripp 1977). The chimpanzees produced requests less frequently than children. Becker (1982) describes the ability of human children to produce requests as a “highly important social, communicative skill” (p. 3).

Terrace (1979) claimed that chimpanzees only use their signs to request objects and actions. Terrace trained his chimpanzee Nim in the following way:

Typically, Nim reached for something he might want to play with, eat, or inspect. The teacher withheld the item, molded the objects name sign, and then asked Nim to sign for the object. Signs such as give, me, and Nim, while appropriate, were deemed unacceptable when we were trying to teach Nim a new sign. Since the age of 18 months, Nim often offered his hands to his teacher in an apparent request for the teacher to mold the new sign that the teacher wanted him to use (Terrace et al. 1980, p. 377).

The frequency of requests is expected in this context. Human children make significantly more requests in a structured context, where desired objects are out of reach, than in an unstructured context where they are freely available (Wetherby and Rodriguez 1992). A structured context may bias subjects to elicit more requests than in an unstructured context (Wetherby and Prutting 1984; Wetherby et al. 1988; Wetherby et al. 1989).

When chimpanzees learn signs in a complex and enriching environment, like human children, their sign use mirrors that complex environment (B.T. Gardner and Gardner 1989). Though their environment was highly enriched as previously discussed, their environment was a captive one that created a dependence on human caregivers. According to Ervin-Tripp (1977) “A person can, after all, let things be, or act independently rather than induce a listener to serve as an instrument

to needs... The high frequency of directives from children relates to their realistic dependency" (p.165). This same dependency has often been overlooked or ignored in chimpanzee language research (Rivas 2005; Terrace 1979). Yet despite this the cross-fostered chimpanzees use their signs in a variety of functions and are not limited to just requesting (R.S. Fouts 1987; R.S. Fouts and Fouts 1989, 1993; R.S. Fouts; Fouts and Schoenfeld 1984; R.A. Gardner and Gardner 1978, 1988; O'Sullivan, Fouts, Hannum and Schneider 1982).

The chimpanzees produced the function Performative in 7.9% of their utterances. Deaf children produced Performative in 5.7% of their utterances (Day 1986) while hearing children produced Performative in 10.8% of their utterances (Dore 1977a, 1977b). The chimpanzees produced five of the seven subcategories, with Performative Game Marker occurring most frequently (5.4%). The chimpanzees initiated and maintained the occurrence of games with the function Performatives Game Marker. For example, in an interaction with a caregiver, Tatu signed TATU CHASE YOU CHASE, then she ran into the other room (Sign Log #437, 12/28/2001). The chimpanzees regularly engage in games of chase. Human children also regularly engage in games of chase and produced the communicative function Performative Game Marker to initiate bouts of play similar to the chimpanzees, saying, for example, "You can't catch me" (Dore, 1977a, p. 238).

The chimpanzees produced a humorous effect with the function Performative Joke. For example, during an interaction, Tatu called a caregiver STUPID, the caregiver then asked ME STUPID? Tatu responded by signing LAUGH (Sign Log #410, 06/18/2001). Human children produced Performative Joke similarly, for example saying, "I threw the soup in the ceiling" (Dore 1977b, p. 146). The chimpanzees established rights to objects with the function Performative Claim. For example, when a caregiver was serving gum, she first asked Moja to sign CAR. Moja responded READY, READY GUM (Sign Log #97, 07/04/2001). The chimpanzees calmed others and provided support with the function Performative Reassurance. For example, following an agonistic interaction, Washoe approached Loulis with an extended hand to which Loulis ran away. As Loulis ran away, Washoe signed HUG/LOVE HURRY HUG/LOVE (Sign Log #49, 09/28/2001).

The chimpanzees objected to a previous behavior with the function Performative Protest. For example, Washoe had been asking a caregiver for a variety of food items she could not have, upon her last request being denied, Washoe signed DIRTY (Sign Log #17, 06/28/2002). The chimpanzees have previously used their signs to protest the behavior of human caregivers or each other, such as when Washoe referred to Deborah Fouts as DEB DIRTY DEB (R.S. Fouts and Fouts 1993, pp. 34) and when Washoe signed DIRTY DIRTY after Loulis stole her magazine (D.H. Fouts 1994, p. 281).

The chimpanzees produced the function Statement in 3.9% of their utterances. Deaf children produced Statement in 10.3% of their utterances (Day 1986), and hearing children produced Statement in 13.8% of their utterances (Dore 1977a, 1977b). The chimpanzees evaluated their caregivers with the function Statement Evaluation. For example, Tatu signed STUPID to a caregiver. The caregiver replied NO ME NOT STUPID, ME SMART. Tatu replied STUPID (Sign Log #453, 05/30/2002). On another occasion, Moja and a caregiver had been grooming. The caregiver asked WHO ME? Moja replied FRIEND (Sign Log #105, 03/23/2001).

In this study the chimpanzees produced utterances that evaluated their own behavior with the function Statement Evaluation. For example, over a short period the chimpanzees did not receive blankets (their normal nesting materials) due to a study on nesting material use and preference. Dar protested, repeatedly asking for blankets. The human caregivers responded SORRY CAN'T, to which Dar replied BLANKET DAR GOOD BOY (Sign Log #270, 07/04/2003). This study was then discontinued because the chimpanzees demonstrated their desire for blankets and nothing else.

The chimpanzees described their internal states with the function Statement Internal Report. For example, when it was time for dinner, a caregiver asked Moja if she was ready to eat. Moja replied HUNGRY, signed across her stomach (Sign Log #80, 05/14/2002). Previously, Washoe used her signs to inform her caregivers she had the flu by signing HURT, indicating her stomach pain (R.S. Fouts and Mellgren 1976). Human children similarly produced the function Statement Internal Report to express their internal state, saying for example, "My leg hurts" (Dore 1977b, p. 146).

The chimpanzees, like hearing children (Dore 1977a, 1977b), produced Conversational Device least frequently (0.9%). In contrast, deaf children produced Conversational Device third most frequently (18.2%) (Day 1986). While living in the Psychology Building at Central Washington University, the chimpanzees had access to a suite of enclosures. One of the enclosures was across the hall from a human workroom, where the chimpanzees often sought interactions with caregivers. Bodamer and Gardner (2000) systematically studied these initiations. The interlocutor sat in the workroom with his back toward the chimpanzees' enclosure. When the chimpanzee made a noise, he turned and faced the chimpanzee immediately or after a 30 second delay. When the interlocutor faced away, the chimpanzees made noises, such as bronx cheers, and rarely signed. In the delay condition, the noises became louder and faster. Once the interlocutor faced the chimpanzees, they signed and stopped making sounds. Using a naturally occurring situation, this experiment showed the chimpanzees produced the function Conversational Device. The current study only coded the signed behaviors of the chimpanzees,

and thus likely missed a variety of nonsigning behaviors the chimpanzees use to initiate and maintain conversations.

The chimpanzees' utterances were Uninterpretable in 20.8% of the sample. The frequency in deaf children (Day 1986) and hearing children (Dore 1977a) was 3.3% and 7.9% respectively. This difference may be due to methodological reasons. Dore's (1977a, 1977b) methodology allowed coders to consider the interlocutor's subsequent behavior in categorizing utterances. In the current study coders received instruction to disregard the behavior of the interlocutor following the chimpanzees' utterance. This was to avoid the possibility of it influencing the coding of utterances (Lonborg, Daniels, Hammond, Houghton-Wenger, and Brace 1991). This difference may have increased some ambiguity in this study. Another source for Uninterpretable utterances was inappropriate answers to questions. For example, a caregiver was looking through a picture book of Moja with Washoe. The caregiver asked WHO THAT? pointing to a picture of Moja. Washoe signed RED (Sign Log #16, 09/21/2002). This utterance did not answer the interlocutor's question, nor did it contain any semantic or contextual information to determine clearly its function, and thus was coded as Uninterpretable.

Rivas (2005) claimed that the cross-fostered chimpanzees' sign use was non-linguistic because they primarily produced requests with human caregivers. Rivas coded videotapes of the chimpanzees' conversations that had a structured context. They often occurred directly in front of desired out-of-reach objects or during meals. Yet a structured context can bias the use of communicative functions (Wetherby and Rodriguez 1992). Miles (1976) also reported on the significance of the conversational setting for acquiring a representative sample of communicative functions. The current study utilized utterances from relaxed, day-to-day conversations that occurred spontaneously, and showed that the chimpanzees use a variety of communicative functions, with requests occurring only fourth most frequently.

Chimpanzees are highly social and with that they utilize a wide range of communicative functions to navigate their interactions. The chimpanzees' sign use is a robust and flexible aspect of their lives that has persisted throughout the decades. When treated as conversational partners and provided with varying conversational input, the chimpanzees' responses are equally varying (Leitten et al. 2012). The chimpanzees are presented with a variety of conversational partners and topics every day. When compared with methods used in human development, they produce a variety of communicative functions that mirror the use of human children.

Acknowledgements

Preparation of this manuscript was partially supported by the Office of Graduate Studies, Central Washington University, Ellensburg, WA, USA. This research was in partial completion of a Master of Science degree. The authors would also like to thank Amanda Davis for her assistance in coding the data for this study.

Note

1. Here and throughout this report, transcriptions of signs appear in all capital letters. Signed utterances are transcribed into word-for-sign English because more literal translations would add words and word endings that lack signed equivalents either in the vocabularies of the chimpanzees or in ASL. This mode of transcription makes the utterances appear to be in a crude or pidgin dialect, but the reader should keep in mind the fact that equally literal word-for-word transcriptions between English and say, Russian or Japanese, appear equally crude.

References

- Akhtar, N. and Martinez-Sussmann, C. 2007. "Intentional communication". In C.A. Brownell and C.B. Kopp (eds.), *Socioemotional development in the toddler years: Transitions and transformations*. New York: Guilford, 201–220.
- Aureli, T., Perucchini, P., and Genco, M. 2009. "Children's understanding of communicative intentions in the middle of the second year of life". *Cognitive Development* 24: 1–12.
- Austin, J.L. 1962. *How to do things with words*. New York: Oxford University Press.
- Barachetti, C. and Lavelli, M. 2010. "Preschoolers' communicative functions during shared book reading with mothers and fathers". *Early Education & Development* 21: 595–613.
- Becker, J.A. 1982. "Children's strategic use of requests to mark and manipulate social status". In S. Kuczaj (ed.), *Language development: language, thought, and culture* (Vol. 2). London: Lawrence Erlbaum Associates, 1–35.
- Bodamer, M.D., Fouts, D.H., Fouts, R.S., and Jensvold, M.L. 1994. "Functional analysis of chimpanzee (*Pan troglodytes*) private signing". *Human Evolution* 9: 281–296.
- Bodamer, M.D. and Gardner, R.A. 2002. "How cross-fostered chimpanzees (*Pan troglodytes*) initiate and maintain conversations". *Journal of Comparative Psychology* 116: 12–26.
- Brown, R. 1973. *A first language: the early stages*. Cambridge: Harvard University Press.
- Bruce, S., Godbold, E., and Naponelli-Gold, S. 2004. "An analysis of communicative functions of teachers and their students who are congenitally deafblind". *Rehabilitation Education for Blindness and Visual Impairment* 36: 81–90.
- Carpenter, R.L., Mastergeorge, A.M. and Coggins, T.E. 1983. "The acquisition of communicative intentions in infants eight to fifteen months of age". *Language and Speech* 26: 101–116.
- The Chimpanzee Sequencing and Analysis Consortium. 2005. "Initial sequence of the chimpanzee genome and comparison with the human genome". *Science* 437: 69–87.

- Coggins, T.E., Olswang, L.B., and Guthrie, J. 1987. "Assessing communicative intents in young children: low structured observation or elicitation tasks?". *Journal of Speech and Hearing Disorders* 52: 44–49.
- Covington, V.C. 1973. "Juncture in American Sign Language". *Sign Language Studies* 2: 29–38.
- Day, P.S. 1986. "Deaf children's expression of communicative intentions". *Journal of Communication Disorders* 19: 367–385.
- Desrochers, S., Morissette, P., and Richard, M. 1995. "Two perspectives on pointing in infancy". In C. Moore and P.J. Dunham (eds), *Joint attention: Its origins and role in development*. Hillsdale, NJ: Erlbaum, 85–101.
- Dore, J. 1973. "Speech act production and comprehension". *Annals of the New York Academy of Science* 98: 456–469.
- Dore, J. 1974. "A pragmatic description of early language development". *Journal of Psycholinguistic Research* 3: 343–350.
- Dore, J. 1975. "Holophrases, speech acts and language universals". *Journal of Child Language* 2: 21–40.
- Dore, J. 1977a. "Children's illocutionary acts". In R.O. Freedle (ed.), *Discourse production and comprehension (Vol. 1)*. New York: Ablex, 227–244.
- Dore, J. 1977b. "'Oh them sheriff': A pragmatic analysis of children's responses to questions". In S. Ervin-Tripp and C. Mitchell-Kernan (eds.), *Child discourse*. New York: Academic Press, 139–164.
- Drumm, P., Gardner, B.T., and Gardner, R.A. 1986. "Vocal and gestural responses of cross-fostered chimpanzees". *American Journal of Psychology* 99: 1–29.
- Ervin-Tripp, S. 1977. "Wait for me, roller skate!". In S. Ervin-Tripp and C. Mitchell-Kernan (eds.), *Child discourse*. New York: Academic Press, 165–188.
- Flax, J., Lahey, M., Harris, K., and Boothroyd, A. 1991. "Relations between prosodic variables and communicative functions". *Journal of Child Language* 18: 3–19.
- Fouts, D.H. 1994. "The use of remote video recordings to study the use of ASL by chimpanzees when no humans are present". In R.A. Gardner, B.T. Gardner, B. Chiarelli, and F. X. Plooij (eds.), *The ethological roots of culture*. Boston: Kluwer Academic, 271–284.
- Fouts, R.S. 1975. "Communication with chimpanzees". In G. Kurth and I. Eibl-Eibesfeldt (eds.), *Hominisation und verhalten*. Stuttgart: Gustav Fischer Verlag, 137–158.
- Fouts, R.S. 1987. "Chimpanzee signing and emergent levels". In G. Greenberg and E. Tobach (eds.), *Cognition, language and consciousness: Integrative levels. The T.C. Schneirla Conference Series (Vol. 2)*. Hillsdale, NJ: Lawrence Erlbaum Associates, 57–84.
- Fouts, R.S. 1994. "Transmission of a human gestural language in a chimpanzee mother-infant relationship". In R.A. Gardner, B.T. Gardner, B. Chiarelli, and F.X. Plooij (eds.), *The ethological roots of culture*. Boston: Kluwer Academic, 257–270.
- Fouts, R.S., Abshire, M.L., Bodamer, M.D., and Fouts, D.H. 1989. "Signs of enrichment: toward psychological well-being of chimpanzees". In E. Segal (ed.), *Housing, care, and psychological wellbeing of captive and laboratory primates*. Park Ridge: Noyes Publications, 376–388.
- Fouts, R.S. and Fouts, D.H. 1989. "Loulis in conversation with cross-fostered chimpanzees". In R.A. Gardner, B.T. Gardner, and T.E. Van Cantfort (eds.), *Teaching sign language to chimpanzees*. Albany: State University of New York Press, 293–307.
- Fouts, R.S. and Fouts, D.H. 1993. "Chimpanzees' use of sign language". In P. Cavalieri and P. Singer (eds.), *The great ape project*. New York: St. Martin's Griffen, 28–41.
- Fouts, R.S., Fouts, D.H., and Schoenfeld, D. 1984. "Sign language conversational interaction between chimpanzees". *Sign Language Studies* 42: 1–12.

- Fouts, R.S., Fouts, D.H., and Van Cantfort, T.E. 1989. "The infant Loulis learns signs from cross-fostered chimpanzees". In R. Gardner, B. Gardner, and T.E. Van Cantfort (eds.) *Teaching sign language to chimpanzees*. Albany: State University of New York Press, 281–292.
- Fouts, R.S., Hirsch, A.D., and Fouts, D.H. 1982. "Cultural transmission of a human language in a chimpanzee mother-infant relationship". In H. Fitzgerald, J. Mullins, and P. Gage (eds.), *Child nurturance* (Vol. 3). New York: Plenum, 159–192.
- Fouts, R.S. and Mellgren, R.L. 1976. "Language, signs, and cognition in the chimpanzee". *Sign Language Studies* 13: 319–346.
- Furrow, D. 1984. "Social and private speech at two years". *Child Development* 55: 355–362.
- Gardner, B.T. and Gardner, R.A. 1975. "Evidence for sentence constituents in early utterances of child and chimpanzee". *Journal of Experimental Psychology* 104: 244–267.
- Gardner, B.T. and Gardner, R.A. 1989. "A test of communication". In R. Gardner, B. Gardner, and T.E. Van Cantfort (eds.), *Teaching sign language to chimpanzees*. Albany: State University of New York Press, 181–197.
- Gardner, B.T. and Gardner, R.A. 1994. "Development of phrases in the utterances of children and cross-fostered chimpanzees". In R.A. Gardner, B.T. Gardner, B. Chiarelli, and F.X. Plooij (eds.), *The ethological roots of culture*. Boston: Kluwer Academic, 223–255.
- Gardner, R.A. and Gardner, B.T. 1969. "Teaching sign language to a chimpanzee". *Science* 165: 664–672.
- Gardner, R.A. and Gardner, B.T. 1978. "Comparative psychology and language acquisition". *Annals of the New York Academy of Sciences* 309: 37–76.
- Gardner, R.A. and Gardner, B.T. 1988. "Feedforward versus feedbackward: an ethological alternative to the law of effect". *Behavioral and Brain Sciences* 11: 429–493.
- Gardner, R.A. and Gardner, B.T. 1989. "A cross-fostering laboratory". In R.A. Gardner, B.T. Gardner and T.E. Van Cantfort (eds.), *Teaching sign language to chimpanzees*. Albany: State University of New York Press, 1–28.
- Gardner, R.A., Gardner, B.T. and Van Cantfort, T.E. (eds.). 1989. *Teaching sign language to chimpanzees*. Albany: State University of New York Press, PAGES.
- Garvey, C. 1975. "Requests and responses in children's speech". *Child Language* 1: 41–63.
- Goodall, J. 1986. *The chimpanzees of Gombe: patterns of behavior*. Cambridge: Harvard University Press.
- Hartmann, J.Q. 2011. "Timing of turn initiations in signed conversations with cross-fostered chimpanzees (*Pan troglodytes*)". *International Journal of Comparative Psychology* 24: 177–209.
- Jeanes, R.C., Nienhuys, T. and Rickards, F.W. 2000. "The pragmatic skills of profoundly deaf children". *Journal of Deaf Studies and Deaf Education* 5: 237–247.
- Jensvold, M.L. and Gardner, R.A. 2002. "Interactive use of sign language by cross-fostered chimpanzees (*Pan troglodytes*)". *Journal of Comparative Psychology* 114: 335–346.
- John, A.E. and Mervis, C.B. 2010. "Comprehension of the communicative intents behind pointing and gazing gestures by young children with Williams syndrome or down syndrome". *Journal of Speech, Language, and Hearing Research* 53: 950–960.
- Keenan, E.O. 1977. "Making it last: repetition in children's discourse". In S. Ervin-Tripp and C. Mitchell-Kernan (eds.), *Child discourse*. New York: Academic Press, 125–138.
- Keenan, E.O. and Klein, E. 1975. "Coherency in children's discourse". *Journal of Psycholinguistic Research* 4: 365–380.
- Krause, M.A. and Fouts, R.S. 1997. "Chimpanzee (*Pan troglodytes*) pointing: Hand shape, accuracy, and the role of eye gaze". *Journal of Comparative Psychology* 111: 330–336.

- Leitten, L., Jensvold, M.L., Fouts, R.S. and Wallin, J. 2012. "Contingency in requests of signing chimpanzees (Pan troglodytes)". *Interaction Studies* 13: 147–164.
- Lonborg, S.D., Daniels, J.A., Hammond, S.G., Houghton-Wenger, B. and Brace, L.J. 1991. "Counselor and client verbal response mode changes during initial counseling sessions". *Journal of Counseling Psychology* 34: 394–400.
- Lyn, H., Greenfield, P.M., Savage-Rumbaugh, S., Gillespie-Lynch, K., and Hopkins, W.D. 2011. "Nonhuman primates do declare! A comparison of declarative symbol and gesture use in two children, two bonobos, a chimpanzee". *Language & Communication* 31: 63–74.
- MacRoy-Higgins, M. and Kaufman, I. 2012. "Pragmatic functions of toddlers who are late talkers". *Communication Disorders Quarterly* 33: 242–244.
- Miles, L.W. 1976. "Discussion Paper: The communicative competence of child and chimpanzee". In S.R. Harnad, H.D. Steklis and J. Lancaster (eds.), *Origins and evolution of language and speech: Annals of the New York Academy of Sciences*, (Vol. 280). New York: New York Academy of Sciences, 592–597.
- Nicholas, J.G. and Geers, A.E. 1997. "Communication of oral deaf and normally hearing children at 36 months of age". *Journal of Speech, Language, and Hearing Research* 40: 1314–1327.
- Nicholas, J.G. and Geers, A.E. 2003. "Hearing status, language modality, and young children's communicative and linguistic behavior". *Journal of Deaf Studies and Deaf Education* 8: 422–437.
- Ninio, A., Snow, C.E., Pan, B.A. and Rollins, P.R. 1994. "Classifying communicative acts in children's interactions". *Journal of Communication Disorders* 27: 158–187.
- O'Sullivan, C., Fouts, R.S., Hannum, M.E. and Schneider, K. 1982. "Chimpanzee conversations: language, cognition, and theory". In S. Kuczaj (ed.), *Language development: language, thought, and culture* (Vol. 2). London: Lawrence Erlbaum Associates, 397–428.
- Patterson, F., Tanner, J. and Mayer, N. 1988. "Pragmatic analysis of gorilla utterances". *Journal of Pragmatics* 12: 35–54.
- Rivas, E. 2005. "Recent use of signs by chimpanzees (Pan troglodytes) in interactions with humans". *Journal of Comparative Psychology* 119: 404–417.
- Ruvolo, M., Pan, D., Zher, S., Goldberg, T., Disotell, T. and von Dornum, M. 1994. "Gene trees and hominoid phylogeny". *Proceedings of the National Academy of Sciences* 91: 8900–8904.
- Searle, J. R. 1969. *Speech acts: An essay in philosophy of language*. Cambridge: Cambridge University Press.
- Sibley, C. and Ahlquist, J. 1984. "The phylogeny of the hominoid primates, as indicated by DNA-DNA hybridization". *Journal of Molecular Evolution* 20: 2–15.
- Stamps, J. 2003. "Behavioral processes affecting development: Tinbergen's fourth question comes of age". *Animal Behaviour* 66: 1–13.
- Stanyon, R., Chiarelli, B., Gottlieb, K. and Patton, W. 1986. "The phylogenetic and taxonomic status of pan paniscus: a chromosomal perspective". *American Journal of Physical Anthropology* 69: 489–498.
- Terrace, H.S. 1979. *Nim*. New York: Alfred A. Knopf.
- Terrace, H.S., Petitto, L.A., Sanders, F. J. and Bever, T.G. 1980. "On the grammatical capacity of apes". In K. Nelson (ed.), *Children's language* (Vol. 2). New York: Gardner Press, 371–496.
- Van Cantfort., T.E., Gardner, B.T. and Gardner, R.A. 1989. "Developmental trends in replies to Wh-questions by children and chimpanzees". In R.A. Gardner, B.T. Gardner and T.E. Van Cantfort (eds.), *Teaching sign language to chimpanzees*. Albany: State University of New York Press, 198–239.

- Wedell-Monnig, J. and Lumley, J. 1980. "Child deafness and mother-child interaction". *Child Development* 51: 766–744.
- Wetherby, A.M. 1986. "Ontogeny of communicative functions in autism". *Journal of Autism and Developmental Disorders* 16: 295–316.
- Wetherby, A.M., Cain, D.H., Yonclas, D.G. and Walker, V.G. 1988. "Analysis of intentional communication of normal children from the prelinguistic to the multiword stage". *Journal of Speech and Hearing Research* 31: 240–252.
- Wetherby, A.M. and Prutting, C.A. 1984. "Profiles of communicative and cognitive-social abilities in autistic children". *Journal of Speech and Hearing Research* 27: 364–377.
- Wetherby, A.M. and Rodriguez, G.P. 1992. "Measurement of communicative intentions in normally developing children during structured and unstructured contexts". *Journal of Speech and Hearing Research* 35: 130–138.
- Wetherby, A.M., Yonclas, D.G., and Bryan, A.A. 1989. "Communicative profiles of preschool children with handicaps: Implications for early identification". *Journal of Speech and Hearing Disorders* 54: 148–158.
- Ziats, K., Durkin, K. and Pratt, C. 2003. "Differences in assertive speech acts produced by children with autism, asperger syndrome, specific language impairment, and normal development". *Development and Psychopathology* 15: 73–94.

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