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Caregiver–chimpanzee interactions with species-specific behaviors

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The relationships between captive primates and their caregivers are critical ones and can affect animal welfare. This study tested the effect of caregivers using chimpanzee behaviors or not, in daily interactions with captive chimpanzees. In the Chimpanzee Behavior (CB) condition the caregiver presented chimpanzee behaviors. In the Human Behavior (HB) condition the caregiver avoided using chimpanzee behaviors. The chimpanzees had individual patterns of response and had significant differences in their responses to each condition. These data are compared to a similar study conducted at The Zoo Northwest Florida (ZNWF). Both groups of chimpanzees were sensitive and responsive to the differences in conditions. These data suggest ways to improve animal welfare.

Keywords: chimpanzee behavior; animal welfare;
species-specific behavior; husbandry

1. Introduction

The relationships between captive non-human animals and their caregivers are critical ones and can affect animal welfare. Across taxa friendly relationships can improve the quality of life; adversely, agonistic relationships can decrease quality of life. In terms of negative interactions, captive primates often react fearfully and aggressively toward their caregivers (O'Neill, 1989) and the mere presence of the caregiver can have a negative effect (Line, Markowitz, Morgan & Strong, 1991; Bloomsmith, Baker, Ross & Lambeth, 1999). In addition to the quality of relationships, the activities associated with the captive environment can affect its residents. During husbandry activities, chimpanzees have higher wounding rates (Lambeth, Bloomsmith & Alford, 1997). Monkeys (Alford, Nash, Fritz & Bowen, 1992) have more births over weekends when husbandry activities are decreased. Husbandry activities are associated with elevated heart rates in laboratory monkeys (Line, et al., 1991).

In terms of positive relationships in a comparison of laboratory macaques who were friendly versus aggressive toward caregivers, the friendly ones were less disturbed by daily laboratory activities (Waite, Buchanan-Smith & Morris, 2002). In another study, when caregivers spent 2 min per day interacting with and distributing food treats to laboratory rhesus macaques, abnormal behaviors were reduced (Bayne, Dexter & Strange, 1993). Likewise, when chimpanzee caregivers spent 10 min a day engaging laboratory chimpanzees in play, grooming, and treat provisioning, the chimpanzees showed an overall increase in play and grooming and a reduction in abnormal behaviors (Baker, 2004). A singly housed gorilla who had intensive one-on-one interaction with a caregiver had a complete reduction of aggressive behaviors and an increase in browsing behaviors over the 5 ½ year study period (Pizzutto et al., 2007). In a developmental study, infant laboratory chimpanzees received “responsive care” for 4 hours per day (Bard & Gardner, 1996). This care included treatment in which caregivers carried infants in species-typical ways such as dorsal riding and initiated and reciprocated “social behaviors primarily with conspecifics but also with humans” (Van IJzendoorn, Bard, Bakermans-Kranenburg & Ivan, 2009, p. 176). In comparison to standard laboratory-reared infants, the responsive-care infants performed higher in multiple measures of development. These included cognitive development and responses to strangers. Also the responsive-care infants were less attached to objects.

While research shows that the mere presence of caregivers is stressful (Alford et al., 1992; Bloomsmith et al., 1999; Lambeth et al., 1997; Line et al., 1991), the research that manipulates caregivers’ behaviors suggests that in some cases it is the caregivers’ behaviors and the nature of their interactions that are the basis for the stress (Baker 2004; Bayne et al., 1993; Pizzutto et al., 2007; Van IJzendoorn et al., 2009; Waite et al., 2002). This study investigates these interactions.

One method claimed to mitigate potential negative effects of caregivers and promote positive relationships is for caregivers to employ species-specific behaviors in their interactions with their charges. At the Chimpanzee and Human Communication Institute (CHCI) in Ellensburg, Washington, USA, all caregivers learn to identify chimpanzee behaviors and their contextual meanings. During husbandry activities caregivers use these behaviors in interactions. This study systematically compared the responses of these chimpanzees during different conditions when caregivers did not use these behaviors during some interactions versus other interactions when the caregivers did use these behaviors. The hypothesis was that there would be differences in the amount of time they spent in the behavioral contexts between conditions and that the chimpanzees would interact more with caregivers when in a condition when caregivers’ used chimpanzee behaviors.

2. Method

Chimpanzees. The chimpanzees were Tatu, Dar, and Loulis living at CHCI. Tatu, a female, was born on December 30, 1975 at the Institute for Primate Studies, at the University of Oklahoma in Norman, USA. Dar, a male, was born on August 2, 1976 at Holloman Air Force Base in Alamogordo, New Mexico, USA. Loulis, a male, was born on May 10, 1978 at the Yerkes Regional Primate Research Center in Atlanta, Georgia, USA. They have resided together in a group since 1981.

As infants Tatu and Dar were raised by humans who all used American Sign Language (ASL) in a cross-fostering laboratory at the University of Nevada-Reno USA (Gardner & Gardner, 1989). They acquired signs in this environment (Gardner & Gardner, 1974; Gardner, Gardner & Van Cantfort, 1989). Loulis was raised by another cross-fostered chimpanzee, Washoe, from the age of 10 months and acquired his signs primarily from her and the other signing chimpanzees (Fouts, Hirsch & Fouts, 1982; Fouts, 1994). As adults the chimpanzees sign in all of their interactions with their caregivers (Jensvold & Gardner, 2000; Bodamer & Gardner, 2002).

Humans. During an experimental interaction one caregiver interacted with the group of chimpanzees. A total of four caregivers participated in this study. Morning interactions were equally divided among three caregivers. The fourth caregiver interacted in the midday interactions. All chimpanzee caregivers at CHCI, including the ones who participated in this study, received individualized hands-on training that generally lasted 3–6 months. During CHCI's caregiver training, experienced staff members demonstrated safety protocols, the use of chimpanzee behaviors, and fostered positive relationships between the trainee and the chimpanzees. Additionally, trainees learned to interpret chimpanzee behavior and incorporate appropriate chimpanzee behaviors in their interactions with the chimpanzees.

The methods were approved by the CWU Institutional Animal Care and Use Committee and the Human Subjects Committee. All caregivers signed an informed consent agreement.

Interactions. Experimental interactions occurred before breakfast or after lunch. During meal times the chimpanzees had access to the Night Enclosures and it was there that the interactions occurred. The caregiver interacted with any of the chimpanzees who were in the Night Enclosures. Caregivers always remained outside of the enclosures, so the interactions occurred through a wire fence. The interactions lasted 10 min. The experimental interactions during data collection were typical of the normal daily activities. Caregivers followed the lead of the chimpanzee or the normal routine. This included grooming,

playing, serving meals, or presenting enrichment. The chimpanzees were never forced to participate.

Conditions. Some days the human participant presented chimpanzee behaviors and vocalizations as the Chimpanzee Behavior (CB) condition in the interactions with the chimpanzees, which means she behaved in the usual way. For example, when a human participant groomed a chimpanzee, she lip smacked and made other grooming noises. During greetings she presented head nods, pants, and offered the back of the wrist for a kiss. During times of excitement, she pant hooted and head nodded. When the chimpanzees were served food, she food grunted. On other days the human participant presented human behaviors as the Human Behavior (HB) condition in the experimental interactions with the chimpanzees. In this condition, during grooming she only examined the chimpanzee's hair without lip smacking. During greeting she smiled and occasionally touched but did not head nod or pant. When serving food she did not use food grunts. The use of ASL was held constant in both conditions. The caregiver and the chimpanzees signed to one another in the same way they did during usual, day-to-day interactions across conditions.

There were a total of 30 experimental interactions, 15 in each condition. In each condition six interactions were in the morning before lunch and nine interactions were after lunch. Only one interaction occurred per day and there were several interactions per week. The schedule of presentations of conditions for each day was randomized within the morning and midday interactions. Each caregiver's interactions were evenly divided between the two conditions and the order of presentation was random.

Videotaping. A camera person videotaped all experimental interactions. The only difference between experimental and normal daily interactions was the videotaping and the caregiver's use of human behaviors during the HB condition sessions. A total of 300 min of data was recorded.

Data coding. Using a continuous focal sampling procedure, data coders viewed and coded each chimpanzee's behaviors as they appeared on the videotape. They categorized behaviors into contexts using an ethogram. The ethogram contained 12 behavioral contexts: Affinitive Social, Agonistic, Greeting, Grooming, Non-affinitive Social, Non-interactive, Play, Reassurance, Serving, Threat, Multiple Interactive, and Not Visible. The ethogram appears in Table 1. The interactive contexts could involve any partner, human or chimpanzee. Coders also recorded the time that each context began. Each time the context shifted for more than 5 sec, the coder recorded the new context and its start time. This produced a duration for each context for each chimpanzee. If the behaviors that make up a particular context never occurred, then that context may have a total duration of 0 seconds.

Table 1. Context Definitions

Context	Definition
Affinitive Social	Interactions often accompanied by embraces, open mouth kisses, touching, or following another chimpanzee or human. Includes soliciting an object or contact from another individual; approaching another individual that results in an affinitive social interaction; when the focal is displaced by another chimpanzee or displaces another chimpanzee. Includes receiving affinitive interactions. For example a chimpanzee allows another individual to take an object or another individual touches the focal chimpanzee. The focal chimpanzee may be either delivering or receiving these behaviors.
Agonistic	Interactions that have aggressive physical contact. Behaviors include poking, kicking, biting, spitting (with contact), throwing an object at another individual, or hitting another individual with an object. The focal chimpanzee may be either delivering or receiving these behaviors.
Greeting	An interaction between individuals who meet after a separation. Behaviors in this category include panting, bobbing, head nodding, arm stretch, kiss, and wrist bend. The focal chimpanzee may be either delivering or receiving these behaviors.
Grooming	A variety of skin care patterns directed at another individual. Behaviors include parting the hair with the lips, fingers, or objects, inspecting another individual's body, lip smacking, and teeth clacking. The focal chimpanzee may be either delivering or receiving these behaviors.
Multiple Interactive	When two interactive contexts occur simultaneously. For example the focal greets one individual and is groomed by another. If one context is interactive and the other is non-interactive, only the interactive category is coded.
Non-affinitive Social	Mildly aggressive interactions including behaviors such as blocking passage or screaming in the absence of submissive gestures or postures. The focal chimpanzee may be either delivering or receiving these behaviors.
Non-interactive	The focal chimpanzee is not engaged in an interaction. Behaviors include coprophagy, eating, lone play, masturbation, object manipulation, rest, self-groom, stereotypic behaviors, and travel. Also includes when the chimpanzee is showing signs of arousal such as piloerect hair or swaggering but is clearly not interacting with another individual.
Play	Interactions are marked by specific behaviors such as play face, laugh, play walk, tickling, or chasing. Behaviors include object play, head butts, dragging, or pinching. The play face and exaggerated behaviors are key indicators of this category. The focal chimpanzee may be either delivering or receiving these behaviors.
Reassurance	An interaction in which one individual calms another after a high arousal situation. Behaviors include hug, kiss, hand hold, whimpering and crouching. The focal chimpanzee may be either delivering or receiving these behaviors.
Serving	The focal chimpanzee receives food from the caregiver. Behaviors include approaching the caging to be served or positioning self to receive food. The context must be interactive; simply eating food is not included in this category.
Threat	An interaction with aggressive behaviors and no contact. Behaviors include display, bipedal swagger, back hand thump, cough bark, spitting, or poking. The focal chimpanzee may be either delivering or receiving these behaviors.
Not Visible	No data is available because the focal chimpanzee's behavior is not visible for longer than 3 sec.

Six data coders independently coded the data. To establish interobserver reliability, another coder independently coded 20% of each of the original coders' data. Percent agreement (Hartman, 1977) was 90% for the times the context changed and 88% for the context coding.

The contexts Affinitive Social and Greet were combined since Greet was infrequent. Chi-Square Goodness of Fit tests were calculated on the distribution of seconds in CB versus HB for each chimpanzee. To calculate expected frequencies for CB, the proportion of seconds in each cell in HB to the total seconds in HB was used. Post-hoc pairwise comparisons were calculated using the observed frequency in a cell versus the expected frequency for that same cell.

3. Results

Tatu had a significant difference in the distribution of time between the conditions $\chi^2(4, N = 9628) = 637, p < .0001$. Figure 1a shows the distribution of her time. Pairwise chi-square comparisons showed Tatu spent significantly more time in HB than CB in Affinitive Social/Greet $\chi^2(1, N = 4720) = 36.01, p < .0001$, Groom $\chi^2(1, N = 178) = 159.2, p < .0001$, and Serve $\chi^2(1, N = 403) = 21.36, p < .0001$. She spent significantly more time in CB than HB in Non-interactive $\chi^2(1, N = 4653) = 40.95, p < .0001$ and Play $\chi^2(1, N = 124) = 159.2, p < .0001$. She never engaged in the Agonistic, Non-affinitive Social, Multiple Interactive, Reassurance, or Threat contexts.

Loulis had a significant difference in the distribution of time in each condition $\chi^2(4, N = 3855) = 196.57, p < .0001$. Figure 1b shows the distribution of his time. Pairwise chi-square comparisons showed Loulis spent significantly more time in HB than CB in Play $\chi^2(1, N = 655) = 6.74, p = .0094$ and Serve $\chi^2(1, N = 1393) = 16.93, p < .0001$. He spent significantly more time in CB than HB in Affinitive Social/Greet $\chi^2(1, N = 452) = 33.63, p < .0001$ and Groom $\chi^2(1, N = 61) = 89.04, p < .0001$. His time was equally distributed in the Non-interactive context. He never engaged in the Agonistic, Non-affinitive Social, Multiple Interactive, Reassurance, or Threat contexts.

Dar had a significant difference in the distribution of time in each condition $\chi^2(4, N = 4512) = 1320.06, p < .0001$. Figure 1c shows the distribution of his time. Pairwise chi-square comparisons showed Dar spent significantly more time in HB than CB in Groom $\chi^2(1, N = 699) = 7.5, p = .0062$, Non-interactive $\chi^2(1, N = 1943) = 182.3, p < .0001$, and Serve $\chi^2(1, N = 333) = 42.28, p < .0001$. He spent significantly more time in CB than HB in Affinitive Social/Greet $\chi^2(1, N = 860) = 154.4, p < .0001$ and Play $\chi^2(1, N = 677) = 410, p < .0001$. He never engaged in the Agonistic, Non-affinitive Social, Multiple Interactive, Reassurance, or Threat contexts.

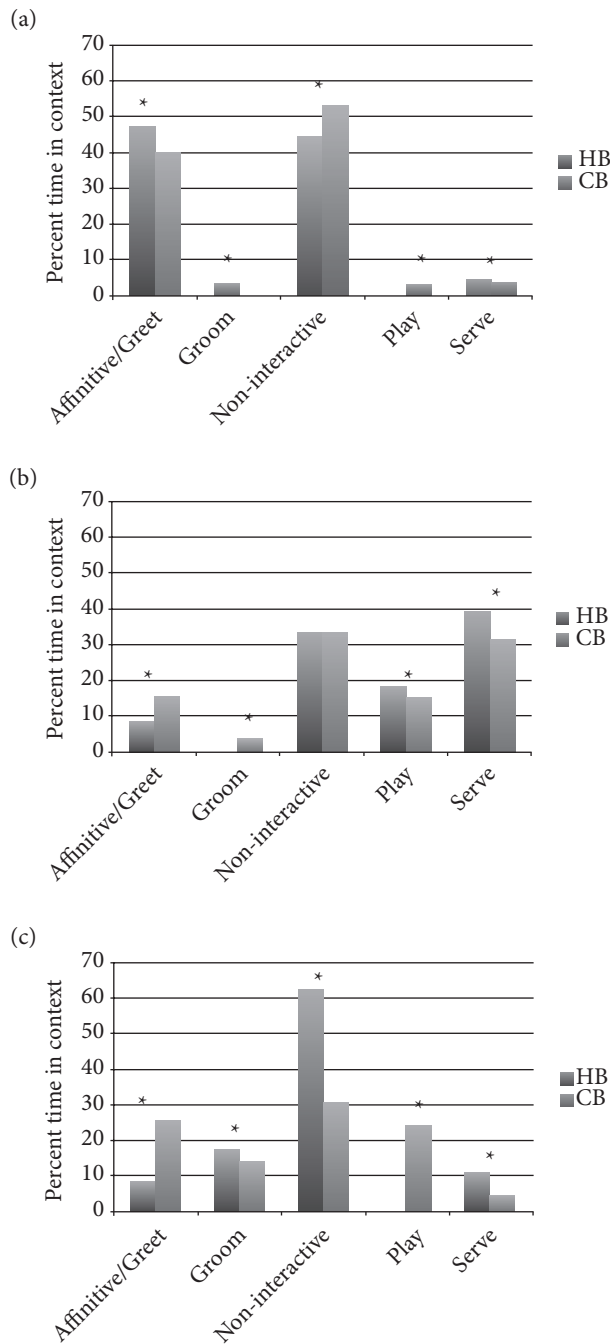


Figure 1. (a) Percentage of time Tatu spent in behavioral contexts; (b) Percentage of time Loulis spent in behavioral contexts; (c) Percentage of time Dar spent in behavioral contexts. *Indicates significant differences at $p < .05$. See text for exact P -values

4. Discussion

Each chimpanzee discriminated between the conditions with individual patterns in their responses and all three had significant differences in their responses to the conditions. While Tatu and Dar played significantly more in CB than HB, Loulis played more in HB than CB. The Non-interactive category showed that Tatu interacted significantly more often in HB, Loulis interacted equally often in each condition, and Dar interacted significantly more often in CB. Each chimpanzee engaged in the Serve context significantly more in HB than CB. Individual differences also appeared when Baker, Bloomsith, Griffis, and Gierhart (2003) exposed rhesus monkeys to different amounts of caregiver interaction and training. Monkeys who often engaged in self-injurious behaviors were more sensitive to the varying level of treatment than non-self-injurious monkeys. Waitt et al. (2002) also found that individual monkeys reacted differently to the same caregiver treatment based on the monkey's temperament. Monkeys who were rated as unfriendly by caregivers reacted aggressively to caregivers. Suomi (1991) also found differences in how "uptight" versus "laid-back" monkeys responded to social changes. For example young "uptight" monkeys became withdrawn after a separation from their mothers while "laid-back" monkeys adjusted quickly. Consideration of individual differences should be considered in care protocols.

CHCI is unique in that caregivers routinely use chimpanzee behaviors, so the HB condition was unusual for the chimpanzees in this study. In contrast, at most other facilities caregivers use only human behaviors. This raises an interesting question of how standard-reared chimpanzees would react if caregivers began to use chimpanzee behaviors. Jensvold (2008) presented the same HB and CB conditions to three chimpanzees Patrick, Zachary, and ZooGood at The Zoo Northwest Florida (ZNWF) in Gulf Breeze, Florida, USA. Prior to the experiment the participant caregivers had never used chimpanzee behaviors, so the introduction of the CB condition was novel in this study. Like Tatu, Dar, and Loulis the ZNWF chimpanzees discriminated between conditions. Additionally the three ZNWF chimpanzees interacted significantly more and two played significantly more in CB than HB. Table 2 shows a comparison of the CHCI data to the ZNWF data and shows there were some overall trends in the responses of both groups. Four of the six chimpanzees showed significantly more play in CB than HB. Four of the six chimpanzees showed significantly more Non-interactive in HB than CB. The non-interactive context is an indicator of how engaged the chimpanzees were with the caregiver. A higher non-interactive means the chimpanzees were less engaged with the caregiver. The ZNWF chimpanzees had been reared from a young age away from their mother in a zoo setting, while Tatu and Dar were home-reared by humans, and Loulis was raised by a chimpanzee. This data shows that the chimpanzees, regardless of their history, are sensitive to the caregivers' behaviors.

Both groups were exposed to a novel condition of interaction, and both groups discriminated between conditions. The CHCI data is strengthened somewhat by the replication of the zoo findings and indicates a need for further research with a larger population.

Table 2. Comparison of results from CHCI and ZNWF

	Affinitive	Groom	Non-interactive	Play	Serve
CHCI					
Tatu	HB	HB	CB	CB	HB
Loulis	CB	CB	=	HB	HB
Dar	CB	HB	HB	CB	HB
ZNWF					
Patrick	CB	=	HB	=	=
Zachary	=	CB	HB	CB	=
ZooGood	=	HB	HB	CB	=

Note. CB indicates for that context the chimpanzee spent significantly more time in CB than HB. HB indicates for that context the chimpanzee spent significantly more time in HB than CB. = indicates that for that context the chimpanzee spent equal amounts of time in each condition.

Studies of other taxa show that caregivers can influence the interaction by using species-typical behaviors. For example, Bayne et al. (1993) showed caregivers' use of species-specific behaviors decreased abnormal behaviors in monkeys. Upright postures in kangaroos are threats and Hediger (1965) described a reduction in kangaroo aggression when keepers bowed. Similarly Lott and Hart (1979) described how Fulani herdsmen in Africa strengthen bonds with their cattle by stroking cattle on the inside of the rear leg, a place where mothers lick their calves. The cattle in return approach and lick the herdsmen indicating a friendly relationship. Species-specific behaviors might incorporate the human into the non-human animal's social structure. Caregivers can incorporate themselves in various ways to achieve differing ends depending on the management goal and the social organization of the species.

When humans interact with each other they exhibit postural congruency; partners' heads, bodies, and limbs match each other. For example, both partners may cross legs or tilt heads. Additionally, their movements are synchronized and coordinated (Condon & Ogston, 1967; Kendon, 1970). Both naturalistically (Charney, 1966; LaFrance & Broadbent, 1976) and experimentally (Trout & Rosenfeld, 1980) when postures match between partners, observers judge the partners as having high rapport. When individuals experience partners who match their behavior, they report increased liking for the partner (Chartrand & Bargh, 1999) and are more helpful, generous, and cooperative with the partner (van Baaren, Holland, Kawakami & van Knippenberg, 2004; Wiltermuth & Heath, 2009). This has implications for

improving therapeutic (Maurer & Tindall, 1983) and teacher–student relationships (Bernieri, 1988) by strengthening social attachment (Lakin & Chartrand, 2003; Lakin, Jefferis, Valerie, Cheng & Chartrand, 2003). Postural congruency also occurs among chimpanzees (Jazrawi, 2000) and Toque macaques (Boyd, 1997). In a laboratory setting capuchin monkeys handled a ball in the presence of two experimenters one who mimicked the monkey's actions and another who did not. The monkeys increased eyegaze, moved closer to, and were more cooperative in a token exchange paradigm with the mimicking experimenter (Paukner, Suomi, Visalberghi & Ferrari, 2009). In the present study when caregivers used species-specific behaviors, they were matching the behaviors of the chimpanzees. Thus using species-specific behaviors is a way to increase rapport, cooperation, and affiliation between chimpanzees and their caregivers. The interaction of the use of species-specific behaviors and postural congruency is an area that deserves further systematic research.

The use of species-specific behaviors can extend beyond familiar caregivers; in both laboratory (Lambeth, et al., 1997; Maki, Alford & Bramblett, 1987) and zoo (Chamove, Hosey & Schaetzel, 1988; Davey, 2007) settings, visitors can increase aggression in chimpanzees. Typical visitor behaviors such as grins and bipedal stances are either friendly or benign human behaviors, but signal aggression among chimpanzees (Goodall, 1986). Public visitors at CHCI are educated to use nonthreatening behaviors such as sitting, instead of standing, and showing playfaces, instead of grins. Chamove, et al. (1988) asked zoo visitors to use the submissive monkey behavior of crouching while in front of monkey exhibits. The monkeys were less aggressive when the visitors were crouching versus standing. Thus the use of species-typical behaviors can be extended beyond caregivers to visitors and this could be an area of future research.

The CHCI results and other supporting studies show in some individuals an increase in play and approach and a reduction in aggression when caregivers use species-typical behaviors (Jensvold, 2008; Bayne, et al., 1993; Hemsworth et al., 1992), which are characteristic of relaxed friendly relationships. Relaxed friendly relationships are a critical aspect of life in captivity (Poole, 1996; Reinhardt, 1992) and there is physiological as well as behavioral evidence that friendly interactions are beneficial (Hemsworth, et al., 1992; Nerem, Levesque & Cornhill, 1980; Pizutto, et al., 2007). Indeed, humans with more friends live longer (Giles, Glonek, Luszcz & Andrews, 2005), have reduced stress (Taylor, Klein, Lewis, Gruenewald, Gurung & Updegraff, 2000) and more health benefits (Costanzo, Lutgendorf, Sood, Anderson, Sorosky & Lubaroff, 2005) than those with fewer friends. Thus the evidence with humans shows that friendly relationships can improve quality of life and this study demonstrates a potential way to attain this in nonhumans.

The data presented in this paper coupled with similar evidence from the zoo group (Jensvold, 2008) provide evidence that chimpanzees are sensitive to their caregivers' nonverbal behavior and preliminary evidence that caregivers' use of chimpanzee behaviors elicits more interaction and playful interaction from some chimpanzees. It may be beneficial if caregivers receive training in chimpanzee behaviors and utilize them in interactions with their charges to promote well-being in captive chimpanzees.

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