

## ORIGINAL ARTICLE

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**Do chimpanzees tailor their gestural signals to fit the attentional states of others?**

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**Abstract** The use of vocalizations and tactile gestures by seven juvenile chimpanzees was experimentally investigated. The subjects interacted with an experimenter who typically handed them food rewards. In some trials, however, the experimenter waited 20 s before doing so. In these trials the experimenter's eyes were either open or closed, or the experimenter was either looking away from the subject or looking directly at him/her inquisitively with head movements. Although the chimpanzees produced at least one of the non-visual gestures mentioned (touching/tapping the experimenter or vocalizing) in 72% of all experimental trials, these actions and vocalizations were deployed without regard to the attentional state of their potential recipient, despite evidence that the subjects noticed the postures that defined the experimenter's attentional state. The results are discussed in the context of the distinction between the evolution of an understanding of seeing/attention as an internal mental state versus an understanding of behavioral postures alone.

**Key words** Chimpanzees · Theory of mind · Mental state attribution · Attention · Gaze-following

**Introduction**

An emerging question for the field of comparative cognition concerns to what extent (if at all) non-humans reason about internal mental states (Premack and Woodruff 1978; Povinelli 1993; Tomasello et al. 1993; Vaclair 1996). Although no definitive answers have been obtained, investigators working with non-human primates have recently made progress by focusing on separate problems

relating to imitation, attention, intentions, knowledge, and belief (see reviews, Byrne 1995; Povinelli and Preuss 1995; Tomasello and Call 1997). One promising area of research has focused on chimpanzees' understanding of attention. Several reasons for this focus exist. First, chimpanzees (like other non-human primates) are very interested in the eyes of other organisms. Povinelli and Eddy (1996 a, b, c, 1997), for example, have shown that chimpanzees are sensitive to the direction of gaze of others, and will track that gaze into areas outside their immediate visual field (for additional evidence of gaze-following in chimpanzees and other non-human primates see Emery et al. 1997; Tomasello et al. 1998). Indeed, chimpanzees will even follow the line-of-sight of others in response to eye movements alone. In addition, in affiliative situations, direct eye contact is an especially salient cue for chimpanzees and other great apes (Köhler 1925; Schaller 1963; Goodall 1986; de Waal 1989; Bard 1990; Gómez 1990; Povinelli and Eddy 1996 c). For example, de Waal (1982) notes that reconciliation does not begin until eye contact is established between the relevant individuals. These facts are important because they raise the possibility that chimpanzees may appreciate that seeing is about (or refers to) objects or events in the external world.

Despite their excellent ability to follow and use the gaze of others, several recent studies have cast doubt on the idea that chimpanzees interpret gaze as a projection of an internal mental state of attention. For example, when required to reason about two individuals, one who could see them, another who could not, Povinelli and Eddy (1996 a) reported that despite extensive experience, 5- to 6-year-old chimpanzees behaved as if they did not appreciate that only one of the experimenters could see their gestures. Furthermore, longitudinal studies which followed these same animals into young adulthood have recently confirmed these findings (Povinelli 1996; Reaux et al. 1999).

One understudied area of chimpanzees' natural behavioral repertoire are gestures which are structurally similar to human attention-getting behaviors. Chimpanzees spontaneously display behaviors such as touching and vocalizing at others both in captivity and in the wild (Goodall

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1986; Tomasello et al. 1994; Gómez 1996a). At some point during the first 2 or 3 years of life, human children develop the ability to use their gestural signals appropriately, adjusting to the internal attentional state of the intended recipient (e.g., O'Neill 1996; Povinelli and Eddy 1996a). For example, when a mother is turned away from her child, and the child is seeking to gain the mother's visual attention, the child will touch the mother, and in some cases the child will turn the mother's face toward her. Thus, some researchers believe that the execution of similar behaviors in chimpanzees may be evidence that they understand others as possessing internal mental states related to attention – comparable to the kind of understanding present in human children (Leavens et al. 1996; Krause and Fouts 1997).

The above considerations can be used to generate two models of chimpanzees' understanding of seeing and attention. First, it is possible that, like humans, chimpanzees reason about seeing as both a behavioral state *and* a mental state. That is, they interpret particular physical postures of other organisms (e.g., eyes open and oriented towards an object or event) as meaning that the other organisms is having the perceptual experience of seeing or attending to that object or event. If true, chimpanzees ought to understand that when another organism is looking at them, this other organism can receive any visually based signals that they might send. Conversely, auditory or tactile gestures, although possible, are superfluous.

In contrast, a second model asserts that chimpanzees simply reason about how the physical postures of others are connected to behavioral outcomes. In short, this model states that they reason about the behavioral propensities associated with particular movements of the eyes and heads of other organisms, and do not reason about internal perceptual states that the other organism may experience. If true, chimpanzees could understand that their own gestural signals may affect the behavior of others, but not that these signals are received (in any psychological sense) by the recipient.

We sought to test these two models by determining if the patterns of our chimpanzees' use of non-visually-based gestural signals such as touches and vocalizations would systematically differ depending on the visual attentional state of the experimenter (that is, whether the frequency of touches and vocalizations would vary as a function of whether a familiar experimenter was visually attending to them). We focused on chimpanzees' use of vocalizations and tactile gestures because these appeared to be intermediate behaviors not directly part of the act of receiving food. This is especially true for the subjects who participated in this study. Throughout their experimental histories, these apes participated in hundreds of trials in which they used a visual gesture in front of an experimenter, which is part of chimpanzees' natural behavioral repertoire (Bygott 1979; de Waal 1982; Goodall 1986). After the gesture had been made, the experimenter handed them a food reward. In contrast, reinforcement was never contingent upon vocalizations or tactile gestures in this setting, although the apes certainly use such gestures in

their spontaneous, daily interactions with their human caretakers. This is an important conceptual point, because even when a chimpanzee vocalizes or touches an experimenter with the goal of receiving food, the visual gesture (arm extended, palm open) must always be the final behavior by the chimpanzee in the sequence leading up to receiving a reward. Tomasello et al. (1994) used an analogous rationale to operationalize similar non-visual behaviors used by chimpanzees to aid in the communication of visual play gestures.

Although this study is broadly similar to one briefly described by Gómez (1994, 1996a, b), it was not intended as a formal replication as the two studies differ in several important aspects (see Discussion). Rather, this study was intended as a follow-up to our previous work on our chimpanzees' understanding of seeing as attention (Povinelli and Eddy 1996a). Perhaps our previous designs in which we asked the chimpanzees to reason about the attentional states of two experimenters was too complex to enable the chimpanzees to display an understanding of attention as a mental state that they did, in fact, possess. In this study we simplified the design, asking the chimpanzees to only consider the attentional state of a single individual.

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## Methods

### Subjects

The subjects were seven 6- to 7-year-old chimpanzees (age range = 6 years 5 months to 7 years 3 months; 6 females, 1 male). All were born at the University of Louisiana at Lafayette. Five of the subjects (Kara, Jadine, Mindy, Brandy, Candy) were raised together by human caretakers from birth in a nursery setting with peers. Two of the subjects (Apollo, Megan) were reared by their mothers in a social group of adult chimpanzees for approximately 1 year and were then placed in the nursery with the other subjects. From that point onwards they were reared by caretakers in the same fashion. Detailed descriptions of the subjects' indoor/outdoor living environments as well as their rearing and experimental histories are provided by Povinelli and Eddy (1996a).

Both before and during the experiment reported in this article, the subjects participated in numerous studies investigating their social intelligence (Povinelli et al. 1993, 1994, 1998; Povinelli and Eddy 1996a, b, c, 1997). The subjects had received extensive contact with humans throughout their rearing (and especially so during the preceding 4 years) as part of a long-term study of their cognitive abilities.

### Testing procedure

Each subject was tested individually by transferring him or her out of their social group and into an exterior waiting area. The shuttle door between the waiting area and

the interior testing room was operated by a pulley system that allowed a trainer to open or close the door as necessary. The interior test unit was divided by a plexiglas partition that contained several holes through which the subjects could reach easily.

Each subject received eight sessions, each consisting of six trials. Two of the six trials (excluding the first and last trials) were randomly selected to serve as test trials to deliver the experimental treatments (described below). The remaining four trials were spacer trials which were implemented for the purpose of maintaining the subjects' motivation throughout the experiment. Spacer trials proceeded as follows. Before the subject was allowed into the test unit, one of two experimenters participating in the session sat on a small crate in front of a hole on the far right or left of the plexiglas partition, just out of the subject's reach. A food reward was positioned behind the experimenter, out of the subject's view. When the shuttle door was opened, the subject entered from the outside and the experimenter encouraged the subject to approach him or her. If the subject reached through the hole directly in front of the experimenter, the experimenter praised the ape and immediately handed him or her a food reward. If the subject gestured through any other hole, he or she was not given a food reward and was ushered outside. The trial was then re-administered following a 30–60 s time period. On the spacer trials, the experimenter attempted to make as much eye contact as possible with the subjects, and encouraged and praised them as they would do in free play. The identity of the experimenter and the side on which he or she sat were counterbalanced within session so that each experimenter was seated equally often on each side. Within the context of numerous other experiments, these subjects had considerable experience gesturing directly in front of an experimenter in order to receive a food reward (Povinelli and Eddy 1996 a, b, c).

The test trials proceeded as follows. First, the experimenter adopted the posture for the treatment assigned to that trial (see descriptions of the treatments below). Next, the shuttle door was opened and the subject entered the test unit and reached through the partition. If he or she gestured through the hole in front of the experimenter, the trainer (located in the rear of the test room) initiated a hand-held timer (connected via earphone to his ear), and a 20 s period ensued (during which the experimenter maintained the assigned posture for that treatment, regardless of the subject's behavior). After 20 s had elapsed, the trainer alerted the experimenter at which time the experimenter looked at the subject, praised her or him, and offered a piece of fruit or a vanilla wafer cookie. On these test trials, if the subject reached through a different hole, the trial continued, but the 20 s interval, which determined when the subject would be rewarded, did not begin until the subject gestured through the hole directly in front of the experimenter.

Four treatments were created for the test trials. For all treatments, the experimenter was seated so that his or her knees were 30 cm from the Plexiglas, easily within the subject's reach. In the eyes open (EO) treatment, the ex-

perimenter's eyes were open and he or she visually tracked the subject throughout the duration of the trial (always attempting to make eye contact). The head movement (HM) treatment was identical to the EO treatment except that the experimenter also engaged in slight back-and-forth, circular movements of the head. These movements were designed to resemble movements used by chimpanzees when they are carefully attending to objects or events. In experiments investigating chimpanzees' recognition of attention, Povinelli and Eddy (1996c) demonstrated that these movements had a high valence for chimpanzees. The same chimpanzees who participated in the present experiment preferred to gesture to an experimenter who engaged in these head movements significantly more than a comparable experimenter who also visually attended to the subjects but did not produce these head movements (Povinelli and Eddy 1996c). In the above chimpanzee (AC) treatment, the experimenter fixed his or her gaze on a predetermined target located above and behind the subject. Finally, in the eyes closed (EC) treatment the experimenter's eyes were closed and therefore could not visually track or make eye contact with the subject. The EO and HM treatments (experimenter's visual attention focused on subject) were designed to serve as controls for the AC and EC treatments (experimenter's attention not focused on subject). An exhaustive list was created, comprising all possible combinations of the four treatment types with the two experimenters' identities along with the left/right location at which each experimenter was to be seated, yielding 16 possible configurations. Each subject received all 16 test trial combinations in a completely randomized order across the eight sessions.

Remote video cameras recorded the experimenter's and subject's behaviors on each trial. Sets of standardized written instructions were developed for coding the tapes for the frequency of several of the behaviors of the subjects during the 20 s duration of the test trials: touching the experimenter, vocalizing, and looking into the rear left and right corners of the test unit. Touching was defined as the chimpanzee making any physical contact with the experimenter. Vocalizing was defined as the chimpanzee making any vocalizations. The tapes of the test trials were marked in blocks of 5 s and data sheets were constructed so that the raters could record the frequencies in these 5-s blocks. One rater was asked to record the frequency of touches for the 16 test trials for each of the seven subjects ( $n = 112$ ). A reliability rater scored 25% of these trials (four of the 16 test trials for each of the seven subjects,  $n = 28$  trials). For the judgements of whether the subjects touched the experimenter ("yes" or "no") during each 5-s interval, the reliability rater agreed with the main rater on 110 out of 112 occasions (Cohen's Kappa ( $\kappa$ ) = 0.95). For frequency of touches, the reliability rater agreed with the main rater on 105 of 112 intervals ( $\kappa = 0.87$ ). The vocalization data were coded in a similar manner by a second pair of raters. For the judgements as to whether the subjects vocalized on each trial ("yes" or "no"), the raters agreed on 26 of 28 cases ( $\kappa = 0.82$ ). In addition, the raters

agreed on 107 of 112 intervals for whether the subjects vocalized during each interval ( $\kappa = 0.80$ ). An additional rater observed each test trial and recorded whether the subjects glanced above and behind themselves into one of the corners of the ceiling. A reliability rater separately coded 25% of the trials and agreed with the main rater on 26 of 28 cases ( $\kappa = 0.86$ ). Finally, although not part of our planned dependent measures, we coded the videotapes for the latency to the first occurrence of a visual gesture, a touch, and/or vocalization on each trial to determine if the subjects selectively produced either of these three gestural types sooner on attentive versus inattentive trials. Using a set of standardized, written instructions, a main rater coded all of the experimental trials ( $n = 112$ ) and a reliability rater coded 25% ( $n = 28$ ). The raters were instructed to measure the elapsed time between when any part of a subject entered the test unit and when the relevant behavior occurred. Touches and vocalizations were defined the same way as above. Visual gestures were defined as behaviors such as begging, reaching, or arm-waving through any hole in the Plexiglas. Behaviors such as touching the floor, the experimenter, or tactually examining the Plexiglas were excluded from this category. The reliability for the latency to first visual gesture, touch, and vocalization yielded a Pearson's coefficient of determination ( $r^2$ ) of 0.91, 0.99, and 0.91, respectively. The latency data allowed a rank ordering to be made for which of the relevant behaviors occurred first on each trial. The reliability coding generated agreement on 27 of 28 trials ( $\kappa = 0.83$ ).

### Predictions

The model which stated that chimpanzees understand seeing as an internal attentional state predicted that in the conditions where the experimenter's visual attention was either not present (EC), or directed away (AC), the chimpanzees would attempt to compensate by supplementing their trained visual gesture with appeals to one of the other sensory modalities (tactile or auditory) at higher frequencies than in those conditions where the experimenter's attention was focused on them (EO, HM). In contrast, the model which asserted that the chimpanzees reason solely about behavioral states predicted no difference in these behaviors as a function of the presence/direction of the experimenter's visual attention.

### Results

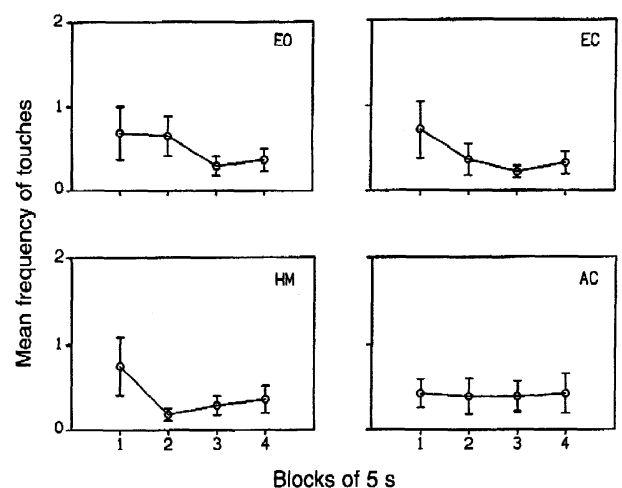
The data were analyzed in several steps to test the predictions of the two models described earlier. To begin, the data for touches and vocalizations were analyzed individually. For touches, we first calculated the number of trials (out of a possible total of four) that each subject touched the experimenter for each treatment (see Table 1). Despite a high level of general touching (averaged across the four treatments, the subjects touched the experimenter

**Table 1** Percentage of trials that subjects displayed attention-getting behaviors (touching experimenter or vocalizing)

Subject	Attentive conditions				Inattentive conditions			
	Eyes open		Head movement		Eyes closed		Above chimp	
	Touch <sup>a</sup>	Voc <sup>b</sup>	Touch	Voc	Touch	Voc	Touch	Voc
Kara	75	25	75	25	75	0	75	0
Candy	100	50	75	75	75	50	50	25
Jadine	100	0	100	0	100	0	100	0
Brandy	0	25	50	50	50	0	75	0
Megan	25	75	50	0	0	75	25	25
Mindy	25	0	25	25	50	0	0	0
Apollo	100	0	50	25	75	0	75	25
Mean ( <i>M</i> )	60.7	25.0	60.7	28.6	60.7	17.9	57.1	10.7
<i>SD</i>	43.0	28.9	24.4	26.7	31.8	31.3	34.5	13.4

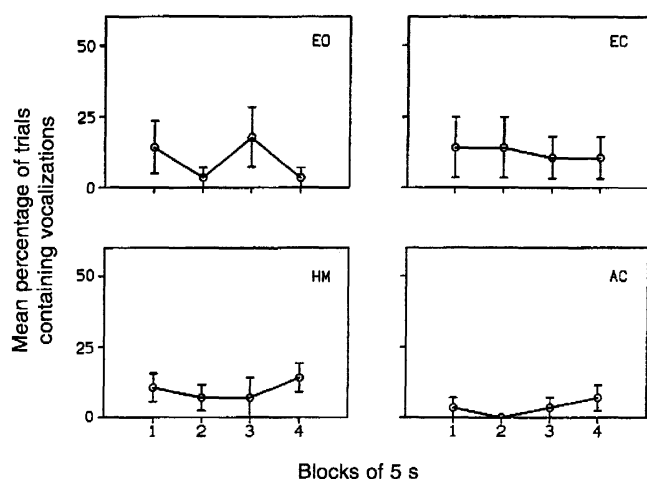
<sup>a</sup> Touches

<sup>b</sup> Vocalizations



**Fig. 1** Mean frequency of touches in blocks of 5 s when experimenter had eyes open (EO), head movements (HM), eyes closed (EC), and above chimpanzee (AC) line of vision

at least once in 60% of the trials), a one-way repeated measures ANOVA confirmed that the subjects did not touch the experimenter in a higher percentage of trials in some conditions than others,  $F_{3,18} = 0.05085$ ,  $P > 0.05$ . Furthermore, a one-way repeated measures ANOVA indicated that there was no significant difference in the frequency of touches across the four treatments,  $F_{3,18} = 0.1674$ ,  $P > 0.05$ . To determine if the chimpanzees distinguished between the treatments on a broader level, we collapsed the individual conditions into two main treatment types: attentive (EO, HM) and inattentive (EC, AC). However, a paired  $t$ -test showed that there was no significant difference between the percentage of attentive trials that the subjects touched the experimenter ( $M = 60.7$ ,  $SD = 31.0$ ) and the inattentive trials ( $M = 58.9$ ,  $SD = 30.4$ ),  $t_6 = 0.2255$ ,  $P > 0.05$ . Finally, because the subjects may have distinguished among the conditions on a temporal



**Fig. 2** Mean percentage of trials containing vocalizations in blocks of 5 s when experimenter had eyes open (EO), head movement (HM), eyes closed (EC), and above chimpanzee (AC) line of vision

basis, the subjects' mean frequency of touches were plotted in blocks of 5 s for each treatment (Fig. 1). However, a two-way ANOVA failed to detect any significant interaction between time intervals and the type of test trial administered, with the mean frequency of touches to the experimenter serving as the dependent variable  $F_{3,96} = 0.19$ ,  $P > 0.05$ . (A similar analysis was conducted for the mean percentage of trials containing a touch in each 5 s interval, but again no statistically significant patterns were present.

We conducted a similar set of analyses for the vocalization data. First, on average, the subjects vocalized on 21% of the test trials (Table 1). However, a one-way repeated measures ANOVA indicated that there was no significant difference in the percentage of trials containing vocalizations across the four treatments,  $F_{3,18} = 1.041$ ,  $P > 0.05$ . Even when the conditions were collapsed into the two broad treatment categories, attentive (EO, HM) and inattentive (EC, AC), a paired  $t$ -test showed no effect of category on the percentage of trials on which the chimpanzees vocalized (attentive:  $M = 26.8$ ,  $SD = 21.0$ ; inattentive:  $M = 14.3$ ,  $SD = 21.0$ ),  $t_6 = 1.871$ ,  $P > 0.05$ . Furthermore, a two-way ANOVA also failed to detect any significant variation among the type of test trials administered, the interval of time, and the mean percentage of trials on which the chimpanzees vocalized,  $F_{3,96} = 1.26$ ,  $P > 0.05$  (Fig. 2).<sup>1</sup> Finally, to address the possibility that the subjects' vocalizations were perhaps motivated strictly by the feeding context and without any regard at all to the experimenter, we coded for the type of the first vocalization. Two raters with extensive experience interacting with chimpanzees were instructed to independently rate the first vocalization on each trial where a vocalization oc-

<sup>1</sup> Because chimpanzees' vocalizations tend to fade in and out along a gradient without clear beginning and ending points, it was impossible to obtain acceptable inter-observer reliability for the frequency of this behavior. We therefore restricted our analysis to the percentage of trials on which vocalizations occurred.

**Table 2** Percentage of trials in which a visual gesture was produced first, before vocalizations or tactile gestures

Subject	Attentive		Inattentive	
	EO	HM	EC	AC
Kara	75	100	50	75
Candy	50	100	75	100
Jadine	100	75	25	100
Brandy	100	75	50	100
Megan	75	100	100	100
Mindy	100	100	100	100
Apollo	50	100	100	75
Mean ( $M$ )	78.6	92.9	71.4	92.9
SD	22.5	12.2	30.4	12.2

All trials contained at least one of the three gestural types (visual, vocal, tactile). EO Eyes open, HM head movement, EC eyes closed, AC above chimpanzee

curred as either a "food-bark" or "other". Only the first vocalization was coded because of the reliability issue discussed above. A food-bark is a distinctive type of vocalization most often used by chimpanzees in situations where food is involved. For the purpose of coding, "other" was defined as any other vocalizations such as (but not limited to) "pant-hoots" or "alarm-calls". One rater coded all 112 of the test trials (of the 112, 20 trials contained vocalizations) while the reliability rater coded 25% (28 trials, 6 of which contained vocalizations). The raters were in complete agreement. The data showed that the first vocalization on all test trials was never of the type commonly referred to as a food-bark.

Next, a composite score was created by combining the vocalization and touching data into a single measure of attention-getting. For each test trial, each subject was assigned a score of 0, 1, or 2, corresponding to whether they displayed no attention-getting behavior, either a vocalization or a touch, or both, respectively. This composite score revealed that on average the subjects deployed at least one attention-getting behavior on 72% of the test trials. However, consistent with the separate analyses of touches and vocalizations presented above, a one-way repeated measures ANOVA did not detect a significant effect of treatment  $F_{3,96} = 1.161$ ,  $P > 0.05$ . Again, after collapsing the data into attentive (EO, HM) and inattentive (EC, AC) conditions, a paired  $t$ -test showed that there was no difference in the mean composite scores for the two main categories,  $t_6 = 2.065$ ,  $P > 0.05$  (attentive composite score:  $M = 0.88$ ,  $SD = 0.35$ ; inattentive composite score:  $M = 0.73$ ,  $SD = 0.26$ ).

Finally, we examined the data for the latency to the first occurrence of each gestural type. Although these data were not part of our planned dependent measures, they were of interest because if chimpanzees do understand seeing as attention, they could be expected to exhibit shorter latencies to first visual gesture on the attentive trials (EO and HM) than on the inattentive trials (EC and AC). A one-way repeated measures ANOVA comparing

the mean latency to first visual gesture for each treatment indicated no effect of treatment, and thus failed to support this prediction. Similar ANOVAs for mean latency to touch or vocalization also indicated no effect of treatment. Because there were many trials on which the apes did not exhibit a touch (approximately 40% of trials) or a vocalization (approximately 80% of trials), on those trials where a touch or vocalization was not produced, for the purpose of these analyses the subjects were assigned a ceiling score of 60 s. Next, we used the raw latency data to determine the percentage of trials in which a visual gesture occurred first, before the other two gestural types, for each treatment (Table 2). A one-way repeated measures ANOVA revealed that there was no overall effect of treatment, thus failing to confirm this post hoc prediction.

Although the subjects deployed their attention-getting behaviors on over 70% of all trials, is it possible that the subjects were simply not attending to the postures of the experimenter that defined each condition? As a manipulation check, we analyzed the results for whether the subjects turned and looked into the corner of the ceiling above and behind themselves. If the subjects were attending to the experimenter's posture, they should be expected to display more looks in response to the AC (above chimp) treatment than the other treatments. These are exactly the results we obtained, with the subjects glancing above and behind themselves on 89% (SD = 20%) of the AC trials, as compared to 25, 28 and 43% of the EO, EC, and HM trials (SD = 25, 28, and 37%, respectively). A one-way repeated measures ANOVA confirmed the presence of a strong overall effect,  $F_{3,18} = 7.792$ ,  $P < 0.002$ , and Tukey-Kramer Multiple Comparison tests confirmed that this was because the subjects looked into the rear upper corners of the test unit more in the AC treatment than in each of the other three treatments ( $P < 0.05$  or less in all three cases). No other treatments differed from each other. Thus, the subjects clearly noticed, and responded to, the behavioral expression of the experimenter's attentional posture (at least in the AC treatment).

## Discussion

Despite the fact that our procedures were effective in causing the chimpanzees to deploy their attention-getting behaviors (they displayed at least one such behavior on 72% of all experimental trials), and despite unambiguous evidence that the subjects noticed the direction of the experimenters' gaze in the condition in which the experimenter's attention was directed above and behind the subjects, we obtained no evidence that the overall frequency or temporal patterning of the subjects' behavior was affected by the degree to which the experimenters were visually attending to them. Our results are consistent with the a priori prediction generated by the model which states that chimpanzees' use of what we call 'attention-getting' behaviors are deployed without being mediated by an explicit understanding of the internal attentional state of the recipient. This model predicted that the sub-

jects' behaviors would not vary as a function of the experimenter's visual attention, whether it was focused on the subject (EO, HM), directed elsewhere (AC), or even whether it was present at all (EC). Of course, since there was no cost to the subjects for vocalizing or touching the experimenter, the most revealing results are perhaps that the temporal patterning of these gestural signals within trials was the same across conditions, regardless of the experimenter's attentional state.

There are two sets of related data which deserve further comment in the light of our findings. First, Gómez (1996 a, b) has reported that juvenile chimpanzees displayed attention-getting behaviors on about 50% of trials where experimenters were inattentive in the context of a task similar to the one used here (Gómez 1996 b).<sup>2</sup> Although the formal methods and results of Gómez's study have not yet been published, the summary descriptions he has published do not show that these behaviors were specific to conditions in which attention is shut off (or largely redirected) as opposed to other conditions in which attention is focused on the subject (Gómez 1994, 1996 a, b). However, J. C. Gómez (personal communication, 1998) has provided supplemental information that "the proportion of normal attentive trials in which chimps used attention-getting behaviours was 3%." Gómez's results are likely to be confounded by his procedure of having the experimenters immediately respond to the chimpanzees' requests (e.g., begging gesture) on the attentive trials: "In normal trials the human was looking at the chimpanzee and would immediately answer any request" (Gómez 1996 b). Thus, in Gómez's procedure for attentive trials, after the chimpanzees had made an initial request there was little or no opportunity for them to display attention-getting behaviors before being rewarded. In contrast, we equalized the amount of opportunity that the apes had to display attention-getting behaviors across all conditions by requiring our experimenters to refrain from responding to the subjects for 20 s on both attentive and inattentive trials alike. This allowed us to compare both the frequency of the relevant behaviors on attentive and inattentive trials over an identical time period, as well as the temporal patterning of the behaviors during this time period (Figs. 1, 2). As reported above, we found that although the chimpanzees exhibited high levels of attention-getting behaviors, they did not perform significantly more (or less) of these gestures when the experimenter's visual attention was focused on them, directed elsewhere, or shut off altogether.

A second relevant data set was reported by Tomasello et al. (1994) who found that in their spontaneous interactions with each other, chimpanzees adjust their communicative signals based on the behavioral state of the recipient. Thus, senders used visually-based gestures only when the recipient was facing them. From an evolutionary

<sup>2</sup> Although values for inattentive trials reported by Gómez (1996 b) are "about 50%", the value reported by Gómez (1996 a) is "68%". It is unclear whether the 1996 a data were intended to supplant the 1996 b data.

perspective, this makes perfect sense because in order to have evolved visually-based gestures must have been used by senders predominantly when the recipients were capable of receiving them (i.e., visually oriented toward the sender). However, results such as those presented here suggest that chimpanzees' knowledge of this process is largely governed by the general posture of others (facing toward versus facing away), not a conception of the relevance of such postures for internal mental states such as attention (e.g., Povinelli and Eddy 1996a; Reaux et al. 1999). On the other hand, as we have repeatedly emphasized, it is possible that chimpanzees may conceive of attention as an internal mental state, but envision it less as a spotlight emanating from the face and/or eyes, and more as a lantern, flooding away from the front of the body. At present we have no direct evidence to support such a conjecture, and indeed have some evidence which may be at odds with it (such as their ability to follow the line-of-sight of others precisely). Nonetheless, we are currently constructing procedures for testing this idea.

Clearly, chimpanzees display gestures that human observers recognize and label as 'attention-getting' behavior. What remains less clear is whether the chimpanzees themselves appreciate that these gestures appeal to an internal state of attention in the recipient. Our results are consistent with the possibility that they do not. Thus, although humans and chimpanzees may possess many of the same behavioral mechanisms for regulating and responding to the behavior of others, chimpanzees may not conceive of those behaviors as indicators of unobservable mental states such as 'attention'. There are at least two implications of this view. First, regardless of species differences in how these behaviors are conceptualized, humans and chimpanzees produce and respond to many of the same behavioral signals to negotiate their way through the attentional matrix of group living. Second, the emergence of an ability to conceive of attention as a mental state in our own species may have forever altered how we conceive of behaviors that evolved long before we did (see Povinelli and Prince 1998).

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