Factors Influencing Young Chimpanzees’ \textit{(Pan troglodytes)} Recognition of Attention

Daniel J. Povinelli and Timothy J. Eddy
University of Southwestern Louisiana New Iberia Research Center

By 2½ years of age, human infants appear to understand how others are connected to the external world through the mental state of attention and also appear to understand the specific role that the eyes play in deploying this attention. Previous research with chimpanzees suggests that, although they track the gaze of others, they may simultaneously be unaware of the underlying state of attention behind gaze. In a series of 3 experiments, the investigators systematically explored how the presence of eyes, direct eye contact, and head orientation and movement affected young chimpanzees’ choice of 2 experimenters from whom to request food. The results indicate that young chimpanzees may be selectively attracted to other organisms making direct eye contact with them or engaged in postures or movements that indicate attention, even though they may not appreciate the underlying mentalistic significance of these behaviors.

The eyes occupy center stage in human folk psychology. For example, when we see someone turn and look at an object, our folk psychology typically assumes that the person is connected to it through the mental state of attention. Likewise, a shift in gaze from one object to another is equated with a shift in attention. This kind of mentalistic understanding of visual perception is commonly referred to as an intentional understanding of seeing. By intentional, researchers imply the philosophical notion of “aboutness”—that is, seeing (as a mental event) is about (or refers to) things in the external world (Baldwin & Moses, 1994; Baron-Cohen, 1994; Brentano, 1874/1960). With respect to the development of this understanding, there is evidence (reviewed by Baldwin & Moses, 1994) that suggests that, by 18 months of age, human infants grasp the idea that when others are oriented and looking at objects, their utterances or affective outbursts refer to those specific objects. However, although 18-month-olds seem to understand attention as a “psychological spotlight” of sorts (Baldwin & Moses, 1994), there is no clear evidence that they understand the particular role that the eyes play in deploying such attentional states. Indeed, it may not be until about 2½ years or so that children localize the eyes as a separate attentional channel (Gopnik, Meltzoff, & Esterly, 1995; Lempers, Flavell, & Flavell, 1977; Povinelli & Eddy, 1996b). Furthermore, between 3 and 5 years of age, children develop the even deeper folk understanding that visual perception is a process through which information about the external world is imported into the mind (Flavell, Everett, Croft, & Flavell, 1981; Flavell, Shipstead, & Croft, 1978; Gopnik & Graf, 1988; O’Neill & Gopnik, 1991; Pillow, 1989; Pratt & Bryant, 1990; Ruffman & Olson, 1989; Wimmer, Hogreve, & Perner, 1988).

Although there can be little doubt that humans construct this kind of folk understanding of seeing, there are more general learning mechanisms, as well as more tightly canalized developmental mechanisms, which can and do support the ways in which organisms (including humans) process information related to the eyes. First, young human infants, as well as many animal species, have been shown to be sensitive to eyes or eyelike stimuli (Argyle & Cook, 1976; Baron-Cohen, 1994; Gallup, Nash, & Ellison, 1971; Perrett et al., 1990). For example, developmental psychologists have discovered that by 4 or 5 months of age human infants will look longer at faces that display direct eye contact (Johnson & Vicera, 1993; Lasky & Klein, 1979). At a more active level, between 6 and 18 months of age, human babies and infants progressively elaborate an ability to spontaneously turn their heads in response to a shift in the gaze direction of an adult (i.e., gaze following; Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991; Corkum & Moore, 1994; Scaife & Bruner, 1975). Young chimpanzees also exhibit gaze following and do so in response to head and eye movement in concert, as well as eye movement alone (Povinelli & Eddy, 1996a, 1996b). Indeed, chimpanzees track the visual gaze of others into space outside their own immediate visual field (i.e., behind themselves), a feat not consolidated in human infants until about 18 months of age.
age (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991). Chimpanzees are also able to take into account whether a barrier is opaque or not opaque when following the gaze of someone whose line-of-sight strikes such a barrier (Povinelli & Eddy, 1996a). However, the fact that very young human infants and members of other species are in general attracted to the eyes, and can process and use information derived from the gaze direction of others, in no way guarantees that they appreciate anything at all about the mentalistic aspects of visual perception (Butterworth & Jarrett, 1991; Moore, 1994). For example, although there are no experimental data from species other than humans and chimpanzees, it is possible that gaze following is a fairly ancient behavioral mechanism that evolved independently of an understanding of the mental state of attention.

Chance (1967) and van Schaik, van Noordwijk, Warsono, and Sutriono (1983) have discussed naturalistic contexts in which the adaptive benefits of processing information about other group member’s line-of-sight could be easily imagined for group-living nonhuman primates. Thus, despite the possibility of a phylogenetically widespread use and exploitation of the visual systems of others, it may be that only humans reinterpret the behavior in intentional terms.

There have been several attempts to move beyond demonstrations that other species are sensitive to eyes and gaze direction and to explore whether they also understand seeing as a mental event (Call & Tomasello, 1994; Gómez; 1991; Povinelli, Nelson, & Boysen, 1990; Povinelli, Rulf, & Bierschwale, 1994; Premack, 1988). Although some of this work has suggested that chimpanzees or other great apes may understand certain mentalistic aspects of visual perception, there is reason to doubt this possibility (Povinelli & Eddy, 1996b; see also reviews by Povinelli, 1996, and Tomasello & Call, 1994). For example, in an extensive series of experiments with chimpanzees and young children, we recently tested the predictions generated by a folk psychological framework of chimpanzee’s understanding of visual attention versus a learning theory framework. We trained chimpanzees to use a species-typical begging gesture (arm extended, palm up) to request a food reward from a human experimenter. In each trial, the subjects were released into a testing unit and were confronted with an experimenter who sat facing them. The subject and experimenter were separated by a clear Plexiglas partition that contained two holes of identical size and height, one on the left of the panel and one on the right. All of the subjects readily learned to enter the unit, scan to see which side the experimenter was on, and gesture through the hole directly in front of them. If the subjects gestured through the correct hole, they were rewarded; if the subjects gestured through the incorrect hole they were not. With this technique as a background, 14 studies were conducted in which probe trials were introduced and two familiar experimenters were present instead of one. On each probe trial, one of the two experimenters could see the subject, whereas the other could not. We reasoned that if the chimpanzees understood the attentional aspect of seeing, they ought to gesture selectively in front of the person who could see them.

Despite many attempts to make the correct option as obvious as possible, the overall pattern of results strongly suggested that the animals did not understand the role that the eyes play in deploying an internal mental state of attention (Povinelli & Eddy, 1996b). After repeated testing, however, the subjects learned a series of rules in order to obtain a food reward. For example, the first appeared to acquire a “pick the person whose face is visible” rule. However, further testing revealed that it did not matter whether that face contained eyes or not. One possible explanation for this was that the subjects had (through differential reinforcement) formed a rule based on the observable configurations of the experimenter’s faces, as opposed to having arrived at an appreciation of the underlying mental state of attention. With further experience the subjects acquired at least two rules that allowed them to base their choices either on the presence of the eyes or the face. When these two rules were in conflict, the subjects tended to prefer the face rule. In contrast, even older 2-year-old children were generally correct from their first trial (Povinelli & Eddy, 1996b).

In summary, the results of studies investigating chimpanzees’ understanding of visual perception are presently consistent with at least two hypotheses. First, it is possible that young chimpanzees (and perhaps older ones as well) simply do not understand attention as a subjective, unobservable mental state. This hypothesis could account for why our chimpanzees have consistently performed according to predictions generated by a learning theory framework, as opposed to those generated by a folk psychology framework. However, a second possibility is that chimpanzees possess a folk psychological theory of attention but that they do not understand the eyes as portals through which attention emanates. In other words, chimpanzees may have a thoroughly mentalistic notion of attention as a mental state but simply fail to grasp how specific sensory modalities deploy this mental state. In principle, there is no reason why an organism must understand the ways in which individual sensory structures (e.g., eyes, ears, noses, hands) are linked to underlying subjective states of attention in order to appreciate the mental state of attention. For example, an organism might recognize the mental state of attention by bodily orientation.

The studies reported in this article had a common general aim. We wanted to determine whether we could isolate behavioral variables related to attention that would attract chimpanzees to one experimenter over another in a context similar to our previous experiments. That is, we wanted to know whether we could control which of the two experimenters a chimpanzee would gesture to in order to receive a food reward, by manipulating the experimenters’ eye direction or presence, facial orientation, and head movement. If our chimpanzees were selective in this context, it would (a) suggest a commonality in the ontogenetic pathways of the two species in this area and (b) set the stage for future investigations to attempt to determine if their selectivity was due to an attribution of greater attention on the part of the experimenter making direct eye contact or merely a general attraction to direct eye contact. Thus, in the current studies we were interested in determining which (if
any) behavioral indicators of visual attention our chimpanzees would find selectively attractive when forced to request food from one of two experimenters; we were less interested in choosing between the predictions generated by a folk theory of attention and a learning interpretation. To this end we focused on two questions. First, is direct eye contact a sufficient condition to cause chimpanzees to gesture toward someone in the context of our task (Experiment 1)? Second, do species-typical behavioral patterns (that chimpanzees exhibit while intensely attending to objects and events) have valences at least as strong as the presence and direction of the eyes (Experiments 2 and 3)? The studies reported here began 1 month after the final study reported by Povinelli and Eddy (1996b) and they involved the same subjects.

Experiment 1

In the first study we tested the hypothesis that chimpanzees would be systematically attracted to an experimenter displaying direct eye contact, as opposed to another experimenter whose eyes were open, but not directed toward the subjects’ eyes. As mentioned above, in previous studies of this type with these subjects, experimenters did not make direct eye contact with the subjects, but instead oriented their eyes to the partition where the subjects responded (see Povinelli & Eddy, 1996b).

Method

Subjects and Housing

The subjects were seven 5½- to 6½-year-old chimpanzees living in captivity at the University of Southwestern Louisiana New Iberia Research Center. Six of the subjects were female and one was male. All of the subjects had been born in captivity and had either been transferred into a nursery at birth (Brandy, Jadine, Mindy, Kara, and Candy) or had been reared with their mothers for about 1 year before being transferred into the general nursery (Megan and Apollo). In the nursery, the animals had extensive contact with their peers as well as with human nursery personnel. Additional details of their rearing histories can be found in Povinelli and Eddy (1996b). The subjects participated in a number of previous studies examining the development of the ability to recognize themselves in mirrors and their possible capacity to reason about mental states (Povinelli & Eddy 1996a, 1996b; Povinelli et al., 1994; Povinelli, Rulf, Landau, & Bierschewale, 1993). In general, their prior histories involved participating in a variety of experiments with humans from behind a Plexiglas partition. At the time of testing, the subjects were living in a series of five large indoor–outdoor housing units that were connected by passageways that could be closed off as needed. The subjects had free access to these areas except during testing.

Procedure

General setup. Prior to this study, the subjects had been trained for several years to transfer out of their social group for individualized testing, typically 2 or 3 times a day. In particular, the subjects were extremely familiar with being individually transferred out of their main housing area into an adjacent outdoor waiting area. A blue screen that covered a shuttle doorway blocked their access into an indoor testing unit. The trainer (situated on the inside of the testing unit) signaled the beginning of a test trial by removing the screen, thus allowing the subjects to enter the test unit and approach a Plexiglas partition that separated them from human experimenters. Large holes in the partition allowed the subject to manipulate apparatuses or gesture to experimenters.

In the present study, a trainer and two experimenters participated in each trial. The role of the trainer was to control the subject’s access into the test unit. The trainer removed the screen, immediately exited the test unit, and assumed a neutral position to the left of the response panel. This action allowed the subject to freely enter the test unit from the outside waiting area and to execute a begging gesture (see the introduction) in front of one of the two experimenters. The two experimenters sat on crates directly in front of a clear Plexiglas panel; one sat in front of the response hole on the left, and the other sat in front of a response hole on the right. Aspects of the experimenter’s behavior were manipulated to study their effects on the animals (see below). After the subjects had made their choice and had been rewarded, the trainer picked up the screen and reentered the test unit, thus signaling the subjects to return to the outside waiting area until the beginning of the next trial.

Nature of the treatments. In preparation for each trial, both experimenters sat with their hands on their knees, oriented their faces to the Plexiglas panel, and looked at the response hole directly in front of them. Next, according to a predetermined schedule (see below), one of the experimenters attempted to make direct eye contact with the chimpanzee as it entered the testing lab. To accomplish this, the experimenter moved only his or her eyes while keeping the facial orientation the same as the other experimenter’s. The other experimenter maintained his or her eye gaze at the response hole in front of them. Each experimenter had an identical food reward hidden behind him or her on a crate out of the chimpanzee’s view. As in previous studies, the chimpanzee’s choice was defined as the first hole through which any part of a hand passed. Regardless of the choice, the subject was immediately praised and rewarded by the experimenter in front of whom the subject gestured. This nondifferential reinforcement procedure was used to eliminate learning theory accounts of the animals’ performances. Although nondifferential reinforcement procedures were used, the correct choice was defined as choosing the experimenter making direct eye contact.

Six of the subjects were tested across 2 sessions of 12 trials each. One of the subjects (Candy) was only administered a single 12-trial session because she refused to cooperate in the second session. Within sessions, the side on which the particular treatments occurred was randomized to occur with equal frequency in both right and left positions. The identity of the experimenter executing the particular behavior was also randomized within sessions such that each experimenter was associated equally often with each treatment. For purposes of counterbalancing, two schedules meeting the above criteria were constructed so that for each trial the two schedules differed in terms of side correct. Four of the subjects (Kara, Jadine, Brandy, and Megan) were assigned to one schedule, and three (Mindy, Apollo, and Candy) were assigned to the other schedule.

Results and Discussion

In order to evaluate the hypothesis that the subjects would gesture preferentially to the experimenter making direct eye contact, we examined the data to determine if the subjects displayed a preference for the direct eye contact condition.
across all trials. When summed across the 24 trials, the subjects’ performances ranged from 42% to 75% correct. Only one subject (Megan) displayed an overall performance significantly above chance (18 out of 24 correct, binomial test, \( p = .011 \)). Megan displayed a clear preference for the experimenter attempting to make direct eye contact from Trial 1 forward (5 correct out of her first 6 trials, 10 correct out of her first 12), although the effect waned across trials. Another subject (Mindy) responded well in the first session (6 out of the first 7 and 8 out of the first 10 correct), although her performance declined after that. In order to examine the data for more subtle effects, we analyzed the group’s performance during the first several trials. Six of 7 subjects were correct on Trial 1. Furthermore, the subjects averaged 79% correct across the first 2 trials, and a one-sample \( t \) test (two-tailed) revealed that their averaged performance on the first 2 trials differed significantly from random responding, \( t(6) = 2.828, p < .03 \), hypothetical mean = 50%. Figure 1 displays the trial-by-trial results for the percentage of subjects on each trial choosing the experimenter who made direct eye contact. These results show that in 9 of the 12 trials the majority of subjects chose the correct experimenter (binomial test, \( p = .073 \)).

The results of this study support the hypothesis that direct eye contact was sufficient to cause the chimpanzees to gesture in front of the person displaying this behavior. Despite not being differentially reinforced for their responses, the subjects displayed an initial preference for gesturing in front of someone making direct eye contact with them. Indeed, in the case of 1 animal (Megan) the preference was strong and only gradually declined across the administration of the 24 trials. The other 6 subjects’ preferences for direct eye contact declined more rapidly (by Trials 3–6 in most cases), presumably because they were not differentially reinforced for choosing the experimenter who made direct eye contact over the one who was looking straight ahead. We can be reasonably confident that this attraction was not learned in the context of this experiment, both because the subjects’ preference for the experimenter making eye contact was present during the first two trials and because the subjects were not differentially reinforced for choosing one experimenter over the other. Furthermore, in over a dozen previous studies in which these same subjects were required to choose between two experimenters, they were never differentially reinforced for choosing an experimenter making direct eye contact with them. Indeed, the subjects had been extensively reinforced for choosing an experimenter with eyes open but no direct eye contact (the stimulus configuration defined as the incorrect choice in this study) and had never been reinforced for choosing direct eye contact in this context. Thus, from the perspective of a simple learning framework, the subjects should have selected the experimenter looking at the partition, not the one looking directly into their eyes. The fact that in the initial trials they did not suggest that direct eye contact could control the subjects’ behavior in a manner not predicted by a simple learning framework. Finally, it is not the case that the mere presence of the eyes attracted the subjects, because the eyes of both experimenters were clearly visible. Thus, these results are consistent with the hypothesis that young chimpanzees are more likely to deploy a food begging gesture in front of someone making direct eye contact than someone whose eyes are open but not looking directly at them.

Experiment 2

The results of Experiment 1 suggested that direct eye contact alone could be sufficient to cause the subjects to gesture in front of an experimenter. In Experiment 2, we examined the influence of head orientation and movement similar to that we have observed chimpanzees spontaneously display when they intensely monitor objects or events (for descriptions of these and other related behaviors, see Yerkes & Yerkes, 1929). We reasoned that having the experimenters exhibit behavioral patterns similar to those exhibited by chimpanzees when they are closely attending to something might strongly influence their responses. In particular, we tested the hypothesis that someone whose head was oriented in their direction and moving it slightly would have a higher valence than alternatives missing these features.

Method

The same subjects from the previous experiment participated in the present study 2½ weeks after the completion of Experiment 1. The subjects had participated in several unrelated studies in the interim.

Two experimental conditions were created and are depicted in Figure 2. In Condition A, one experimenter oriented his or her head toward the subject, attempted to make direct eye contact, and engaged in slight back-and-forth circular movements of the head designed to mimic the natural movements of chimpanzees described above. The movements were slow and steady and were choreographed in such a manner that the details of the face would not be obscured by motion blur. This option was defined as the
correct choice. The other experimenter also engaged in the same head movements, but oriented his or her head to the partition with his or her eyes open. This experimenter was designated as the incorrect choice. This condition thus contrasted two experimenters who exhibited species-typical indices of “attention” but who differed with respect to the object of that attention. For one experimenter the object of attention was an incidental aspect of the general environment (the Plexiglas), whereas for the other experimenter the object of attention was the subject. Condition B contrasted two experimenters who both oriented their heads to the chimpanzees as they entered the room and who both engaged in the head movements. The only difference between the experimenters was that one had his or her eyes closed (incorrect choice), whereas the other had his or her eyes open and attempted to make direct eye contact with the subjects (correct choice). Because it was impossible to have the experimenter whose eyes were closed track the chimpanzee with head orientation while the subject entered the room, the experimenter whose eyes were open followed the chimpanzee with his or her eyes but not the head as the chimpanzee moved into the unit. As in Experiment 1, a non-differential reward procedure was used. Because the subjects could sometimes gesture to an experimenter whose eyes were closed (in Condition B) after the subject had made either choice, the experimenter verbally praised them from where he stood. This served to alert the individual whose eyes were closed to open them and reward the subject. As in previous experiments, the trainer fixed his gaze on a neutral spot on the wall directly in front of him while watching the chimpanzee in his peripheral vision.

These two conditions were designed to test the relative influence of head orientation and direct eye contact as compared to head movements and the mere visibility of the experimenters’ eyes. If subject-focused head orientation and head movements had a strong valence, we predicted the subjects would respond well in Condition A (because only one experimenter executed both of these behaviors), whereas they would perform poorly in Condition B (because both options displayed subject-focused head orientation and head movements). From a human perspective, the latter part of this prediction is surprising because the orientation and movements of the head of the “incorrect” experimenter are irrelevant given this person’s eyes are closed. However, we reasoned that if the presence of eyes (whether through direct contact or mere presence) are sufficient but not necessary for chimpanzees to attribute “attention,” the subjects might weigh the orientation and movements of the experimenters’ heads more heavily than the presence or orientation of their eyes. On the other hand, if the presence of eyes was a necessary component of the stimulus, then the subjects would respond well in Condition B.

Each subject was administered one session consisting of six trials of each of the two conditions. In order to administer the two conditions in a counterbalanced order, we randomly divided the subjects into two groups (Group 1 with Kara, Jadine, Mindy, and Apollo; Group 2 with Brandy, Megan, and Candy). Group 1 received Condition A first and Condition B second, whereas Group 2 received the treatments in the opposite order. Within the constraints of the sample size, multiple schedules were created so that within each group on each trial, half of the subjects received the correct option on the right and half on the left. Otherwise, we used the same randomization and counterbalancing procedures as those described for Experiment 1.

### Results and Discussion

First, we examined the data for each treatment on a trial-by-trial basis (see Figure 3) to determine whether more subjects chose the correct option than would be expected by chance (50% of the subjects, or 3.5 animals per trial). One-sample \( t \) tests (two-tailed) indicated that in Condition A, the number of animals choosing the experimenter who displayed subject-focused head orientation, head movement, and direct eye contact approached a statistically significant above-chance performance (\( M = 62\% \) of the animals per trial, \( SD = 3\% \)), \( t(5) = 2.5, p = .054 \), hypothetical \( M = 50\% \). In Condition B, a one-sample \( t \) test provided no evidence that a greater number of subjects preferred the experimenter with his or her eyes open than would be expected by chance (\( M = 60\%, SD = 20\%, p = .274 \)), although, as Figure 3 reveals, the pattern of results is similar to Condition A. (Indeed, although the hypotheses we were testing concerned whether in each treatment the subject’s choices between the two experimenters departed from chance responding, an unplanned paired \( t \) test did not detect a significant difference in the means of the two conditions.) As in Experiment 1, we also examined the first several trials

---

**Figure 2.** Stimulus configuration for treatments used in Conditions A and B (Experiment 2). See text for details of individual treatments. The left/right positions of the correct choice and individual experimenters, along with the identity of the experimenter associated with the correct choice, were randomized within counterbalancing constraints described in text. Subjects were separated from experimenters by a Plexiglas partition (not shown) with holes in front of each experimenter.
of each condition for evidence that the subjects possessed an initial preference that waned with time. Although the subjects tended to perform well in both conditions in the first two trials, the results indicated no significant trial-related changes. An examination of the data for individual subjects indicated that only one subject (Megan) displayed a significant preference for the correct experimenter summed across both conditions (5 out of 6 correct in each condition: 10 out of 12 correct overall, \( p = .02 \), binomial test).

Two aspects of these results are of interest. First, they provide tentative support for the hypothesis that some combination of the head movements and head orientation on the part of the experimenters was at least as important a stimulus in attracting the subjects as was the presence of direct eye contact. If direct eye contact was both necessary and sufficient to cause the subjects to gesture to someone, the subjects should have shown a clear preference for the experimenter with eye contact in Condition B. The fact that they did not suggests that the combined effect of head movement and orientation (possessed by both experimenters) had a significantly stronger valence than direct eye contact. However, we remain cautious about our interpretation because Condition A confounded head orientation with presence or absence of direct eye contact. Nonetheless, the fact that the subjects approached a significant preference for the oriented experimenter in Condition A further suggests that head movement by itself is not a critical variable, because both experimenters displayed head movement in this condition but the subjects preferred the experimenter displaying oriented head movements.

Experiment 3

Given the suggestive pattern of results in Experiment 2, we decided to further dissect the influence of head movement and orientation on the chimpanzees’ behavior. In particular, we attempted to pit head movements against other factors such as the orientation of the head, the presence of the eyes, and the orientation of the eyes.

Method

The same subjects from the previous two experiments participated in the present tests 5 weeks after the completion of Experiment 2. In the interim, the subjects participated in several unrelated studies.

The experiment was divided into a retention phase and a test phase. The retention phase was designed to re-orient the subjects to the general procedures used in the previous experiments. Each session of the retention phase consisted of 10 trials with a single experimenter seated in front of either the right or left hole. In this phase, the task for the subject was simply to enter the test unit and gesture through the hole in front of the experimenter.

For the test phase, four conditions (A–D) were created and are depicted in Figure 4. The behaviors indicating attention were manipulated in order to test the influence of head orientation and movement on the subjects’ responses. Although we did not attempt to investigate all possible permutations of the presence versus absence of eyes, eyes directed at Plexiglas versus subject, head oriented at Plexiglas versus subject, and presence versus absence of head movements, we did perform several key contrasts of theoretical interest. In particular, we sought to test the hypothesis suggested by the results of Experiment 2 that subject-focused head orientation along with head movement would override other stimulus patterns (such as direct eye contact, eyes open or closed) in terms of their valence for the chimpanzees. In Condition A, both experimenters oriented their heads toward the subject and attempted direct eye contact as the subject entered the testing unit, but the correct experimenter also engaged in the circular head movements (see Experiment 2). In Condition B, neither experimenter oriented toward the subject, but again the correct experimenter displayed head movements. In Condition C, we tested the relative salience of head movements versus direct eye contact by having both experimenters orient their heads toward the subject, but the correct experimenter making direct eye contact with the subject but no head movements, and the incorrect experimenter with eyes closed but engaging in the head movements. In Condition D, both experimenters closed their eyes and oriented their heads to the Plexiglas, but the correct experimenter engaged in the head movements whereas the incorrect experimenter did not.

If the general hypothesis were correct (that subject-focused head movements would override other stimulus features), we predicted that the subjects would respond significantly above chance in Condition A, and significantly below chance in Condition C (see Figure 4). In addition, we decomposed this idea further to determine whether the head movements had strong valence independent of the other stimulus patterns. For example, if head movement could serve as an indicator of attention in the absence of either direct eye contact (but with eyes open) or subject-focused head orientation, we predicted the subjects would perform well in Condition B. Likewise, if head movements could signal attention even in the absence of eyes and subject-focused orientation, we predicted the subjects would perform above chance in Condition D.

The test phase consisted of four sessions (each separated by 24 to 72 hr) of eight trials each. For Trials 1–4, individual subjects were assigned one of each of the four conditions in a random order, and this process was repeated for Trials 5–8. Thus, each eight-trial
session consisted of two trials of each of the four conditions. The left/right position of the correct and incorrect choices on each trial was randomized with the constraint that each side was associated with a correct option equally across the eight trials and that each condition appeared equally often on each side within each session. For each of the four conditions, within each session all of the experimenters were equally associated with the correct and incorrect option and were equally often in the left and right positions.

The general structure of trials were the same as in Experiments 1 and 2, and the subjects were rewarded for all choices by the experimenter in front of whom they gestured. As in Experiment 2, in those conditions (C and D) in which one or both of the experimenters had their eyes closed, the trainer praised the subjects after they made either choice (hand passing through a response hole) in order to alert the experimenter(s) to open their eyes.

Results and Discussion

No subject made an error across the 3 days of the retention trials in which one experimenter was present on each trial. Therefore all subjects were advanced to the testing phase on Day 4 of the study.

Again, we reasoned that if subject-focused head movements would override other stimulus features, then our subjects should differentially choose the experimenter making head movements in Conditions A and C, regardless of other factors. If head movements possess a strong valence independent of other factors, then the subjects should choose the experimenter making such movements in Condition B. Finally, when head movements have strong valence event in the absence of eyes, the chimpanzees should preferentially choose the experimenter making head movements in Condition D. To examine whether these predictions were supported, we calculated for each subject the average number of correct responses for each condition (out of eight possible). These results are depicted in Figure 5. These scores were subjected to a repeated measures one-way analysis of variance that revealed an overall effect of condition, $F(3, 18) = 8.00, p < .002$. Tukey-Kramer multiple comparisons tests indicated that the effect was the result of the subject's significantly better performance in Condition A ($M = 64\%, SD = 9\%$) than in Conditions C and D ($M = 4\%$ and $48\%, SD = 7\%$ and $9\%$, respectively, $p < .01$ in both cases). No other conditions differed significantly from each other. To determine whether the subjects were performing at levels above what would be expected by chance, we analyzed the subject's scores for each condition using one-sample $t$ tests (two-tailed) by comparing their actual performance to a hypothetical mean of 50% (the level
expected by chance responding). The results of this analysis indicated that the subjects performed significantly above chance in Condition A, \( t(6) = 4.38, p = .005 \), and, as predicted, tended toward below-chance performance in Condition C, \( t(6) = 2.121, p < .08 \). No other performances significantly departed from (or approached significant departure from) random responding. In addition, no individual subjects displayed unique response profiles as had Megan in Experiments 1 and 2. Finally, because the subjects were nondifferentially reinforced, we examined the data to determine whether the subjects possessed initial dispositions that waned across trials by analyzing the data from the subjects' first two trials in each condition using one-sample \( t \) tests (two-tailed, hypothetical \( M = 50\% \)). In no case did the subjects respond at above-chance levels.

The overall pattern of the results is consistent with our hypothesis that subject-focused orientation, coupled with head movements, held a significantly higher valence for the subjects than other stimulus configurations. Indeed, the fact that the subjects tended toward a below-chance performance in Condition C further highlights the idea that for these subjects, coupled head orientation and movement were at least (if not more) critical than whether or not the experimenter's eyes were open or closed. In this condition, the subjects tended to prefer the experimenter whose eyes were closed, but whose head was oriented toward them and moving, even though the subjects had the option of choosing someone else who was making direct eye contact with them. Indeed, in this case it appeared to be the interaction between head movement and orientation that was the critical factor, because the experimenter making direct eye contact was also oriented to the subject. Finally, the fact that the subjects did not perform significantly different from chance in Conditions B and D indicates that head movements alone were not sufficient to cause the chimpanzees to respond to the individual exhibiting that behavior.

**General Discussion**

Two major findings emerged from these studies. First, the results of Experiment 1 indicate that young chimpanzees may be attracted to direct eye contact in the context of a task where they are requesting food. Second, the pattern of results obtained in Experiments 2 and 3 suggests that chimpanzees are sensitive and attracted to individuals whose heads are oriented toward them and include slight movements typical of this species' natural behavior in attentive situations. Of interest to this second finding is that, although direct eye contact or the visibility of the eyes may contribute to the valence of an individual, it does not contribute more than other "attentional" components, such as head movement or orientation. Indeed, it may not even be a necessary component as the results of Condition C from Experiment 3 suggest.

Two competing interpretations of our results are possible. One is that behavioral parameters associated with "attention" serve to augment the valence of social stimuli during affiliative behavioral interactions of this species. This low-level account is silent with respect to the question of whether the animals understand attention as a mental state per se. Thus, chimpanzees might selectively request food from someone making eye contact not because they appreciate the person's underlying mental state of attention is focused on them, but simply because this behavioral component triggers underlying positive affect. In this respect, the valence of social stimuli may depend on the number of cues present, so that the number of cues indicating "attention" is proportional to the strength of the valence. Brothers and Ring's (1992) distinction between "hot" and "cold" aspects of "theory of mind" is of direct interest here. They note that a distinction can be drawn between social stimuli that possess an emotional (hot) valence for organisms and more cognitive (cold) intentional-based interpretations of social action. Our subjects' preferences for an experimenter making direct eye contact with them or an experimenter engaging in subject-focused head movements may reflect the operation of hot aspects of theory of mind, not the recognition of the intentional aspect of seeing. On the other hand, our results do not rule out the competing possibility that a high-level mechanism is, in fact, in place and contributes to the attraction of young chimpanzees to some attentional indices over others. Although the results of our earlier extensive studies suggested that young chimpanzees do not understand the intentional aspects of seeing, their choices in the experiments reported here could indicate that, although they do not understand the precise role that the eyes (or other senses) play in deploying attention, they nonetheless attribute attention to others (see Povinelli & Eddy, 1996b).

With respect to the original aims of the investigations presented here, we have identified several key behavioral components that appear to attract chimpanzees and at least leave them acting as if they can distinguish between the different attentional states of others. Additional studies should now focus on using these attentional cues in order to explore the predictions of mentalistic versus nonmentalistic
accounts of this species’ behavior. Although the present studies were not an attempt to subject these competing frameworks to a test, the results highlight the fact that our adult human dispositions about the connections between specific behaviors and attendant or dependent mental states (i.e., theory of mind) may not be the only ones possible. It is possible that both human infants and members of other species may have some grasp of attention as a mental state without understanding all of the ways in which the senses combine (and dissociate) to regulate attention. Indeed, when it comes to other species, they may develop altogether different assumptions about the connection between particular behavioral configurations and underlying states of attention.

References


Pratt, C., & Bryant, P. (1990). Young children understand that looking leads to knowing (so long as they are looking into a single barrel). Child Development, 61, 973–982.


Received August 2, 1995
Revision received February 7, 1996
Accepted February 14, 1996

---

**New Editors Appointed, 1998–2003**

The Publications and Communications Board of the American Psychological Association announces the appointment of five new editors for 6-year terms beginning in 1998.

As of January 1, 1997, manuscripts should be directed as follows:

- For the *Journal of Experimental Psychology: Animal Behavior Processes*, submit manuscripts to Mark E. Bouton, PhD, Department of Psychology, University of Vermont, Burlington, VT 05405-0134.

- For the *Journal of Family Psychology*, submit manuscripts to Ross D. Parke, PhD, Department of Psychology and Center for Family Studies–075, 1419 Life Sciences, University of California, Riverside, CA 92521-0426.

- For the Personality Processes and Individual Differences section of the *Journal of Personality and Social Psychology*, submit manuscripts to Ed Diener, PhD, Department of Psychology, University of Illinois, 603 East Daniel, Champaign, IL 61820.

- For *Psychological Assessment*, submit manuscripts to Stephen N. Haynes, PhD, Department of Psychology, University of Hawaii, 2430 Campus Road, Honolulu, HI 96822.

- For *Psychology and Aging*, submit manuscripts to Leah L. Light, PhD, Pitzer College, 1050 North Mills Avenue, Claremont, CA 91711-6110.

Manuscript submission patterns make the precise date of completion of the 1997 volumes uncertain. Current editors, Stewart H. Hulse, PhD; Ronald F. Levant, EdD; Russell G. Geen, PhD; James N. Butcher, PhD; and Timothy A. Salthouse, PhD, respectively, will receive and consider manuscripts until December 31, 1996. Should 1997 volumes be completed before that date, manuscripts will be redirected to the new editors for consideration in 1998 volumes.