

A Brief Report: The Use of Experimenter-Given Cues by South American Sea Lions

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South American sea lions (*Otaria byrona*) were tested in an object choice task in which they had to use one of the following experimenter-given cues to choose the correct object for a reward: (1) the experimenter pointed and gazed at the object, (2) the experimenter pointed at the object, (3) the experimenter gazed at the object, (4) the experimenter placed a marker on the object, or (5) the experimenter presented a replica of the target object. The sea lions were able to successfully use three of these five cues. These results demonstrate that relatively little experience with human trainers was necessary for the subjects to perceive and act on select attentional cues given by a human experimenter. These results indicate that sea lions are able to interpret certain untrained communicative cues successfully.

Humans often use pointing and gazing to communicate their attention to something of interest. The ability to attribute attention based on such communicative cues has also been studied in a variety of nonhuman species (e.g., chimpanzees: Call, Hare & Tomasello, 1998; dogs: McKinley & Sambrook, 2000; dolphins: Herman, et al., 1999; Tschudin, et al., 2001; fur seals: Scheumann & Call, 2001; horses: McKinley & Sambrook, 2000). Within this comparative approach, two communicative behaviors have received special attention: point and gaze direction. Unlike symbols, these cues are not totally arbitrary but instead contain a resemblance to the action they represent (Tschudin, 2001). For example, Tomasello and colleagues (1998) found that individuals from each of five primate species were capable of following the gaze of conspecifics to an outside object: chimpanzees (*Pan troglodytes*), sooty mangabeys (*Cercocebus atys torquatus*), rhesus macaques (*Macaca mulatta*), stump-tail macaques (*M. arctoides*), and pigtail macaques (*M. nemestrina*). The experimenters had one individual look at a food item on display and then observed the reaction of a second individual (the subject) that was looking in the direction of the first individual. They found that subjects from all five species consistently followed the gaze of conspecifics to the food. Another study indicated that 12 of 16 domestic dogs were able to use pointing gestures performed by humans to successfully choose between two cups for a food reward (McKinley & Sambrook, 2000).

One experimental model often used by researchers to study the comprehension of communicative signs is the object-choice task (e.g. Call et al., 1998; Kaminski et al., 2005; McKinley & Sambrook, 2000). In this paradigm, an

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animal must use a variety of communicative signals to choose the location of a food reward. Surprisingly, a number of primate species have performed poorly on this type of task (Itakura & Anderson, 1996). However, Itakura and Tanaka (1998) found that chimpanzees and one orangutan were successful at the object-choice task when it required them to attend to a number of gestural cues presented by humans (e.g. tapping, pointing, gazing, and glancing). Success in such tasks is not limited to the great apes. For example, McKinley and Sambrook (2000) reported that horses have a limited ability to use communicative cues given by humans, and that dogs have substantial success in such situations. Their research indicated that dogs can successfully use human pointing, head orientation and eye gaze as communicative cues. Similar results were found with marine mammal species. Bottlenose dolphins were able to use human pointing gestures for selecting one of three objects, including objects located behind the subject (Herman et al., 1999). Fur seals were able to use point and gaze, point only, gaze only, and asymmetrical point and gaze (experimenter sits closer to non-target object) to correctly choose between two objects for a reward (Scheumann & Call, 2004).

One criticism of these studies has concerned the fact that most subjects studied are living under human care, and so have had ample opportunity to observe humans using pointing or gazing. For example, domestic dogs may be exposed to many pointing gestures when living within a human family setting. Also, some apes that have been studied had extensive human contact (see Miklósi & Soproni, 2005, for a review), suggesting that an individual's previous social experience influences the extent to which an animal can comprehend points and gazes. It can be difficult to evaluate the amount of inadvertent previous exposure an enculturated animal might have because pointing is such a natural behavior in humans. This is especially true for animals involved in behavioral training (e.g. dolphins: Herman et al., 1999; Tschudin et al., 2001 or seals: Scheumann & Call, 2001). As a result, some species have been tested using communicative cues that would not have observed in normal human interactions. Novel cues have included placing a marker (i.e. a wooden block) on top of the correct target or displaying a replica of the correct target (Tomasello, Call, & Hare, 1998; Tschudin et al., 2001; Scheumann & Call, 2004).

The goal of the current study was to investigate whether South American sea lions (*O. byrona*) would be able to use communicative cues in the absence of formal training to correctly choose a target within an object-choice task. To date, there have been no studies addressing this ability in sea lions. This study investigated a number of cues varying in difficulty, none of which had been explicitly trained. However, the sea lions engaged in daily interaction with humans, so some of the cues to be investigated, such as pointing, may have been produced by their human caretakers. In addition to the normally occurring cues that the sea lions may have observed while humans interacted with one another, the current study also examined sea lion comprehension of novel communicative cues. Previous studies with other species have indicated limited success with these more difficult communicative cues, especially, marker and replica. However, past research would suggest that sea lions are prime candidates for the replica study due to their previous success on match-to-sample tasks (Kastak & Schusterman, 1994).

Method

Subjects

Three female South American sea lions (*O. byrona*) housed at Tiergarten Schönbrunn in Vienna, Austria participated in this study. Carmen and Moneta, both approximately 10 years old, were born in the wild whereas Zwerg was born in captivity and was 8 years old. The sea lions were housed with four other sea lions in an outdoor pool, which allowed access to a set of indoor rooms. All three subjects' training experience was limited. Carmen and Zwerg had only been trained to perform 2 veterinary procedures, which were to open their mouth and show their flippers. In addition to these two veterinary procedures, Moneta had also been trained to stand vertically against a door.

Procedure

During the experimental sessions, the subjects were separated from the other animals. Two identical objects were placed on the ground equidistant from the subject (approximately 1.2 m on either side of subject). A 0.60 m tall cylindrical block of wood (approximately 0.75 m in diameter) was placed in the center of the two objects and acted as a pedestal for the subjects. Each subject was initially trained to simply target an object (touch an object with her nose). During the experimental sessions, the subjects were asked to touch the target object designated by one of the communicative cues used by the trainer. Again, none of these cues had been trained. If the subject touched the correct object, the trainer reinforced her with a fish or with tactile interaction. A fish reward was always offered first, however if the subject rejected the food reward, the trainer would provide tactile reinforcement. If the subject touched the wrong object or failed to respond to the experimenter's cue, the trainer said "no" and the reinforcement was withheld. At the beginning of the experimental sessions, the trainer requested that the sea lion stand by the cylindrical block of wood and look in the direction of the trainer. All three subjects would place their front flippers on the block. All three subjects would automatically come back to the block of wood after making their choice. If the choice was correct, the reward was provided while the subject was back at the block of wood.

There were a total of five conditions. For conditions 1-4, the target items were two identical and novel plastic jugs (approximately 5 L each).

Condition 1. Point and Gaze: The trainer extended his arm and index finger toward the correct target while orienting his head and eyes in the direction of the correct target.

Condition 2. Point only: The trainer only extended his arm and index finger toward the correct target while keeping his body and eyes forward.

Condition 3. Gaze only: The trainer only oriented his head and eyes in the direction of the correct target, while keeping his arms straight-down by his sides.

Condition 4. Marker: A marker (a red circle) was placed on the correct target object. Also, the trainer sham-marked the non-target object to reduce the effects of local enhancement. After the marker was placed, the trainer kept his body and eyes facing forward.

Condition 5. Replica: For this condition, the targets were replaced with qualitatively different objects (a flowerpot and a metal plate). Again, both objects were novel to the subject. The trainer kept his body and eyes facing forward while displaying a replica of the correct target object in front of him.

One experimental session consisted of 12 trials (six indicating the correct target to the right, six indicating the correct target to the left), plus two controls in which the experimenter exhibited no communicative gesture while looking directly at the subject. The location of the correct target object within each session was randomized with restrictions, so that right and left was indicated an equal number of times. The inter-trial interval was dependent on the time it took the subject to finish her reward (range: 30 – 60 sec). Each condition was tested over four experimental sessions for a total of 48 trials per condition. Zwerg was the only subject to complete all five conditions. The conditions

were presented in the following order: point and gaze, point only, gaze only, marker, and replica. Moneta fully completed the point and gaze condition and partially completed the point only condition. She was tested over six experimental sessions, for a total of 48 trials for the point and gaze condition, and 24 trials for the point only condition. Her participation was terminated because Europe endured a heat wave during July 2006, and all of the sea lions became lethargic, resulting in her loss of willingness to participate. Carmen only completed the point and gaze condition. She was tested over four experimental sessions, for a total of 48 trials for the point and gaze condition. Her participation was terminated after she gave birth to her pup.

Results

Figure 1 presents the percentage of correct choices made by Zwerg across 48 trials for each of the five conditions. She performed above chance in the point and gaze, point only, and gaze only conditions (binomial test: $p < 0.01$ in all cases, with 50% chance). However, she did not perform above chance in the marker or replica conditions. In addition, on five occasions, Zwerg's incorrect response to a communicative cue was not by touching the non-indicated object. For two of the point and gaze sessions, Zwerg touched the trainer's hand and for one of the point and gaze sessions and two of the gaze only sessions, Zwerg gave no response.

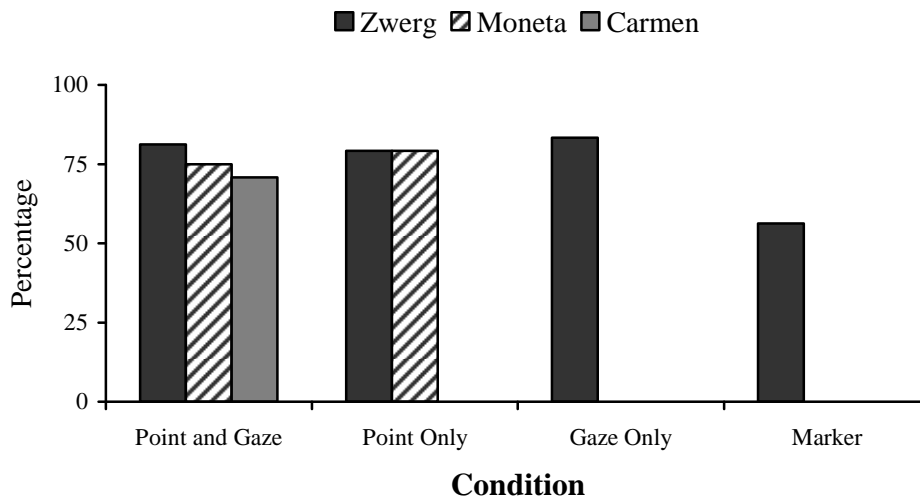


Figure 1. Percentage correct by Zwerg across 48 trials for the six conditions; Percentage correct by Moneta across 48 trials of Point and Gaze and across 24 trials of Point Only; Percentage correct by Carmen across 48 trials of Point and Gaze

Figure 1 also presents the percentage of correct choices made by Moneta across 48 trials for the point and gaze condition and 24 trials for the point only condition. She performed above chance for both of these conditions (binomial test: $p < 0.01$, with 50% chance). On one occasion, Moneta gave no response to the point and gaze cue.

Figure 1 also presents the percentage of correct choices made by Carmen across 48 trials for the point and gaze condition. She performed above chance for this condition (binomial test: $p < 0.01$, with 50% chance).

None of the subjects made any choices when presented with no communicative cue (control trials). All three subjects simply remained in starting position at the block of wood.

Discussion

Three South American sea lions were able to correctly choose an object indicated by the human communicative gestures, point and gaze. Two of these sea lions participated in trials in which the gesture of point only was used to indicate an object. Again, these subjects were able to use this gesture correctly. One sea lion, Zwerg, was the only subject to participate in all five conditions. She was able to correctly choose an object indicated by three human communicative cues (point and gaze, point only and gaze only). However, her performance dropped to chance levels when other communicative cues (marker and replica) were used to indicate an object. Her results are similar to those found with other marine mammals (grey seals: Shapiro, Janik, & Slater, 2003; fur seals: Scheumann & Call, 2004; dolphins: Herman et al., 1999; Tschudin et al., 2001). It is possible that Zwerg would have been able to use the replica and marker cues had she been exposed to additional trials, as was the case for dolphins (Tschudin et al., 2001).

The results of the present study are consistent with those of previous research, suggesting that some marine mammals can use various human communicative cues in the absence of explicit training to do so. The mechanisms that underlie these abilities are unclear. Much of the previous research involving marine mammals has studied subjects with an extensive history of behavioral training (dolphins: Herman et al., 1999; Tschudin et al., 2001; fur seals: Scheumann & Call, 2004). This training could have influenced these subjects' ability to apprehend and comprehend certain human communicative cues. For example, Scheumann and Call (2004) reported that their subjects may have been rewarded for swimming in the direction indicated by the experimenter's arm to find a toy in their pool. They further suggested that their subjects may have generalized this performance to the object-choice testing situation. In the current study, we purposely examined a sea lion with relatively little behavioral training, in order to reduce the chance of previous exposure to human pointing and gazing. However, it is still possible that the sea lion observed trainers pointing and gazing with each other. Furthermore, when the trainers fed this group of sea lions the fish were tossed towards the sea lions. Following the path of the fish is very rewarding for these animals, so the sea lions in this study may have learned to attend to the direction of a trainer's moving arm. Consequently, we cannot be certain of the roles experience with humans played in the subjects' successful performance during point and gaze trials. Nonetheless, it is clear that being trained to attend to human pointing and gazing is not necessary for comprehension of these cues to emerge. In conclusion, this study provided evidence that sea lions are capable of correctly using certain human-given cues without formal training. Of course, much more remains to be learned about the mechanisms responsible for this ability.

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