The response of guide dogs and pet dogs (*Canis Familiaris*) to cues of human referential communication (pointing and gaze)

Miriam Ittyerah · Florence Gaunet

Received: 7 November 2007 / Revised: 15 August 2008 / Accepted: 18 August 2008 © Springer-Verlag 2008

Abstract  The study raises the question of whether guide dogs and pet dogs are expected to differ in response to cues of referential communication given by their owners; especially since guide dogs grow up among sighted humans, and while living with their blind owners, they still have interactions with several sighted people. Guide dogs and pet dogs were required to respond to point, point and gaze, gaze and control cues of referential communication given by their owners. Results indicate that the two groups of dogs do not differ from each other, revealing that the visual status of the owner is not a factor in the use of cues of referential communication. Both groups of dogs have higher frequencies of performance and faster latencies for the point and the point and gaze cues as compared to gaze cue only. However, responses to control cues are below chance performance for the guide dogs, whereas the pet dogs perform at chance. The below chance performance of the guide dogs may be explained by a tendency among them to go and stand by the owner. The study indicates that both groups of dogs respond similarly in normal daily dyadic interaction with their owners and the lower comprehension of the human gaze may be a less salient cue among dogs in comparison to the pointing gesture.

Keywords  Referential communication · Cues · Dog-owner dyads · Guide dogs · Apprenticeship

Introduction

Comparative research on responses to the pointing gesture and gaze at a desired target among animals has revealed a high variability in their comprehension of human-given cues (e.g. Povinelli et al. 1997). Recent experiments have shown that seals (Scheumann and Call 2004), dogs and cats (Miklósi et al. 2005), horses (Maros et al. 2008) and wolves (Virányi et al. 2008) are very skilful in trials with proximal dynamic pointing gestures in contrast to chimpanzees (Tomasello et al. 1997a, b; Bräuer et al. 2006).

Over the past few years, it has been observed that dogs successfully use various nonverbal referential cues to localize an attractive object (favourite toy or food) previously hidden under one of two bowls (Hare and Tomasello 1999, 2005; Soproni et al. 2001, 2002; Miklósi and Soproni 2006). These studies show that dogs can represent and are able to decode the referential information provided by these cues. Various mechanisms have been deemed to be involved in the enactment of human like social skills in dogs (Miklósi et al. 2004; Hare et al. 2005; Hare and Tomasello 2005; Miklósi and Soproni 2006). In particular, living in a human environment may facilitate the development of such skills (Cooper et al. 2003). Since dogs learn to live, communicate and collaborate with humans their social skills may be subject to behavioural changes (Miklósi and Soproni 2006). Communicative behaviours can indeed be viewed as a kind of control system that allows groups to synchronize activities (Csányi 2000). For instance, Kerepesi et al. (2005) observed mutual dependency between dogs and humans during a tower building task as their behaviours become organized into highly complex interactive temporal patterns.

Studies indicate that the main cues that are used above chance are the following: pointing at target (Hare et al. 1998; Miklósi et al. 1998; McKinley and Sambrook 2000;
Soproni et al. 2002), pointing and gaze (Hare and Tomasello 1999; Agnetta et al. 2000) and gaze with head and eye at target (Miklósi et al. 1998; Hare et al. 1998; McKinley and Sambrook 2000; Agnetta et al. 2000; Soproni et al. 2001). It is of interest to note that the use of most cues does not develop with age (Agnetta et al. 2000; Hare et al. 2002). Findings indicate inter-individual variability and suggest that specific instances of variability in the use of the eyes as a cue may need to be considered (McKinley and Sambrook 2000; Soproni et al. 2001).

Furthermore, comparing dogs and apes in experiments where eye contact (accompanied by distal pointing) was obtained before pointing, dogs seem to be more efficient and there are suggestions that eye contact or especially gaze alternation increases the effect of the pointing gesture (Miklósi and Soproni 2006) and might facilitate the comprehension of deictic signals (Byrne 2003; Miklósi and Soproni 2006). Overall there are some indications that the eyes per se are used as cues while the exact conditions do not appear clearly. For this reason we choose to compare guide dogs of blind owners with pet dogs of sighted owners to determine whether dogs are able to respond to the eye-object information of their owners (Heyes 1994). The aim of the present study is thus to determine if dogs are affected by the visual status of their owners, by comparing the responses of pet dogs of sighted owners and guide dogs of blind owners to human given cues.

Evaluating the effect of enculturation in the domestic environment on social cognition among animals is difficult, however, some studies have been performed on single human reared apes (Bering 2004; Tomasello and Call 2004). Apprenticeship, a result of enculturation in apes is strongly linked to the rearing histories of the animals—whether laboratory/zoo trained, nursery-raised or mother reared in captivity (Call and Tomasello 1996). Animals with close association with humans will have the opportunity to learn and respond to both intentional and unintentional behaviours, to predict future events and consequently develop complex social cognitive skills (Cooper et al. 2003). Because guide dogs do not live with their owners until they are 2 years of age, whereas pet dogs are exposed to their sighted owners since birth, the present study is designed to test for the effects of apprenticeship in both groups of dogs. Guide dogs appear to be the best cohorts to study the effects of apprenticeship among dogs (Gaunet 2008). Guide dogs and their blind owners have extensive interaction during free time navigation as they synchronize their actions with a change to-and-from the role of the initiator (Naderi et al. 2001). When dogs were prevented from accessing food that they could previously access, Gaunet (2008) observed that gazing at the food container and gazing at the owner, or gaze alternation between the container and the owner, or vocalisation and contact with the owner did not differ between the guide and pet groups, indicating no differences between guide and pet dogs in the understanding of their owner’s state of attention. However, guide dogs engaged in mouth licking more often than the pet dogs, indicating possibilities of incidental learning that may be deployed. Therefore, it is of interest in the present study to test the dyadic interaction between guide dogs of blind owners and pet dogs of sighted owners with referential cues of communication such as pointing at a target (arm and finger direction), gaze only (head and eye orientation) and pointing and gaze.

The comparison of pet dogs and guide dogs tests whether human vision is a source of information during dyadic interaction. If, during the presentation of the gaze, the eyes or sight of the owner serve as a deictic cue, it may be hypothesized that the response to gaze will be worse in guide dogs than in pet dogs; pointing and gaze may be also affected in guide dogs. If the eyes or sight of the owner do not serve as a deictic cue during the presentation of the gestures, one would expect no differences between the groups and the dogs may perform above chance for the pointing, the pointing and gaze and gaze cues.

**Method**

**Subjects**

Two groups of 13 dogs matched for breed participated in the study along with their owners (see Tables 1, 2 for characteristics of the dogs): one was a group of guide dogs with their blind owners (mean age: 5.96 years/71.54 months; SD: 2.21 years/26.55 months), and the other was a group of pet dogs with their sighted owners (mean age: 6.33 years/76.0 months; SD: 1.76 years/21.1 months). \( t_{24} = -0.48, P = 0.63 \). The mean duration of co-habitation between pairs of dogs and owners is 4.27 years/51.23 months (SD: 2.32 years/27.78 months) for guide dogs and 5.24 years/62.92 months (SD: 2.01 years/24.33 months) for pet dogs, \( t_{24} = -1.42, P = 0.26 \). The guide dogs were raised in sighted families prior to their education and were trained at a school for 6–18 months. All the pet dogs spent, on average, 2 h a day interacting with their owners besides educational games. Both groups of dogs were fed a few hours before the experiment to ensure that they were not hungry.

**Experimental arrangements**

A carpeted room (8 m × 5 m) was dedicated to the experiment. The room was novel to the dogs and their owners. The stimuli consisted of two toys (the favourite toy of the dog as indicated by the owner and a second, unfamiliar, object) and two identical cylindrical bowls (flower pots) \((30 \times 30 \times 30 \text{cm})\), used to conceal the toys.
The instructor [experimenter (E1) or owner (O)] stood half a meter away from the centre of the two bowls. The bowls were 1.5 m apart. The dog stood at a distance of 2.5 m from the instructor, with the holder [either (O) or (E1)]. These distances were marked on the floor of the experimental room. A second experimenter (E2) helped with the dog. The same room was used for training the participants and conducting the experiment. However, to avoid conditioning, the experiment was performed in a different part of the room. A camera placed in a corner of the room, oriented toward the dog recorded the behaviour of the dog, the owner and the experimenter during all the trials.

**Table 1** Characteristics of the guide dogs

<table>
<thead>
<tr>
<th>Guide dogs</th>
<th>Breed</th>
<th>Age (in months)</th>
<th>Gender</th>
<th>Duration with owner (in months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Labrador</td>
<td>84</td>
<td>M</td>
<td>66</td>
</tr>
<tr>
<td>2</td>
<td>Labrador</td>
<td>120</td>
<td>F</td>
<td>102</td>
</tr>
<tr>
<td>3</td>
<td>Golden retriever × Labrador</td>
<td>120</td>
<td>F</td>
<td>96</td>
</tr>
<tr>
<td>4</td>
<td>Labrador</td>
<td>72</td>
<td>F</td>
<td>54</td>
</tr>
<tr>
<td>5</td>
<td>Golden retriever</td>
<td>48</td>
<td>M</td>
<td>24</td>
</tr>
<tr>
<td>6</td>
<td>Labrador</td>
<td>36</td>
<td>M</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>Golden retriever</td>
<td>42</td>
<td>M</td>
<td>12</td>
</tr>
<tr>
<td>8</td>
<td>Golden retriever</td>
<td>72</td>
<td>M</td>
<td>60</td>
</tr>
<tr>
<td>9</td>
<td>Hovawart</td>
<td>78</td>
<td>F</td>
<td>48</td>
</tr>
<tr>
<td>10</td>
<td>Flat coat</td>
<td>48</td>
<td>M</td>
<td>24</td>
</tr>
<tr>
<td>11</td>
<td>Golden retriever</td>
<td>66</td>
<td>M</td>
<td>48</td>
</tr>
<tr>
<td>12</td>
<td>White shepherd</td>
<td>60</td>
<td>F</td>
<td>48</td>
</tr>
<tr>
<td>13</td>
<td>Labrador</td>
<td>84</td>
<td>F</td>
<td>66</td>
</tr>
</tbody>
</table>

**Table 2** Characteristics of the pet dogs

<table>
<thead>
<tr>
<th>Pet dogs</th>
<th>Breed</th>
<th>Age (in months)</th>
<th>Gender</th>
<th>Duration with owner (in months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Labrador</td>
<td>78</td>
<td>M</td>
<td>76</td>
</tr>
<tr>
<td>2</td>
<td>Labrador</td>
<td>96</td>
<td>F</td>
<td>94</td>
</tr>
<tr>
<td>3</td>
<td>Golden retriever</td>
<td>72</td>
<td>F</td>
<td>69</td>
</tr>
<tr>
<td>4</td>
<td>Labrador</td>
<td>72</td>
<td>F</td>
<td>68</td>
</tr>
<tr>
<td>5</td>
<td>Golden retriever</td>
<td>84</td>
<td>F</td>
<td>82</td>
</tr>
<tr>
<td>6</td>
<td>Labrador</td>
<td>47</td>
<td>F</td>
<td>42</td>
</tr>
<tr>
<td>7</td>
<td>Labrador</td>
<td>96</td>
<td>M</td>
<td>93</td>
</tr>
<tr>
<td>8</td>
<td>Golden retriever</td>
<td>96</td>
<td>M</td>
<td>36</td>
</tr>
<tr>
<td>9</td>
<td>Labrador × German shepherd</td>
<td>96</td>
<td>M</td>
<td>90</td>
</tr>
<tr>
<td>10</td>
<td>Labrador × German shepherd</td>
<td>48</td>
<td>F</td>
<td>30</td>
</tr>
<tr>
<td>11</td>
<td>Golden Retriever</td>
<td>96</td>
<td>M</td>
<td>36</td>
</tr>
<tr>
<td>12</td>
<td>German Shepherd</td>
<td>72</td>
<td>M</td>
<td>69</td>
</tr>
<tr>
<td>13</td>
<td>Labrador</td>
<td>36</td>
<td>M</td>
<td>33</td>
</tr>
</tbody>
</table>

Procedure

The experiment was conducted during daytime. The owners were informed about the two experimental phases (training and experiment) and were carefully trained just before each phase.

**Training phase**

The training phase was necessary to ensure that the dogs knew that the toy they had to retrieve was under one of the bowls. The training was performed with the instructor (E1) kneeling at the mid point between the two bowls. The instructor (E1) tried to make eye contact with the dog. If the dog did not pay attention within a few seconds, she called it by its name. While the dog was attentive, the instructor (E1) showed the dog the favourite toy and placed it under one of the bowls. The covering of the toy with the bowl was sounded so that the holder (O) (especially if blind) knew that she/he had to perform the next action: the O gently released the dog, and said “search the ball” or “go to the
ball” and let the dog approach and chose one of the bowls. If the dog chose the correct bowl, the favourite toy was given to her/him, and s/he received verbal praise or a pat by both the instructor and holder. If the dog made an incorrect choice, did not move, walked around or went to the instructor, the experimenter called the dog’s attention and lifted the correct bowl and showed the dog the favourite toy. Toyps were never hidden under the same bowl more than twice consecutively and the order varied with each dog. In total, each dog was required to perform at least eight errorless trials, four on each side, from a minimum of sixteen trials. Dogs that were not able to meet these criteria were excluded after a maximum number of twenty trials, ten on each side.

**Experimental phase**

When the training phase ended, the favourite toy and the unfamiliar object were both wrapped and rubbed together by the owner for a minute. The O took the role of the instructor and E1 took the role of the holder.

Before the experiment was initiated, the dog remained with E1 in an adjacent room, while E2 carefully trained the instructor (O) with the procedure and the four gestures to be performed (see below). Then E1 returned to the experimental room while E2 remained with the dog outside the room in the corridor. E1 took the favourite toy and an unfamiliar toy and placed each of them under one of two bowls. The unfamiliar toy was immediately removed while the favourite toy remained under one of the two bowls. This was done to control for any noise or smell that may be generated by placing the favourite toy under only one of the bowls. At this time the O was informed about the gesture to be performed.

When a ready signal was given, E1 brought the dog into the experimental room and instructed the dog to sit or stand in its place (2.5 m) before the instructor (O). The dog was held by E1, while E2 stood at the side behind E1 during the experimental trials.

The instructor (O) had a relaxed standing posture facing the dog and kept her/his hands by her/his sides. S/he faced and looked at the dog and called it by its name. If the owner was blind, (E1) or (E2) would inform the instructor if the dog was inattentive. If the dog changed its line of view the owner called it again. While the dog was looking at her/him, the instructor performed the predetermined gesture (see below). The time limit for the initiation of the response of the dog to the instructor's gesture was 30 s and the response time was noted by the second experimenter. If the dog failed to attend or if the instructor made an error, the trial was administered later. If the dog chose the correct bowl, it was given the toy and received a verbal reward. If the dog made an incorrect choice, did not move, walked around or went to the instructor, (E1) called the dog, lifted the correct bowl and showed the favourite toy to the dog. The predetermined gestures (cues) given by the instructor during the experiment were:

**Pointing**: The common human pointing gesture was given with the arm and the index finger ipsilateral to the side of the baited bowl. The distance between the pointing finger and the bowl was approximately 60 cm. After the dog attended to the instructor, the instructor immediately pointed at the correct bowl and said “search”. The instructor remained facing the dog and continued to point until the dog performed the indicated task.

**Gaze**: The instructor called the dog by its name. If the dog attended, the instructor immediately turned her/his head and eyes towards the desired bowl and said “search”. The head and eyes remained in this position until the dog responded.

**Pointing and gaze**: After the dog attended to the instructor the pointing gesture, as described above, was immediately performed accompanied by the instructor’s turning of the head and eyes towards the correct bowl, with the search instruction. This gesture was maintained until the dog performed the required task.

**Control**: Control trials were performed along with the experimental trials. The control served to test how the dogs behaved in the absence of any instructor given cues. It also tested whether the dog responded to the odour of the baited bowl. After the dog attended to the instructor, the instructor bowed her/his head with closed eyes and said “search”.

Each cue was presented ten times at random, five times using the left bowl and five times using the right bowl. Each dog received 40 cues from its owner in a random manner. The order of gestures and toy placements was randomised with the restriction that one side could not be used more than twice consecutively and that each combination of a side and gesture was not repeated immediately. On average each experiment lasted an hour. Rest pauses were allowed between trials.

**Scoring and data analysis**

Two guide dogs and four pet dogs did not pass the training phase and were eliminated from the study. If the dog took a period of 30 s or less to respond, the action was considered to be correct, provided the nose of the dog was not further than 15 cm from the bowl.

If the dog went to the wrong bowl, or did not move, or walked about, or went and stood by the owner the trials were treated as errors. The performance of each dog was recorded as being one of five types of responses: going to the right bowl, the wrong bowl, no movement, going to and standing by the owner and walking around the experimental
area. Since there are 13 dogs in a group, there are 520 expected responses, 130 for each cue. The correct place was given a score of 1 and the wrong place and all other actions were scored as 0 and indicated by the performed action. The correct responses of both groups of dogs were analyzed for frequency and latency for each of the four gestures. Latencies in seconds for correct responses were recorded as the time period between the verbal instruction “search” given by the instructor and the dog’s arrival at the correct bowl. The frequencies of the four incorrect responses were also analyzed.

The experimenters analyzed the tapes with the correct and incorrect actions (100% behaviours) of all the 26 dogs for frequencies and latencies. Each experimenter analyzed 13 dogs independently. A third person that did not participate in the experiment independently checked the tapes and analyzed the responses (100% behaviours) of all the 26 dogs. The inter-rater reliability between the experimenters and the external rater was very high for frequencies, latencies and incorrect actions for both guide dogs (κ = 1) and pet dogs (κ = 1) (Siegel and Castellan 1988). The criterion for the alpha level of significance in the study is 0.05.

Results

Frequencies of correct responses

The percentages of correct responses to point, point and gaze, gaze and control cues are presented in Fig. 1.

Wilcoxon one sample tests for chance performance indicate that guide dogs perform above chance for point (n = 13, T = 0, P = 0.001), for point and gaze (n = 13, T = 0, P = 0.001), and for gaze (n = 13, T = 7, P = 0.007) and below chance for control trials (n = 13, T = 4, P = 0.009). Wilcoxon one sample tests indicate that pet dogs perform above chance for point (n = 13, T = 0, P = 0.001), for point and gaze (n = 13, T = 0, P = 0.001), and for gaze (n = 13, T = 0, P = 0.001) and for point and point and gaze (n = 13, T = 0, P = 0.001) and at chance for control trials (n = 13, T = 17.5, P = 0.091). \( \chi^2 \) tests calculated to test for performance differences between the guide dogs and pet dogs in response to the gestures of point, point and gaze, gaze and control, indicate no differences between the two groups of dogs (\( \chi^2 = 0.304, df = 3, P = 0.95 \)). There are no differences in performance for cues presented to the bowls on the left or right side of the owner, for either the guide dogs (\( \chi^2 = 1.05, df = 3, P = 0.75 \)) or the pet dogs (\( \chi^2 = 1.61, df = 3, P = 0.75 \)).

Friedman’s ANOVA, computed to test for differences between the cues, indicates that the responses to the cues differ from each other for the guide dogs (\( \chi^2 = 29.43, df = 3, P = 0.0001 \)) as well as for the pet dogs (\( \chi^2 = 33.52, df = 3, P = 0.0001 \)). Dunn’s post hoc test (Dunn 1964) indicates that for guide dogs, the point and point and gaze cues do not differ, the point cue is better than the gaze cue (\( P < 0.05 \)) and the control cue (\( P < 0.05 \)). The point and gaze cue is also better than the gaze cue (\( P < 0.05 \)) followed by the control cue (\( P < 0.05 \)). The gaze cue is more accurate than the control cue (\( P < 0.05 \)). Among the pet dogs the four cues differ from each other. The point and gaze cue is more accurate than the point cue (\( P < 0.05 \)), and both the point and point and gaze cues are more accurate than the gaze cue (\( P < 0.05 \)), followed by the control cue (\( P < 0.05 \)). Furthermore, the gaze cue is more accurate than the control cue (\( P < 0.05 \)) among the pet dogs.

Latencies for correct responses

The latencies of correct responses to the gestures of point, point and gaze and control were analysed using Friedman’s ANOVA. Since the guide dogs performed below chance for the control trials and the pet dogs are at chance performance, the latencies for the control trials of both groups of dogs were excluded from the analysis.

Friedman’s ANOVA indicates that the latencies of the guide and pet dogs do not differ for the point (\( \chi^2 = 1, df = 1, P = 0.32 \)), point and gaze (\( \chi^2 = 1.5, df = 1, P = 0.22 \)) and gaze (\( \chi^2 = 0.615, df = 1, P = 0.43 \)) cues. However, the cues differ from each other (\( \chi^2 = 10.71, df = 2, P = 0.005 \)) with longer latencies for gaze (mean = 4.27, SD = 2.07) when compared to point (mean = 2.96, SD = 1.72) and point and gaze (mean = 2.12, SD = 1.45). Dunn’s post hoc test shows that the latency for gaze is longer (\( P < 0.05 \)) than that of point and point and gaze. The latencies are presented in Fig. 2.

Comparison of correct responses to the control gesture with incorrect response behaviours

Since the guide dogs performed below chance to the control gesture of their owners, it is of interest to investigate the
The study compared the responses of guide dogs of blind owners and pet dogs of sighted owners to cues of human referential communication to test for effects of apprenticeship in guide dogs with their blind owners. The results, in general, indicate that the two groups of dogs do not differ from each other in response to gestures of point, point and gaze, gaze and control cues. Although both groups of dogs performed above chance for point, point and gaze and gaze, guide dogs performed below chance to control gestures of the bowed head of the owner. The pet dogs were at chance performance for control trials. The results of the control condition for both groups suggest that dogs were not lead by cues of odour to the correct bowl.

Effect of the visual status of the owner

The finding that both groups of dogs do not differ for gestures of point, point and gaze and gaze indicates that there are no differences in apprenticeship according to the visual status of the owners. This is in agreement with Gaunet’s (2008) findings of no differences between guide and pet dogs in the understanding of their owner’s state of visual attention. Overall, the groups do not differ because guide dogs like pet dogs may be influenced by the visibility of sighted people about them, indicating that the comprehension possibility that the guide dogs were less inclined to choose one of the bowls in the control condition. For this the distinctions between the guide and pet dogs for the correct responses of the control gesture are compared with the incorrect response behaviours of no movement, go to owner and walk in the experimental room. This comparison is of interest because there is an absence of response to cues of referential communication in the control gesture as well as in the no response actions. Figure 3 presents these effects.

Figure 3 compares the percentages of correct control responses and the grouped incorrect response actions in the guide and pet dogs. The frequencies of correct responses for the guide dogs in the control condition are 47 and the combination of no movement, go to owner and walk is 49. For the pet dogs, the frequencies of correct responses in the control condition are 52 and the combination of no movement, go to owner and walk are 31. Wilcoxon tests indicate that these differences between the control conditions and the incorrect response actions are not significant for either the guide (\( n = 13, \ T = 36.5, \ P = 0.84 \)) or the pet dogs (\( n = 13, \ T = 21.5, \ P = 0.09 \)).

The grouped incorrect response actions of no movement, go to owner and walk were also compared with the correct responses to point, point and gaze and gaze. A Wilcoxon test comparing the incorrect response actions and the correct responses in the experimental conditions indicate that the point cue is significantly different from the incorrect actions in the guide dogs (\( n = 13, \ T = 9, \ P = 0.01 \)) and in the pet dogs (\( n = 13, \ T = 0, \ P = 0.003 \)). The incorrect response actions and the correct responses to the point and gaze cue also differ in the guide dogs (\( n = 13, \ T = 7, \ P = 0.01 \)) and in the pet dogs (\( n = 13, \ T = 1.5, \ P = 0.002 \)). However, the correct response to gaze and the incorrect actions do not differ in the guide dogs (\( n = 13, \ T = 18.5, \ P = 0.06 \)) whereas they differ for the pet dogs (\( n = 13, \ T = 1.5, \ P = 0.003 \)).

Comparisons of the incorrect responses and the correct actions indicate that the main within group differences between the guide and the pet dogs are in response to the gaze cue and the control gesture of the owner. The incorrect response actions and the response to gaze do not differ for the guide dogs as compared to the pet dogs indicating that the gaze gesture of the blind owner is relatively less comprehended than that of the other gestures. Likewise, guide dogs go to the owner more often in response to the control gesture (\( \chi^2 = 10.7, \ d.f. = 3, \ P = 0.01 \)) as compared to the cues of point, point and gaze and gaze.

Discussion

The study compared the responses of guide dogs of blind owners and pet dogs of sighted owners to cues of human referential communication to test for effects of apprenticeship in guide dogs with their blind owners. The results, in general, indicate that the two groups of dogs do not differ from each other in response to gestures of point, point and gaze, gaze and control cues. Although both groups of dogs performed above chance for point, point and gaze and gaze, guide dogs performed below chance to control gestures of the bowed head of the owner. The pet dogs were at chance performance for control trials. The results of the control condition for both groups suggest that dogs were not lead by cues of odour to the correct bowl.
of deictic cues is not affected by the visual status of the owner. Rather, the ability to use referential cues is attuned with common human behaviour. The absence of differences between the groups for the gaze cue may also suggest that dogs are more sensitive to the head direction rather than to the sight of the owner. Nevertheless, the lower success rates of the use of eyes as cues for referential communication in dogs cannot be ignored (Miklósi et al. 1998; McKinley and Sambrook 2000). These effects will be discussed with reference to the responses to gaze in the present study.

Response to human gaze

The response to gaze was comparatively lower than the point and the point and gaze cues in both groups of dogs indicating lesser comprehension of the gaze gesture produced by the owner. It is of relevance to note the significantly lower success rates for cues that involve eye movement or gaze. For example in Miklósi et al. (1998) study, only one dog out of eleven learnt to use directional glancing. McKinley and Sambrook (2000) observed that only two dogs out of sixteen succeeded in the use of eye direction, however, Soproni et al. (2001) found that the ability to use eye direction as a cue developed across sessions. Although dogs are able to respond correctly to human gaze (Hare and Tomasello 1999), there are only a few instances of the use of eye direction for localizing a target (Miklósi et al. 1998; McKinley and Sambrook 2000; Soproni et al. 2001). In the present study we observed that the dogs could be affected by the head direction of the owner. Furthermore, in within group comparisons among guide dogs, responses to gaze as a cue are fewer when compared to point and point and gaze. However, this does not indicate that the blind owners do not gesture effectively, because blind people, even if early blind, gesture as they speak with both sighted and blind individuals (Goldin Meadow 1999). Bräuer et al. (2006) suggest that the relatively lower performance of dogs to the looking cue in comparison to pointing is probably because looking as a cue is not always used by humans for intentional communication, therefore making it difficult to differentiate between looking (gaze) as a cue and arbitrary looking.

Other studies indicate that of the two methods to test for the use of gaze, non human primates are able to follow gaze by looking in the same direction as the model or experimenter but find it difficult to use gaze as a cue to a hidden object (Call and Tomasello 2004; Call et al. 2000). In contrast to primates, domestic dogs perform well in object choice paradigms (Miklósi et al. 1998; Soproni et al. 2002, 2001; Agnetta et al. 2000). According to Gomez (2005) the superior performance of the dogs could be attributed to their rearing by humans. Bräuer et al. (2006) have also indicated that domestication in dogs has influenced responsiveness to human given social cues as compared to chimpanzees. However, we are unaware of any studies that have compared the latency for the comprehension of the gaze gesture with that of pointing or pointing and gaze. The present findings indicate that not only the frequency of response to gaze is lower than that of pointing and point and gaze in both groups of dogs, but the latency of response to the gaze gesture of the owner is relatively longer in both groups of dogs, indicating uncertainty in the comprehension of the referential nature of gaze.

However, studies that tested the sensitivity of dogs to the visual states of attention in humans (Cooper et al. 2003; Gácsi et al. 2004; Viranyi et al. 2004) have found that dogs are able to differentiate between visual and non visual states of the experimenter. Overall there are some indications that the eyes per se are used as cues for sources of information. Furthermore, when comparing dogs with non human primates and children in tasks that use gaze as a cue to find an object, dogs perform better than primates and are almost on a par with children (Miklósi et al. 2004), although children show spontaneous gaze following in early infancy (Itakura 2004). However, the present findings of both groups of dogs to the gaze cue suggest that dogs are less aware of the referential nature of the eyes of their owners as sources of communication. The results also suggest that, due to the lower comprehension of the gaze cue, gaze may be a less salient cue among dogs as compared to the pointing gesture.

The pointing gesture

The success rates of both groups of dogs were remarkably high for the point and point and gaze gestures. It is also noteworthy that these success rates in the dogs have been achieved with dynamic distal pointing and support the existing evidence of successful use of human pointing cues in dogs (Miklósi and Soproni 2006). The latencies for the point and point and gaze gestures did not differ and were distinctly faster than those for gaze, indicating good comprehension of the point gesture in both groups of dogs and cooperation in dyadic interaction with their owners (Hare 2001; Naderi et al. 2001).

The effects of high levels of pointing comprehension in dogs have also been attributed to domestication and socialization (Hare and Tomasello 2005; Miklósi and Soproni 2006) and this suggests that dogs have evolved socio-cognitive abilities for living in human settings. Bräuer et al. (2006) have clarified that dogs out perform chimpanzees in response to the pointing gesture because dogs are able to comprehend the communicative effects of the pointing gesture, whereas chimpanzees are guided by causal inferences. According to Hare and Tomasello (2004) apes succeed in understanding the goal directed actions of others, but this is not the same as reading communicative cues in which one
individual attempts to direct another’s attention to some third entity in order to provide them with needed information. Therefore, the comprehension of the pointing gesture in dogs cannot be attributed to simple forms of learning (Shapiro et al. 2003), but rather seems to be enhanced by the communicative context with humans (e.g. Agnetta et al. 2000) and/or a predisposition to engage in gazing contact with humans (Miklósí et al. 2003).

The results also indicate that among pet dogs a combination of point and gaze is more facilitative as a cue than point only. This suggests that head direction accompanied by the pointing gesture increases accuracy. Gaze alone as a cue was least salient in both groups of dogs. However, there are suggestions that eye contact or gaze alternation may increase the effect of the pointing gesture or facilitate the development of dog-human communicative interactions (Byrne 2003; Miklósí and Soproni 2006). This indicates that dogs could be sensitive to the eyes of humans for establishing interaction (Call et al. 2003; Bräuer et al. 2004). It seems more pertinent from the present findings to conclude that the dogs were more attentive to the head direction than to the gaze of their owners because both groups of dogs have fewer responses to the gaze of their owners, though performance was better when gaze was accompanied by the point gesture. Further comparisons of the incorrect response actions of the dogs with the correct responses in the control condition indicate that, although there is a tendency amongst the guide dogs to go toward their owners more often and therefore have higher incorrect response actions, both groups of dogs do not differ in sensitivity to the cues of their owners.

In conclusion, although guide dogs and pet dogs alike behave as effectively in normal daily dyadic interaction, the tendency among guide dogs to go to their owners more often in response to the lack of cue (control condition), suggests that this action is an outcome of their training to cooperate with their blind owners.

Acknowledgments This work was supported by INSERM NORD-SUD France and conducted at the Laboratoire Eco-Anthropologie et Ethnobiologie, Muséum National Histoire Naturelle, Paris, France in an Indo-French research collaboration. We are especially grateful to theguide and pet dog-owner dyads for their interest and cooperation and to D. Sulinski for her assistance in the experiment and both P. Piwowar and D. Sulinski for their help in checking the data. The experiments complied with the current French laws governing animal research.

References


Hare B, Tomasello M (2004) Chimpanzees are more skillful in competitive than cooperative cognitive tasks. Anim Behav 68:571–581


Tomasello M, Call J, Hare B (1997b) Five primate species follow the visual gaze of conspecifics. Anim Behav 55:1063–1069