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Why do adult dogs *(Canis familiaris)* commit the A-not-B search error?

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ABSTRACT

It has been recently reported that adult domestic dogs, like human infants, tend to commit perseverative search errors, that is they select the previously rewarded empty location in Piagetian A-not-B search task due to the experimenter's ostensive communicative cues. There is, however, an ongoing debate over whether these findings reveal that dogs' use of human ostensive referential communication as a source of information is more flexible than was formerly thought or the phenomenon can be accounted for by 'more simple' explanations like insufficient attention and learning based on local enhancement.

In two experiments we systematically manipulated the type of human cueing (communicative or non-communicative) adjacent to the A hiding place during both the A and B trials. Results highlight three important aspects of the dogs' A-not-B error: (i) search errors are influenced to a certain extent by dogs' motivation to retrieve the toy object; (ii) human communicative and non-communicative signals have different error-inducing effects; (iii) communicative signals presented at the A hiding place during the B trials but not during the A trials play a crucial role in inducing the A-not-B error and it can be induced even without demonstrating repeated hiding events at location A. These findings further confirm the notion that perseverative search error, at least partially, reflects a "ready-to-obey" attitude in the dog rather than insufficient attention and/or working memory.

Keywords: dog, A-not-B error, social cognition, communication, motivation

INTRODUCTION

Object representational skills in human infants as well as in several animal species develop through successive steps that Piaget (1954) defined as 6 distinctive stages of object permanence. Stage 4 is characterised by perseverative search errors, the so-called A-not-B errors. In the standard A-not-B task usually two (sometimes more e.g. Wellman et al. 1986) hiding locations, A and B, are used. The experimenter first repeatedly hides visibly a target object at the A location and following these A trials the same object is hidden visibly at the B location (B trials). The subject is allowed to search after each hiding and the A-not-B error emerges when the subject searches at location A even when the object is hidden at B.

This error was first described in infants between 8 and 12 months of age (Piaget 1954). Originally Piaget accounted for the A-not-B error by suggesting incomplete comprehension of object permanence, however since then many different proposals have been put forward, including insufficient attention (Harris 1989, Ruffman & Langman 2002), deficits of the short-term memory (Cummings & Bjork 1983), immature sensory motor integration system (Berthental 1996, Baillargeon et al. 1985), inability to inhibit the previously rewarded motor response (Diamond 1985), covert imitation or automatic simulation of movements (Longo & Bertenthal 2006). A recent study (Topál et al. 2008) proposed a quite different explanation based on infants' sensitivity to cues that signal a person's intent to communicate useful information ('pedagogical' receptivity - Csibra & Gergely 2009). They argue that A-not-B search error can be effectively induced in an ostensive-communicative context because young infants, who are especially susceptible to ostensive-referential gestures, tend to misinterpret the object-hidings at location A as potential teaching demonstrations. Thus the ostensively induced A-not-B search error can be seen as a conceptual illusion, the "illusion of being taught".

Humans are not the only species who commit the A-not-B error. Apes (Mathieu & Bergeron 1981, Poti 1989), monkeys (de Blois et al. 1998, Neiworth et al. 2003, Kis et al. 2012a), birds (Pepperberg 1997, Pollok et al. 2000, Zucca et al. 2007) and dogs (Watson et al. 2001, Topál et al. 2009a; but see Gagnon and Doré 1992, 1994) also show evidence of similar errors in object search tasks. Furthermore it has been revealed that, similarly to 8-12 month old infants, adult dogs commit the A-not-B error in the communicative condition but do not show this response bias in a non-communicative context (Topál et al. 2009a). They concluded that dogs' performance in the A-not-B task might reflect their sensitivity to human communication and the increased perseverative error in the "communicative version" of the task is at least partly caused by dogs' willingness to obey experimenter's 'instructions' expressed through ostensive communication. These results also raise the possibility that the experimenter's ostensive-communicative signals such as addressing, eye contact and gaze shifts during the hiding event can guide the dogs' attention more efficiently than other salient, but non-communicative attention getters (e.g. squeaky toy sound).

This communicative account for dogs' perseverative search bias has gained some indirect support from recent studies showing that dogs are sensitive to human cues that signal communicative intent (e.g. Téglás et al. 2012) and often rely on human communication even when it conveys an inefficient or mistaken solution to food choice (Szetei et al. 2003, Prato-Previde et al. 2008), object choice (Erdőhegyi et al. 2007, Kupán et al. 2011) or goal approach (Pongrácz et al. 2003) tasks.

However, the notion that dogs' receptivity to human communication can account for A-not-B errors is still a matter of debate and alternative explanations (insufficient attention, learning based on local enhancement) have also been proposed. Some suggest that dogs committed more error in the communicative condition of Topál et al. 2009a study because the object search task was attentionally more demanding in that context as compared to the non-social version of the task (Fiset 2010). Others (Marshall-Pescini et al. 2010) argue that perseverative search bias can emerge as a result of the local enhancing effect of the unbalanced cuing procedure. Namely, dogs were provided ostensive communicative signals adjacent to the A but not to the B location in the communicative condition while the experimenter used non-communicative attention getter (squeaky rubber toy) at both locations in the non-communicative condition. Although most of these concerns have been addressed (Topál et al. 2010, Kis et al. 2012b) providing further support for the communicative account, there are some open questions that require further investigations.

Firstly, although the aforementioned communicative account predicts different effects of communicative and non-communicative signals the question whether or not communicative and non-communicative attention getters have the same effects on dogs' performance has never been directly tested. A related point is that in Topál et al. (2009a) study the experimenter "marked" the A location using the same salient signals (either communicative or non-communicative) in both phases of the task: in the A trials when the object was left there as well as in the B trials when the object was removed (sham baiting) and moved on to location B. Importantly, therefore, it was impossible to assess the relative significance of communicative signalling at location A in the A-trials versus in the B trials in eliciting the A-not-B errors.

Based on the above findings we may assume that addressing the dog and making eye contact next to location A as well as gaze shifts between the dog and the A location act as a 'general instruction' for dogs that suggest selecting that location (no matter where the toy object is located). If so, then ostensive communicative signals at location A in the A trials should play an important role in the emergence of search error during the B trials. If, however, ostensive communicative signals simply act as here-and-now attention getters then these signals at location A in the B trials are expected to be more influential in provoking search errors.

Another important but often neglected factor of subjects' performance in studies assessing social cognitive skills is motivation (Toates 1995). For example, many argue that the willingness of food-deprived animals to work for food is higher (chicken - Bokkers et al. 2004, sheep -Verbeek et al. 2011, rabbit - Seaman et al. 2008) and recently it has also been shown that highly motivated subjects (Indian Mynas - *Acridotheres tristis*) explore the feeder more and thus perform better in an innovation task (Sol et al. 2012). Generally speaking, evaluating the motivation level is indispensable for deciding whether a subject is 'unable or unwilling' to perform well at a task (Kirkden & Pajor 2006). Motivation for food also strongly affects the dogs' willingness to participate in training and complete the task (training to give "paw" when commanded - Range et al. 2012), to our knowledge however, the effect of motivation on dogs' performance in object search tasks has not yet been investigated.

In the A-not-B object search task motivation can be of great importance as this may effectively modulate subjects' attention towards the target object and/or the dogs' willingness to ignore the experimenter's communicative signals adjacent to the empty A location.

Thus we may hypothesize that highly motivated dogs will be more attentive towards the target object and even if A-not-B error stems from the dogs' "ready-to-obey" attitude they will be less eager to behave according the experimenter's ostensive communication and will search more often at location B in the B trials.

To address these points in the present study we investigated the associations between dogs' motivation to obtain the target object and their tendency to commit search error in different conditions in which we systematically manipulated the attention-getting signals in terms of their communicative character provided by the experimenter during object hiding.

EXPERIMENT 1

In the first experiment we investigated (i) whether or not the subjects' performance in the A-not-B object search task (Topál et al. 2009a) is influenced by their motivation to obtain the target object, (ii) whether human communicative and non-communicative signals have different effects in directing dogs towards the empty A screen during the B trials (perseverative error) and (iii) whether dogs perseverative search bias is more heavily affected by the human ostensive communication at location A presented during the 'introductory' A trials or during the B trials.

Materials and methods

Subjects

Eighty-two pet dogs were recruited on a voluntary basis. All were at least one year of age. The only criterion for selection was that the dog had never participated in an A-not-B object search task, and was motivated to play with a ball. Ten dogs had to be excluded because they were unwilling to participate in the test (they showed signs of distress and/or did not show any interest in retrieving the target object during the warm-up trials). The remaining 72 dogs (mean age±SD: 3.71±2.49 years, 36 males and 36 females, from 27 different breeds and 15 mongrels) were tested and included in the data analysis.

Experimental arrangement

The experiments took place in a room (5 m x 2.5 m) at the Eötvös University, Budapest where two identical opaque plastic boxes (30 cm wide x 42 cm high x 23 cm deep) were placed 0.6 m apart to serve as hiding places. The owner held the collar of the dog that was facing the screens standing equidistant (2 m) from them. A squeaky rubber toy was placed on the floor 0.6 m from the A screen in line with the screens. (Figure 1)

General procedure

Warm up and assessing motivation

Before the test trials, subjects participated in an object retrieval task (2 trials). The purpose of this session was to familiarize the subject with the retrieval task as well as to categorize dogs in terms of their motivation to get the object. In these trials only 1 screen was placed on the floor (halfway between subsequent locations A and B) and the experimenter hid the ball behind it in full view of the dog that was then released to search for it. If the dog was unwilling to search it was encouraged by the owner. The dogs' level of motivation was assessed by scoring their behaviour (see in 'Data analysis' for more details).

Test trials

Test trials consisted of 4 A trials followed by 3 B trials.

During the A trials the experimenter stood next to the dog and attracted the dog's attention using communicative (addressing the dog and establishing eye-contact) or non-communicative (clapping her hand) signals. Then she approached the ball and attracted the dog's attention again with the toy in her hand next to the A location (A_A) either in a communicative or non-communicative manner. If she used communicative signals at the beginning of a trial (while standing next to the dog), she also used the same communicative signals (addressing the dog and establishing eye-contact) when she picked up the ball from the floor. If the experimenter used non-communicative signals while standing next to the dog, she attracted the dogs' attention in a non-communicative manner (the toy in her hand made a squeaky sound) when she picked up the ball. Then she stepped behind screen A with the toy in her hand being constantly visible to the dog and placed the ball behind screen A. She passed behind screen B and went back to her starting point next to the dog. After showing her empty hands to the dog, the subject was allowed to approach the setup and inspect one of the locations.

The procedure in the B trials was similar to that of the A trials (either communicative or non-communicative attention-getting both at the starting point and at location A; B_A) except that the experimenter did not leave the ball behind screen A, but after a few seconds of 'sham baiting' the toy visibly re-emerged in her hand and she attracted the dog's attention by squeaking the toy next to the B screen (B_B). She moved on to screen B and placed the toy behind it, then she went back to her starting point showing her empty hands and finally the dog was allowed to make a choice.

During the whole experiment the owner was not allowed to give any commands to the dog. If the dog chose the baited screen it was allowed to play with the ball, but if the dog first visited the empty screen it was called back by the owner (while the experimenter also tried to prevent it from visiting the baited screen and retrieving the toy) and the next test trial began. Note, that the experimenter put the ball inside the baited box, thus for dogs it was necessary to look into a box to check if it is empty or not. In a few cases (21 out of the 216 B-trials) however, the dog first visited the empty A location, and yet, could retrieve the ball from behind the baited screen. In such cases the owner took the ball away from the dog as quickly as possible, and the dog was not allowed to play with the toy.

Experimental conditions

Subjects were assigned to one of four groups, representing all possible combinations of communicative / non-communicative cuing at the A screen during the first (A trials) and second (B trials) phases of the test. (Table 1). Subjects in the four experimental groups did not differ by age (ANOVA, $F_{(3,68)} = 0.761$, $p = 0.923$).

Data analysis

The number of dogs' correct choices was coded in all conditions. The first inspected location was regarded as the subject's choice and a choice was scored as correct if the dog touched the baited screen with its nose or paw, or stood close to the box and looked behind it. Dogs received scores of 1 or 0 depending on whether they chose the baited or the empty location respectively.

The dogs' level of motivation was assessed by scoring their behaviour during the warm up trials according to the following criteria (for video protocols see: http://www.cmdbase.org/web/guest/play/-/videoplayer/156).

0 - Unmotivated: Total ignorance of the toy during warm-up trials (these dogs had to be excluded from further tests).

1 - Low motivated: The dog calmly waits while the experimenter places the ball behind the screen. Approaches the baited screen indirectly and after 3 sec. or more delay, leaves the toy behind the screen or drops it onto the floor and leaves there at least once.

2 - Moderately motivated: The dog calmly waits while the experimenter places the ball behind the screen. Approaches the baited screen immediately and directly when released. Retrieves the toy object, and readily gives it over to the owner.

3 - Highly motivated: The dog tries to release itself 1-3 times while the experimenter places the ball behind the screen. Approaches the baited screen immediately and directly when released. Subject retrieves the toy object, however, unwilling to give it over to the owner or to the experimenter, and/or tries to take the ball from the experimenter's hand at least twice.

4 - Over-motivated: The dog tries to release itself more than three times while the experimenter places the ball behind the screen. Approaches the baited screen immediately and directly when released. Picks up the toy, however, unwilling to retrieve and give it over

to the owner or to the experimenter. When the toy is obtained by the experimenter the dog is trying to permanently retrieve it from her hand.

As the warm up phase was identical in all experimental conditions, it allowed us to carry out motivation scoring blind to the conditions and without knowing the later performance of subjects.

Furthermore, to check if dogs spent similar amounts of time gazing toward the human actor in the different conditions we measured the duration of time spent orienting toward the object-hiding events in the first A- and the first B trials of each condition.

Subjects' motivation and choice behaviour was assessed by the first author and the reliability of the coding was measured using Cohen's Kappa value. A second person scored a randomly selected sample of 50% and Cohen's Kappa value was 1.0 for dogs' choice and 0.96 for motivation. Concerning the motivation scores there was only one disagreement between coders (moderate or high motivation) and in this case the first coder's score was accepted. The reliability for the duration of time spent orienting toward the object-hiding events was assessed by means of parallel coding of the 25% of the first A- and B trials total trials by two observers. Inter-observer reliability was also excellent (Pearson's correlation $r = 0.925$, $p < 0.001$).

We employed a Generalized Linear Model (binomial distribution) for the analysis of the effects of different signals (communicative vs. non-communicative) during hiding and the dogs' motivation to retrieve the toy on the dogs' tendency to commit A-not-B error. Number of successful B trials (0-3) was set as the dependent variable, type (communicative vs. non-communicative) of the cuing next to the A screen and timing of the sign (during A vs. B trials) as fixed factors and motivation score as covariate.

We used Kruskal-Wallis and Dunn's multiple comparison post tests to compare dogs' performance in the different motivation categories (1-4). The duration of time spent orienting toward the object-hiding events in the different conditions was also analysed by Kruskal-Wallis test, because data didn't follow normal distribution. In order to assess the effect of the different cues given during the hiding procedure the number of correct choices in the A and B trials was also compared to the 50% chance level using one-sample Wilcoxon signed rank tests. To compare the dogs performance in B trials of the different conditions Wilcoxon matched pairs tests and Kruskall-Wallis test were used. We also compared the percentage of dogs showing perseverative search bias towards the empty A location (A-not-B error) in the B-trial phase of the four different hiding-contexts using chi^2 test. A-not-B error was defined as selection of the empty (A) screen in the first B trial and at least one additional 'incorrect' choice during the 2^{nd} and 3^{rd} B trials.

Statistical tests were two-tailed, the α value was set at 0.05 and the statistical package SPSS version 18 was used.

Results and discussion

Analysis with a General Linear Model revealed that the type of attention getting signals (communicative or non-communicative) employed at the A screen during the B trials played a significant role in inducing the A-not-B error ($\chi^2_{(1)}$ = 7.205 p = 0.007), but the type of cuing during A trials had only a marginally significant effect on dogs' performance ($\chi^2_{(1)}$ = 2.907 p = 0.088). It is also worth mentioning that the context dependence of dogs' tendency to commit search error was probably not caused by dogs' selective attention because dogs payed as much attention to the object-hiding event in the non-communicative conditions as they did in the communicative ones (A-trial-phase: $\chi^2_{(3}$ = 6.337 p = 0.096, B-trial-phase: $\chi^2_{(3)}$ = 3.304 p = 0.347). More importantly, although subjects in the four experimental groups showed similar levels of motivation to obtain the target object in the warm up phase (Kruskal-Wallis test, $\chi^2_{(3)} = 3.049$, $p = 0.384$; Table 2), dogs' tendency to commit A-not-B error was heavily affected by their motivation scores ($\chi^2_{(1)} = 21.605$ $p < 0.001$). No interactions were found between the factors and covariate ($p > 0.1$ in all cases).

The effect of dogs' motivational characteristics on performance

The significant role of the level of motivation in the emergence of perseverative search errors is also clearly indicated by the comparison of the dogs assigned to the different motivation categories (Kruskal-Wallis test, $\chi^2_{(3)} = 13.167$, $p = 0.004$). Dogs categorized as over-motivated committed significantly less search errors than subjects belonging to other motivation categories (Dunn's multiple comparison post test, over-motivated vs. highly and low motivated $p < 0.05$, over-motivated vs. moderately motivated $p < 0.01$ Figure 2, Table 2). Our finding suggests that high level of motivation to take possession of the target object, together with other potential contributing factors such as lack of inhibition or training, effectively eliminates A-not-B error. This raises the possibility that extreme motivation can act as a confounding factor for the assessment of the effect of human ostensive communication on dogs' tendency to select the non-baited (A) location.

Thus we removed the eight over-motivated dogs (2-2 subjects from each group), and as there was still no difference between groups concerning their motivation scores (Kruskal-Wallis test, $\chi^2_{(3)} = 4.732$ $p = 0.192$) we re-run the Generalized Linear Model. This analysis revealed a significant effect of the type of attention getting signals (communicative or non-communicative) employed at the A screen during the B trials ($\chi^2_{(1)} = 9.436$, $p = 0.002$), while the type of cuing during A trials had no similar effect on dogs' performance ($\chi^2_{(1)} = 2.482$, $p = 0.115$) and motivation of the subjects did not play a role either ($\chi^2_{(1)} = 1.961$, $p = 0.161$). No interactions were found between the factors and covariate ($p > 0.1$ in all cases).

The effects of communicative vs. non-communicative signals on performance

The remaining 64 dogs showed a similar performance in all four conditions during the A trials (Kruskal-Wallis test, $\chi^2_{(3)} = 2.170$ $p = 0.538$). They fetched the toy reliably as they performed well above the success rate expected by random search (NonCom $T_+ = 153$ $p < 0.001$, $ComA_A$ and $ComA_AB_A$ $T_+ = 136$ $p < 0.001$; $ComB_A$ $T_+ = 120$ $p < 0.001$, Wilcoxon signed rank tests).

However subjects' made fewer correct choices in the B trials than in the A trials in all conditions (Wilcoxon matched pairs tests, NonCom $T_+ = 153$ $p < 0.001$; $ComA_A$ $T_+ = 78$ $p = 0.0078$; $ComA_AB_A$ $T_+ = 105$ $p = 0.001$; $ComB_A$ $T_+ = 120$ $p = 0.001$). Comparisons to the 50% chance level (Wilcoxon signed rank tests) show that dogs displayed a significant search bias towards the empty (A) hiding place only in those conditions in which ostensive communicative signals were employed adjacent to the A screen ($ComA_AB_A$ $T_+ = 26$ $p = 0.029$; $ComB_A$ $T_+ = 1$ $p = 0.0001$) and subjects performed at chance level in the other two groups (NonCom $T_+ = 44.5$ $p = 0.124$; $ComA_A$ $T_+ = 56$ $p = 0.56$, Figure 3).

The key role of ostensive communication adjacent to the empty A screen during the B trials in inducing the A-not-B error is further confirmed by the significant between-group differences (Chi-square test, $\chi^2_{(3)} = 11.656$ $p = 0.009$) in percentage of subjects showing perseverative search bias towards the empty A screen. Again, more dogs showed perseverative search error if the human experimenter employed communicative signals during the B trials next to the A screen (Com A_AB_A and $ComB_A$ vs. Com A_A and NonCom groups, Fischer exact test $p = 0.002$). (Table 3)

In conclusion, dogs seem to react differently to communicative as opposed to non-communicative human signals in the A-not-B task. Subjects in the $ComA_AB_A$ group similarly to subjects in the social-communicative group of Topál et al's (2009a) study displayed a search bias toward the empty A screen in the B trials, thus it seems that the non-communicative attention getters presented close to the B screen are insufficient to eliminate the error. Moreover these results confirm our hypothesis suggesting a specific effect of motivation on dogs' overall search performance. While the cues from the experimenter during hiding seem to affect the search behaviour of dogs with low-to-high motivation in similar ways, subjects who were characterized by extreme high level of motivation tended to ignore the experimenter's signals and focused their attention towards the toy object.

In line with the findings from earlier studies (Topál et al. 2009a, Topál et al. 2010, Kis et al. 2012b) the results of this experiment also support the differential effects of ostensive-communicative (vs. non-communicative) signals on dogs' tendency to commit the A-not-B error. However, the present results do not seem to support the notion that ostensive communication next to location A acts as a 'general instruction' for dogs. In contrast, it seems like dogs rely on the experimenter's ostensive-communication as episodic instructions and/or "here-and-now" attention getters in the B trials because human communicative cuing at location A in the B-trials plays a more important role in the emergence of A-not-B search errors.

EXPERIMENT 2

Based on the above results in a subsequent experiment we expected to induce A-not-B error in dogs without performing any A-trials. Although previous research (Topál et al. 2010; Kis et al. 2012b) has argued that local enhancement or "sham-baiting" of the A hiding place does not alter dogs' perseverative response in the A-not-B context, here we hypothesized that in the 'only B trials' condition it becomes crucial whether or not the A hiding place is enhanced by the experimenter's ostensive communicative cues. Thus we planned a hiding procedure in which in addition to omitting the A-trials we used three different types of B-trials: a *Social-*

Communicative (Topál et al. 2009a) condition in which during the B-trials the dog's attention is directed to location A ('sham-baiting') after ostensively addressing the dog, the so called *Alleviated B trials* (Kis et al. 2012b) condition in which this 'sham-baiting' is omitted and the experimenter goes directly to location B, and a *NonCommunicative* (Topál et al. 2009a) control condition.

Material and methods

Subjects

Sixty five task-naïve pet dogs participated in the study, all were at least one year of age (29 males, 34 females; mean age: 3.92 ± 2.52 years). They were from 17 different breeds and 22 mongrels. Based on warm up trials (see below) all dogs' motivation scores were ranked from-low-to-high. Two dogs had to be excluded due to under-motivation and none of them was categorized as over-motivated (see Exp 1 for criteria). Subjects were assigned to three hiding contexts (see below) so that the distribution of age would not differ across conditions.

Procedure

The experiment was conducted in another room (3.9 m x 4.1 m) but the experimental arrangement was the same as described in Experiment 1 (Figure 1). Before the test trials, subjects participated in two warm up trials where only one screen was placed on the floor using the same procedure as in Study 1.

Test trials consisted of 3 B-trials without any previous A-trials. Depending on the experimental group subjects witnessed one of three different hiding procedures.

In the '*Communicative Hiding*' group *(Com-H*, N = 21, 14 males, 7 females) we aimed to test the role A trials play in inducing the A-not-B error, thus the hiding procedure was the same as reported in previous studies (Topál et al. 2009a; Kis et al. 2012b) with the only difference that the A trials were omitted. During the three B trials the experimenter addressed the subject (dog's name + "Look!" in a high pitched voice), she approached the toy, picked it up and captured the dog's attention with the toy in her hand (by establishing eye-contact and addressing the dog). Afterwards she walked to the adjacent screen (A) and placed the toy behind it, than the toy visibly re-emerged in her hand and she showed the toy to the dog while looking at it. Finally she placed the toy behind screen B, returned to the dog showing her empty hands and the subject was allowed to make a choice. (Figure 4/a)

Testing a second group of dogs, the so called *'Alleviated B trials'* group (*Allev-B*, N = 21, 8 males, 13 females) we aimed to test the role 'sham baiting' of the A hiding place plays in inducing the A-not-B error. Thus in this condition, dogs witnessed the same hiding procedure as previously described in *Com-H* (subjects were addressed in a communicative way, by calling their name and making eye-contact), with the only exception that the experimenter did not 'sham bait' the toy behind screen A. She walked up to screen B following the same track as in the *Com-H*, while holding the toy visibly in her hand at the height of her eyes and looking continuously at the dog. (Figure 4/b)

Finally as a control group we tested a group of dogs in the *'Non-Communicative Hiding'* condition *(NonCom-H*, N = 21, 7 males, 14 females) following the procedure described in Topál et al. (2009a) with the only difference that the A trials were omitted. The experimenter attracted the dog's attention by clapping her hands then she approached the toy and made a beeping sound with it without facing the dog. Afterwards she walked to the adjacent screen (A) with her back turned towards the dogs and placed the toy behind it, than the toy visibly re-emerged and made a beeping sound while the experimenter was still turned with her back. Finally she placed the toy behind screen B, returned to the dog showing her empty hands and the subject was allowed to make a choice. (Figure 4/c)

Data analysis

The dogs' motivation, attention and choices were measured in the same way as in Study 1. We used Kruskal-Wallis tests to check if dogs were similarly motivated to get the toy object and we employed also Kruskall-Wallis test for the analysis of the time spent orienting towards the object hiding events in the different conditions during the first trial. The number of correct choices in all three groups was compared to the 50% chance level using a one-sample Wilcoxon signed rank test. Furthermore, planned pair-wise comparisons between '*Com-H*' and '*Allev-B*' as well as '*Com-H*' and '*NonCom-H*' conditions were performed (Mann-Whitney tests).

Results and discussion

Subjects in the three experimental groups showed similar levels of motivation to obtain the target object in the warm up phase (Kruskal-Wallis test, $\chi^2_{(3)}$ =1.573, p = 0.455) and dogs in all three conditions watched the experimenter's activities for similar durations ('*Com-H*': 96.8 %, '*Allev-B*': 98.2 %, '*NonCom-H*': 98.4 %; Kruskal-Wallis test, $\chi^2_{(2)}$ = 0.329, p = 0.848).

In the '*Com-H*' condition subjects displayed a search bias to the empty (A) location performing well below the success rate expected by random search (25% correct, T- = 190, p = 0.008) in the three B trials despite the fact that location A had never been baited. On the contrary when 'sham baiting' at A was omitted ('*Allev-B*' condition) subjects performed above chance (70% correct, T- = 49, p = 0.019), thus achieving a significantly higher number of correct choices than subjects in '*Com-H*' (U = 84, p < 0.001). Moreover in the '*NonCom-H*' group (neither 'sham baiting' nor communicative cuing at location A) dogs also performed above chance (68% correct, T- = 51, $p = 0.023$) and achieved a higher number of correct choices than subjects in the *'Com-H' condition* (U = 87; $p < 0.001$) (Figure 5).

The analysis based only on the first test trials in the different conditions shows quite similar results. Dogs in the *Com-H* group preferred to choose the empty A location (binomial test, test proportion: 0.5; $p = 0.027$; only 5 dogs of the 21 ones chose the baited location) while dogs in the *Allev-B* and *NonCom-H* groups showed a non-significant trend towards above chance performance (binomial test, test proportion: 0.5; $p = 0.078$; 15 dogs from the 21 ones selected the baited location in both conditions).

These results are in line with previous findings (Kis et al. 2012b) and further confirm the hypothesis that A-trial-phase is not an indispensable part of the procedure inducing A-not-B error in adult dogs. In addition, it seems that 'sham-baiting' at location A and the attraction of the dogs' attention by ostensive addressing signals next to the A location can both play a role in eliciting erroneous choices. A summary of the present results and findings from recent studies (Table 4) indicates that communicative (vs. non-communicative) cuing and other attention-directing acts (sham baiting) affect dogs' search bias in an interactive manner.

This table clearly shows that sham baiting of the A screen without directing the dog's attention towards that location in an ostensive-communicative manner is insufficient to elicit the A-not-B error in dogs. Moreover both the presence/absence and the timing of ostensive addressing signals are of great importance: Cues including eye contact and verbal addressing compared to non-communicative salient attention-getters (squeaking the toy) are more effective in inducing the dog to select the empty (A) location especially if the experimenter provides these signals next to the A location during B trials. Importantly, however, the communicative cuing next to the A location during B trials can increase the dogs' tendency to commit A-not-B error if, and only if it is either complemented with sham baiting of the A screen or the A location was previously repeatedly baited in an ostensive communicative context.

GENERAL DISCUSSION

These experiments have revealed three main characteristics of the A-not-B error committed by adult dogs. We found that i) subjects' performance in this object search task is influenced to a certain extent by their motivation, ii) human communicative and non-communicative signals have different effects in directing dogs' attention to the A hiding place and iii) no A trials are needed to induce A-not-B error.

Although the influence of the dogs' motivational characteristics in food-related test situations (inequity aversion: Range et al 2012; working memory task: Miller & Bender, 2012) has been recently reported, the role of motivation has not yet been investigated in tasks designed to study dogs' search for objects. Experiment 1 provides the first evidence that motivation to obtain the toy object may be one of the key factors for dogs' tendency to commit the A-not-B error. We found that over-motivated individuals' search behaviour was basically goal directed and thus, they showed no tendency to commit search errors even in situations where location A was sham baited and/or the empty location was highlighted by the experimenter's ostensive addressing signals. This suggests that high motivation towards the reward object might overwrite or mask the effect of other cues and therefore it should be taken into account in virtually all cognitive tests.

Our results further support the notion that the communicative and non-communicative signs have different effects in this task (see also Topál et al. 2009a, Kis et al. 2012b). Thus we cannot exclude the possibility that dogs' erroneous choices in the B trials stems from their disposition to act in line with a human demonstration. This account suggests that the experimenter's ostensive addressing signals during object-hiding events acted as not only making the subject recognize the location of the toy but manifesting a specific behaviour.

Obviously, however, several types of cognitive bias can occur due to an attentional bias (Eysenck et a. 2007). Thus the dogs' increased tendency to commit A-not-B errors in the communicative conditions could also be explained by a low level, attentional account. In fact, it has been found (Clearfield et al. 2009) that the salience of cues associated with hiding the object at location B significantly affect human infants' perseverative search bias. In line with this we may assume that the experimenter's 'communicative' activities and sham baitings have simply attracted dogs' attention more than the other conditions, facilitating their learning of the rule 'this goes here'. We should note, however, that the analysis of the dogs' amount of attention toward the object-hiding events in the different conditions does not seem to fully support this attentional account. By using a colourful toy object that emits salient sound cues while being hidden, our study was carefully designed to ensure that dogs pay as much attention to the object-hiding event in the non-communicative conditions as they did in the communicative ones.

As an alternative explanation, we can also presume a merely distracting effect of social cues: more errors could be attributed to the higher attentional demands required to follow the trajectory of the toy in the B trials (c.f. Fiset 2010).

Anyway, our results are in agreement with recent studies which proposed that dogs in object search tasks (Bräuer et al. 2006, Erdőhegyi et al. 2007, Kupán et al. 2011) and in food search (Prato-Previde et al. 2008) tasks often rely on human communicative gestures. An interesting aspect of our findings is that the selection of the empty (A) location can be elicited without any previous A trials and the ostensive addressing signals presented next to the A location during B trials plays a key role in committing search errors. This seemingly contradicts with the results of Osthaus et al. (2010) showing that the number of A trials plays a crucial role in inducing the A-not-B error. But this can be explained by the fact that they used a different method (dogs had to make a detour through a gap at one end of a straight barrier in order to reach a target) with a non-communicative hiding procedure.

The influential effect of the human communication on the dogs' behaviour and several other functional similarities between infants and dogs (like committing the A-not-B error in communicative condition) are widely assumed to be affected by the domestication process (Topál et al. 2009b, Miklósi et al. 2004, Hare & Tomasello 2005, Hare et al. 2002). This hypothesis, among others, is supported by the fact that intensively socialised wolves do not commit the A-not-B error, not even when the experimenter presents ostensive-communicative signals during the hiding event (Topál et al. 2009a). We should also note, that in this comparative study both wolves and dogs were tested with food reward, and the motivation for food may be different between the two species and this can also account for the species differences in search response.

Based on the fact that the over-motivated dogs perform better than the others (see Exp 1), and that wolves tend to show reward oriented behaviour instead of looking at humans (Miklósi et al. 2003) we may assume that wolves in the A-not-B error task were simply much more motivated to get the reward and that is why they committed less errors. In any case, our results suggest that subjects' motivational level in object search tasks including the A-not-B error task must be carefully controlled.

In summary, the present study provides evidence that contrary to previous assumptions in the case of adult pet dogs no A trial is needed to induce the A-not-B error. The finding that search performance is affected by subjects' motivational level as well as by the ostensive communicative signals presented at location A during the B trials suggest that the phenomenon, at least partially, reflects a "ready-to-obey" attitude in the dog rather than insufficient attention and/or working memory.

REFERENCES

Baillargeon, R., Spelke, E. S., & Wasserman, S. (1985). Object permanence in five-month-old infants. *Cognition, 20*, 191–208.

Berthental, B. I. (1996). Origins and early development of perception, action, and representation. *Annual Review of Psychology, 47*, 431-459.

de Blois, S. T., Novak, M. A., & Bond, M. (1998) Object permanence in orangutans (Pongo pygmaeus) and squirrel monkeys *(Saimiri sciureus)*. *Journal of Comparative Psychology 112,* 137–152

Bokkers, E. A. M., Koene, P., Rodenburg, T. B., Zimmerman P. H. & Spruijt, B. M. (20004). Working for food under conditions of varying motivation in broilers. Animal Behaviour, 68, 105–113.

Bräuer, J., Kaminski, J., Riedel, J., Call, J., & Tomasello, M. (2006). Making Inferences about the Location of Hidden Food: Social Dog - Causal Ape. *Journal of Comparative Psychology*, *120,* 38-47.

Clearfield, M. W. Dineva, E. Smith, L. B. Diedrich, F. J. Thelen, E. (2009). Cue salience and infant perseverative reaching: tests of the dynamic field theory. *Developmental Science, 12*, 26-40.

Csibra, G.& Gergely, Gy. (2009). Natural pedagogy. *Trends in Cognitive Sciences, 13,* 148-153.

Cummings, E. M., & Bjork, E. L. (1983). Search behavior on multi-choice hiding tasks: evidence for an objective conception of space in infancy. *International Journal of Behavioral Development 6,* 71–87.

Diamond, A. (1985). The development of the ability to use recall to guide action, as indicated by infants' performance on A-not-B. *Child Development, 56,* 868-883.

Erdőhegyi, Á., Topál, J., Virányi, Zs., & Miklósi Á. (2007). Dog-logic: inferential reasoning in a two-way choice task and its restricted use. *Animal Behaviour, 74,* 725-737.

Eysenck, M. W., Derakshan, N., Santos, R., Calvo, M. G. (2007). Anxiety and cognitive performance: Attentional control theory. *Emotion, 7(2),* 336-353.

Fiset, S. (2010). Comment on ‘‘differential sensitivity to human communication in dogs, wolves, and human infants’’. *Science 329*, 142-b.

Gagnon, S., & Doré, F. Y. (1992). Search behavior in various breeds of adult dogs *(Canis familiaris):* Object permanence and olfactory cues. *Journal of Comparative Psychology*, *106*(1), 58–68.

Gagnon, S., & Doré, F. (1994). Cross-sectional study of object permanence in domestic puppies *(Canis familiaris). Journal of Comparative Psychology, 108*(3), 220–232.

Hare, B., Brown, M., Williamson, C., & Tomasello, M. (2002). The domestication of social cognition. *Science*, *298*, 1634–1636.

Hare, B., & Tomasello, M. (2005). Human-like social skills in dogs? *Trends in Cognitive Science*, *9,* 439-444.

Harris, P. L. (1989). Object permanence in infancy. In A. Slater & G. Bremner (Eds.), *Infant development*, 103–121. Hove, UK: Erlbaum.

Kirkden R. D., Pajor E. A. (2006). Using preference, motivation and aversion tests to ask scientific questions about animals' feelings. *Applied Animal Behavior Science,* 100, 29–47.

Kis, A., Gácsi, M., Range, F., & Virányi, Zs. (2012a). Object permanence in adult common marmosets *(Callithrix jacchus)*: not everything is an "A-not-B" error that seems to be one. *Animal Cognition*, *15,* 97-105.

Kis, A., Topál, J., Gácsi, M., Range, F., Huber, L., & Miklósi, Á. (2012b). Does the A-not-B error in adult pet dogs indicate sensitivity to human communication? *Animal Cognition, 15,* 737-743

Kupán, K., Miklósi, Á., Gergely, Gy., & Topál, J. (2011). Why do dogs (*Canis familiaris*) select the empty container in an observational learning task? *Animal Cognition*, 14, 259-268.

Longo, M. R., & Bertenthal, B. I. (2006). Common coding of observation and execution of action in 9-month-old infants. *Infancy 10,* 43–59

Marshall-Pescini, S., Passalacqua, C., Valsecchi, P., & Prato-Previde1, E. (2010). Comment on “Differential Sensitivity to Human Communication in Dogs, Wolves, and Human Infants”. *Science, 329*, 142-c.

Mathieu, M., & Bergeron, G. (1981). Piagetian assessment of cognitive development in chimpanzees *(Pan troglodytes).* In A. B. Chiarelli & R. S. Corruicini (Eds.), *Primate behavior and sociobiology FRG:* Springer Verlag, Berlin 142-147.

Miklósi, Á., Kubinyi, E., Topál, J., Gácsi, M., Virányi, Z., & Csányi, V. (2003). A Simple Reason for a Big Difference: Wolves Do Not Look Back at Humans , but Dogs Do. *Current Biology, 13,* 763-766.

Miklósi, Á., Topál, J., & Csányi, V. (2004). Comparative social cognition: What can dogs teach us? *Animal Behaviour, 67,* 995-1004.

Miller, H. C., & Bender, C. (2012). The breakfast effect: Dogs *(Canis familiaris)* search more accurately when they are less hungry. Behavioural Processes, 91(3), 313–317.

Neiworth, J. J., Steinmark, E., Basile, B. M., Wonders, R., Steely, F., & DeHart, C. (2003). A test of object permanence in a new-world monkey species, cotton top tamarins *(Saguinus oedipus). Animal Cognition 6,* 27–37

Osthaus, B., Marlow, D., & Ducat, P. (2010). Minding the gap: spatial perseveration error in dogs. *Animal Cognition,* 13, 881–885.

Pepperberg, I. M., Willner, M. R., & Gravitz, L. B. (1997). Development of Piagetian object permanence in a Grey parrot *(Psittacus erithacus). Journal of Comparative Psychology, 111,* 63-75.

Piaget, J. (1954). Intelligence and affectivity: Their relationship during child development. Palo Alto, CA: *Annual Review*, Inc.

Pollok, B, Prior, H, & Gunturkun O (2000). Development of object permanence in food-storing magpies *(Pica pica)*. *Journal of Comparative Psychology 114,* 148–157

Pongrácz, P., Miklósi, Á., Kubinyi, E., Topál, J., & Csányi, V. (2003). Interaction between individual experience and social learning in dogs. *Animal Behaviour, 65,* 595-603.

Poti, P. (1989). Early sensimotor development in macaques *(Macaca fuscata, Macaca fuscicularis).* In F. Antinucci (Eds.), *Cognitive structure and development in nonhuman primates,* Hillsdale, NJ: Erlbaum, 97-112.

Prato-Previde, E., Marschall-Pescini, S., & Valsecci, P. (2008). Is your choice my choice? The owners' effect on pet dogs' *(Canis lupus familiaris)* performance in a food choice task. *Animal Cognition 11*, 167-174.

Range, F., Leitner, K., & Viranyi, Z. (2012). The influence of the relationship and motivation on inequity aversion in dogs. *Social Justice Research, 25*, 170-194

Ruffman, T., & Langman, L. (2002). Infants' reaching in a multi-well A not B task. *Infant Behavior & Development, 25,* 237-246.

Seaman, S: C., Waran, N. K., Mason, G. & D'Eath, R. B. (2008). Animal economics: assessing the motivation of female laboratory rabbits to reach a platform, social contact and food. Animal Behaviour, 75, 31-42.

Sol, D., Griffin, A. S. & Bartomeus, I. (2012). Consumer and motor innovation in the common myna: the role of motivation and emotional responses. Animal Behaviour, 83, 179-188.

Szetei, V., Miklósi, Á., Topál, J., & Csányi V. (2003). When dogs seem to lose their nose: an investigation on the use of visual and olfactory cues in communicative context between dog and owner. *Applied Animal Behaviour Science, 83,* 141-152.

Téglás, E., Gergely, A., Kupán, K., Miklósi, Á., & Topál, J. (2012). Dogs' gaze following is tuned to human communicative signals. *Current Biology, 22,* 1-4.

Toates, F. (1995) Animal motivation and cognition. In: H. L. Roitblat and Jean-Arcady Meyer (Eds.), Comparative Approaches to Cognitive Science (pp. 435-464). Cambridge, MIT Press.

Topál, J., Gergely, G., Miklósi, Á., Erdőhegyi, Á., & Csibra, G. (2008). Infants' perseverative search errors are induced by pragmatic misinterpretation. *Science, 321*, 1831-1834.

Topál, J., Gergely, Gy., Erdőhegyi, Á., Csibra, G., & Miklósi, Á. (2009a). Differential Sensitivity to Human Communication in Dogs, Wolves, and Human Infants. *Science, 325,* 1269-1272.

Topál, J., Miklósi, Á., Gácsi, M., Dóka, A., Pongrácz, P., Kubinyi, E., Virányi, Zs., & Csányi V. (2009b). Dog as a complimentary model for understanding human social behaviour evolution. *Advances in the Study of Behaviour, 39,* 71-116.

Topál, J., Miklósi, Á., Sumegi, Z., & Kis, A. 2010. Response to Comments on “Differential Sensitivity to Human Communication in Dogs, Wolves, and Human Infants.”*Science, 329,* 14-d.

Verbeek, E., Waas, J., R., McLeay, L. & Matthews, L., R. (2011). Measurement of feeding motivation in sheep and the effects of food restriction. Applied Animal Behaviour Science, 132, 121–130.

Watson, J. S., Gergely, Gy., Csányi, V., Topál, J., Gácsi, M., & Sárközi, Zs. (2001). Distinguishing logic from association in the solution of an invisible displacement task by children *(Homo sapiens)* and dogs *(Canis familiaris):* Using negation of disjunction. *Journal of Comparative Psychology*, *115,* 219–226.

Wellman, H. M., Cross, D., & Bartsch, K. (1986). Infant search and object permanence: A meta-analysis of the A-not-B error. *Monographs of the Society for Research in Child Development, 51*, 1–50.

Zucca, P., Milos, N., & Vallortigara, G. (2007). Piagetian object permanence and its development in Eurasian jays *(Garrulus glandarius)*. *Animal Cognition 10*, 243–258

Captions for figures and tables

Figure 1. Experimental set up. Two identical opaque plastic boxes served as hiding places (A and B). The dog was facing the screens standing equidistant from them. A squeaky rubber toy was placed on the floor in line with the screens. The experimenter's starting point was next to the dog.

Figure 2. The effect of the level of motivation on dogs' choice behaviour in the B trials. Over-motivated dogs made significantly less search errors than subjects belonging to other motivation categories (Kruskal-Wallis test, Dunn's multiple comparison post test, different letters (a, b) indicate significant differences between groups * $p < 0.05$).

Figure 3. Number of correct choices in B trials in the four experimental groups (medians, quartiles, whiskers). Dogs in those conditions in which ostensive communicative signals were employed adjacent to the A screen ($\text{ComA}_\text{A}\text{B}_\text{A}$ and ComB_A) show a search bias towards the empty (A) location, and subjects performed at chance level in the other two groups (NonCom and ComA_A). Comparisons to the 50% chance level (Wilcoxon signed rank tests) (* $p < 0.05$; ** $p < 0.01$).

Figure 4. Hiding procedure for the a) *'Com-H'*, b) *'Allev-B'* and c) *'NonCom-H'* conditions.

Figure 5. Number of correct choices in the different hiding conditions of experiment 2; median, quartiles, whiskers, outliers. Comparisons to the 50% chance level (Wilcoxon signed rank test) (* $p < 0.05$; ** $p < 0.01$).

Table 1. Signals presented next to the A- and B screen in the different experimental

conditions. Note: During A trials the experimenter ignored the B screen (no cuing there). Communicative signals: The experimenter turned with her face toward the dog during the hiding event, she addressed the dog (dog's name + Watch!), and established eye-contact with it. Non-communicative signals: The experimenter turned with her back toward the dog during the hiding event and she attracted the dog's attention making a conspicuous noise with the rubber squeak toy. Thus in this context there was no eye-contact, the experimenter did not look at, and did not talk to the dog.

Table 2. Number of dogs in each motivation category in the four groups.

Table 3. Number of dogs in the four different conditions performing different numbers of erroneous choices (searching at the empty screen) in the three B trials.

Table 4. Experiment 2. Summary of results and comparison of findings from different studies. Comm: Eye contact & verbal addressing (*dogs's name* + *Watch!*); NonComm: squeaking the toy while back-turned.

Figure 1

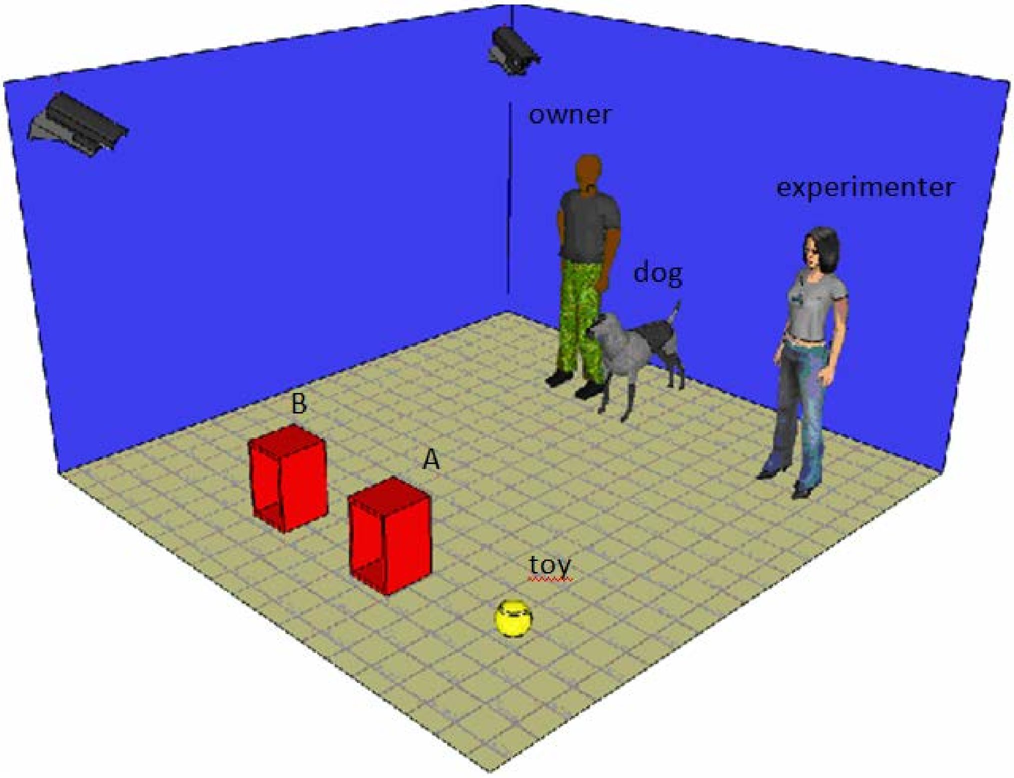
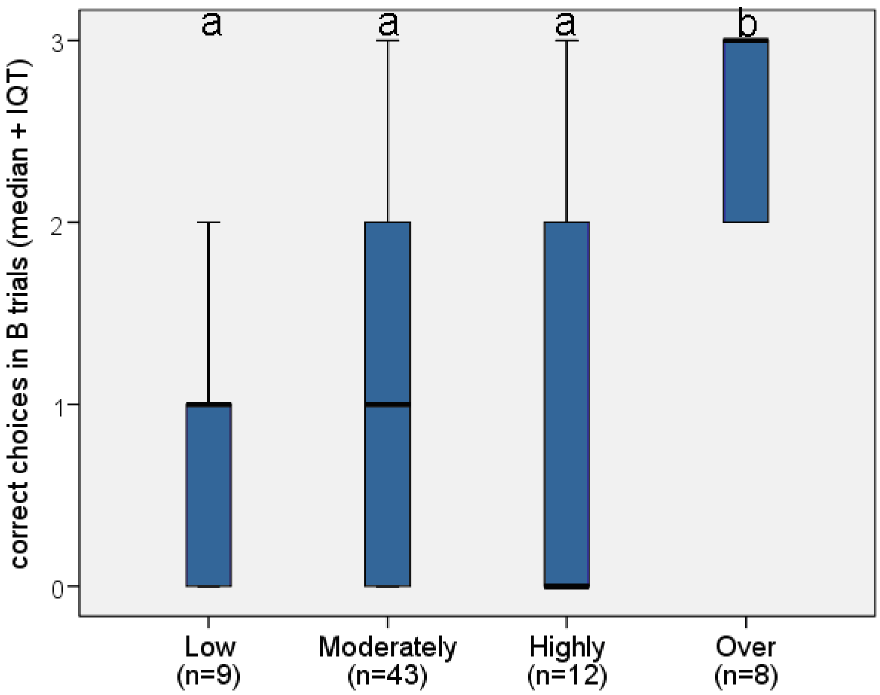


Figure 2



a
a
a
b
3
2
1
0
correct choices in B trials (median + IQT)
Low
(n=9)
Moderately
(n=43)
Highly
(n=12)
Over
(n=8)

Figure 3

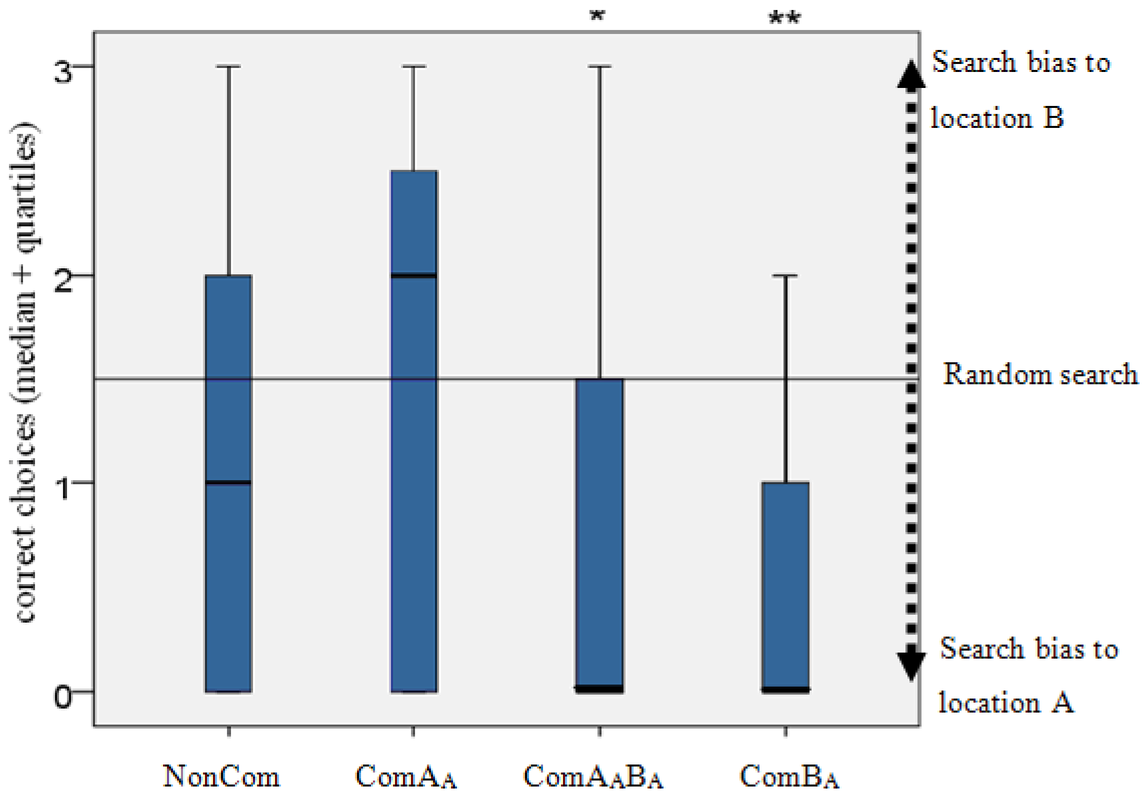
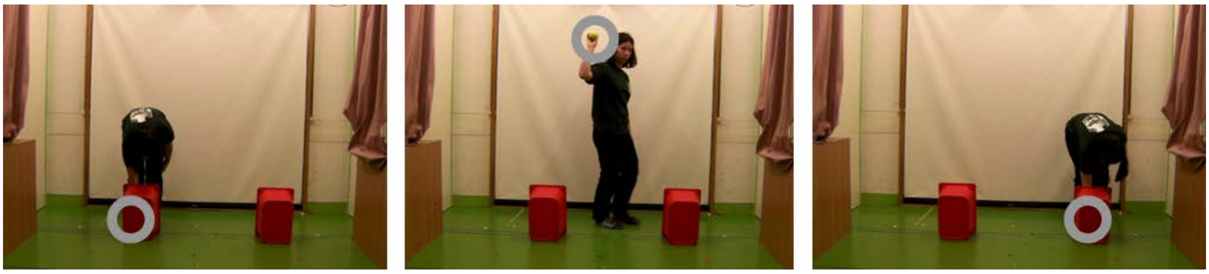
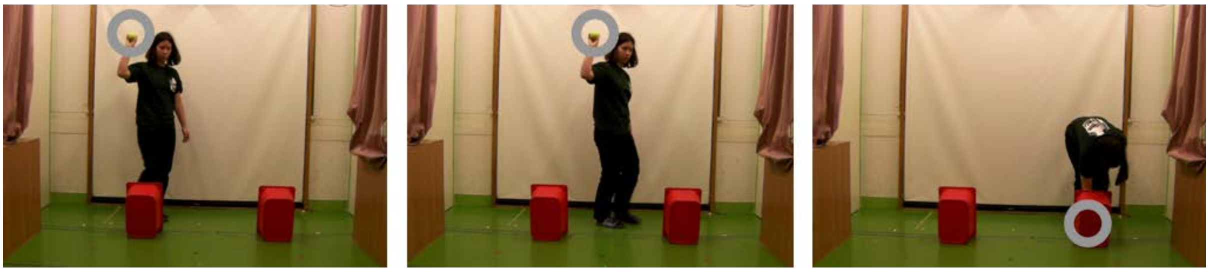

*
**
3
2
1
0
correct choices (median + quartiles)
Search bias to
location B
Random search
Search bias to
location A
NonCom
ComAA
ComAABA
ComBA

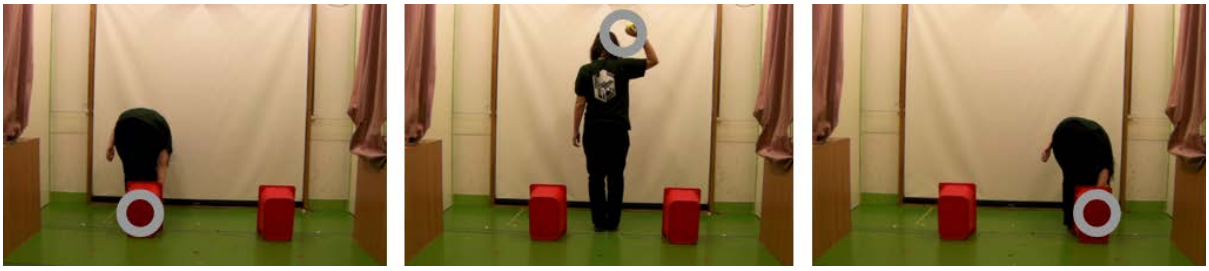
Figure 4



a)



b)



c)

Figure 5

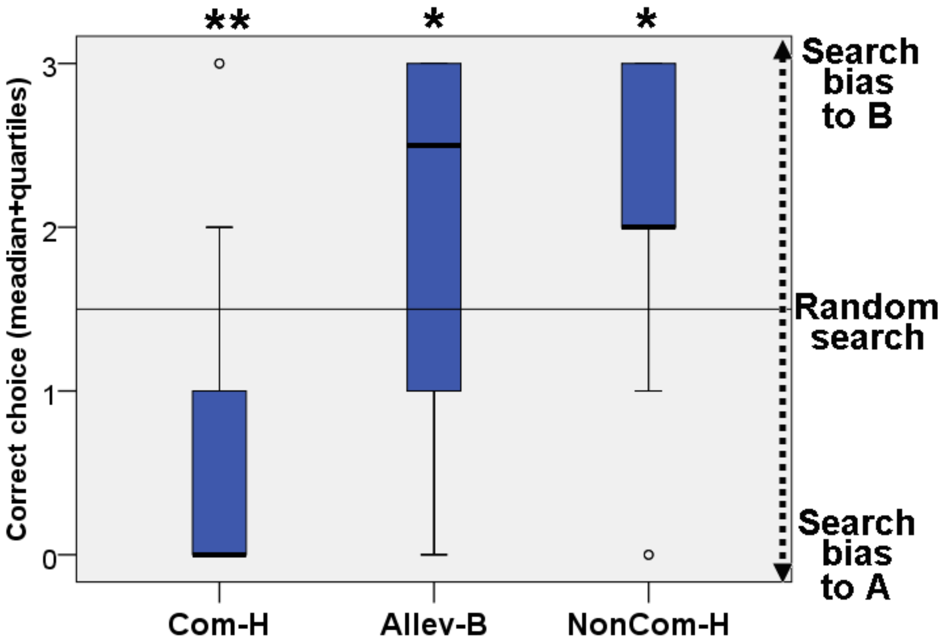

**
*
*
Correct choice (meadian+quartiles)
3
2
1
0
Search bias to B
Random search
Search bias to A
Com-H
Allev-B
NonCom-H

Table 1

<table>
<tr><td></td><td colspan="3">Signals presented</td></tr>
<tr><td>experimental conditions
(N; males/females)</td><td>during A trial
next to the A screen
$\mathbf{A_A}$</td><td>during B trial
next to the A screen
$\mathbf{B_A}$</td><td>during B trial
next to the B screen
$\mathbf{B_B}$</td></tr>
<tr><td>NonCom
(N=19; 10/9)</td><td>Non-communicative</td><td>Non-communicative</td><td rowspan="4">Non-communicative</td></tr>
<tr><td>ComA$\mathbf{_A}$
(N=18; 9/9)</td><td>Communicative</td><td>Non-communicative</td></tr>
<tr><td>$\mathbf{ComA_AB_A}$
(N=18; 7/11)</td><td>Communicative</td><td>Communicative</td></tr>
<tr><td>$\mathbf{ComB_A}$
(N=17; 10/7))</td><td>Non-communicative</td><td>Communicative</td></tr>
</table>

Table 2

	Motivation			
Experimental condition	**Low**	**Moderately**	**Highly**	**Over**
NonCom (N=19)	1	14	2	2
$\mathbf{ComA_A}$ **(N=18)**	5	9	2	2
$\mathbf{ComA_AB_A}$ **(N=18)**	3	9	4	2
$\mathbf{ComB_A}$ **(N=17)**	0	11	4	2

Table 3

Experimental conditions	Number of erroneous choices			
	Zero	**One**	**Two**	**Three**
NonCom (N=17)	2	5	2	8
ComA_A (N=16)	4	4	2	6
ComA_AB_A (N=16)	2	2	4	8
ComB_A (N=15)	0	1	4	10

Table 4

	Cuing next to A during A-trials	Cuing next to A during B-trials	Sham baiting at A during B-trials	Search bias	Source
Com-H	-	**Comm**	**Yes**	**Towards the empty (A)**	***Exp. 2***
Com-H	**Comm**	**Comm**	**Yes**	**Towards the empty (A)**	*Kis et al. 2012b Anim. Cogn.*
NonCom-H	-	**NonComm**	**Yes**	**Towards the baited (B)**	***Exp. 2***
NonCom-H	**NonComm**	**NonComm**	**Yes**	**No search bias**	*Topál et al. 2009 Science*
Allev-B	-	**Comm**	**No**	**Towards the baited (B)**	***Exp. 2***
Allev-B	**Comm**	**Comm**	**No**	**Towards the empty (A)**	*Kis et al. 2012b Anim. Cogn.*