Experiments that use human pointing gestures in two-way object choice tests are popular for studying visual communication and referential understanding but results may be influenced by involuntary cues from handlers or experimenters (i.e., 'Clever Hans Effects'). In this paper we investigated whether such cues from a dog's owner affected performance of dogs during momentary distal pointing trials. Dogs were tested in four groups. In the 'Blindfolded Owner' group, the owners did not see the experimenter's pointing gestures because they wore opaque glasses. In the 'Passive Clever Hans' group, owners were told before the test that if their dogs performed without error, they would receive a gift and their dog would be recorded in the 'smartest dogs registry'. In the 'Active Clever Hans' group, owners were instructed to help their dogs to the correct side by pushing them gently in the correct direction. The fourth group served as a control and owners did not wear a blindfold or receive any specific information. We found no influence of cues from the owners in any of the experimental groups. In contrast to studies based on olfactory cues, this suggests that momentary pointing gestures from a human experimenter can be a reliable communicative cue for adult companion dogs, even when dog owners are present and provide additional voluntary or involuntary cues. We suggest that for short-term studies of visual communication, where individual dogs have little opportunity to learn their owners' cues in the experimental context, the presence of owners may not necessarily distort results.
Response to Reviewers

Click here to download Appendices: Cover_Pongraczetal_CleverHans_Behav_resub3.docx

Ref.: Ms. No. BEH-D-12-00158
There is no ‘Clever Hans Effect’ in clever dogs: Owners fail to influence dogs’ behaviour in a pointing task

Behaviour

Authors’ comments and answers to the Editor and the Reviewer

1) Around L 106 – here you’ve got some discussion of how handlers make mistakes in these kinds of
tasks but what is needed instead are some references to the literature clearly showing CHE in olfactory
tests, as referred to by the reviewer. The paper must be much clearer that CHE does occur in dogs under
some testing scenarios and you must limit your inference throughout to the testing paradigm employed in
this study.

ANSWER: We would like to keep the mentioned reference (Lit et al. 2011). Although it is true that
the mistakes (false alarms during a scent-locating task) could be the results of the handlers
imagination (as we marked it in the original text), we should not forget that the handlers and the
dogs worked here as a team. As some of the handlers were informed where the hidden scent
samples supposedly were, they could show involuntary signals near to these locations, and these
signals could cause CHE in these dogs, resulting in false alarms. This scenario fits to the
suggested direction of discussion of the Reviewer also: when dogs have difficulties in an
olfactory task they may look for another supporting signals or cues in the environment, making
the situation prone to CHE. This point, supported by the literature that was suggested by the
reviewer, is included now to this part of the MS (lines 104-122).

2) Around L250 – as I have commented in this section. How often did dogs actually look at their owners
during the trials? Based on the description, the dogs had their backs to the owners and would have much
more likely been focused on the bowls and the experimenter, especially if they were primed to expect
food in the bowls in front of them. Particularly in light of the reviewer’s comments, this experimental
seems biased against the detection of CHE so it is important to quantify in some way the degree to which
dogs attended to possible cues from their owners.

ANSWER: We added the number of dogs that actually looked back to their owners at the end of
the Results section. Truly, only a few dogs did look back and with the exception of one dog in the
Passive Clever Hans group, they did it only once or twice along the 10 trials. We mention the low
number of looking back now in the Discussion, too. We agree that the pointing task is constructed
on a way that dogs look towards the experimenter and not the owner. However do not forget that
dogs are kept at the start point by their owners, so there is a physical contact between the two,
which makes it possible for the owner to ‘adjust’ the dog’s direction when it starts to go toward
the target. Additionally and most importantly, we told to the owners in the Active CH group to
push their dogs toward the indicated bowl. As now we discuss it at the end of the article, the lack
of looking back to the owner may be the sign of that dogs did not find the task too difficult,
therefore they did not seek actively the contribution of their owners.

3) End of the discussion - We need a couple of concise paragraphs refering to past literature on CHE in
dogs and clarifying limits of the inference provided by your experiment. In particular the limitation that we
don’t know if dogs actually looked at their owners and the fact that dogs had only a very limited time to
learn possible CHE cues from their owners need to be acknowledged. There should also be a general
conclusions paragraph at the end, tying themes together and clarifying the significance of the work. I
would strongly urge you to seek advice on the writing of these paragraphs from an English first language colleague to avoid further delay in acceptance of your work.

ANSWER: Two longer sections were added to the Discussion as you recommended (Lines 344-364 and 368-378). We have a native English speaking friend who helps with most of the articles written at our Department, and she proofread the new sections in this paper, too. However, obviously, things can be worded differently in almost each case, therefore we do not expect to be perfect at this time either.

4) Table 1 still needs to be tidied up. The headings are not all on the same lines and in general it needs to be more polished.

ANSWER: We worked on it, hopefully it looks better now.

Reviewers’ comments:

The paper addresses the question whether dogs in a novel, one time, short duration test, pay attention to other cues than the one being tested, i.e. the experimenter pointing. This is done by comparing 4 different groups, where each of the groups is participating in a different setup with respect to their handler. Since the groups do not differ significantly in general performance, the conclusion is that in this situation, the dogs are not paying attention to other cues, at least not to the handler cues varied between the different situations.

However, this does not mean that the general claim can be made that dogs are not susceptible to the Clever Hans Effect in general, nor that this cannot happen in pointing scenarios. The CHE is usually a result of learning, where dogs pick up those cues that lead most consistently to a reward. In the setup as described in the paper, the case may be made that the dogs that participated as a group in a novel task had not learned to pay much attention to their handlers prior to the experiment that could assist them in this task. This is the maximum that can be claimed and the title should be adjusted to this much more modest claim. After all, Clever Hans was just a single horse…. Besides this main criticism, there are three points that should be addressed in the paper.

ANSWER: We changed the title and address this question also in the Discussion. We have never said that we concluded from the results of this experiment that CHE did not exist in dogs. However, if it was not clear enough in the previous version of the manuscript, now we followed the advice and emphasized that we did not find CHE in dogs in this particular experiment.

As we mentioned in the introduction CHE has a broader practical definition than being only a learned response to some of the (unwanted) environmental cues. Many researchers refer to CHE as the consequence of any kind of human influence to the subjects’ behaviour, of course not regarding here the actual test stimuli, if they were given also by humans. Considering this possibility, the pointing test gives plenty of opportunity for the owners to influence the dogs’ choice behaviour before and at the moment of releasing them toward the target. (Not mentioning the Active Clever Hans group where the owners had to influence the dogs’ direction.)

The first is that individual dogs that actually DO use another cue may be obscured in the group: almost twice as many dogs (7) performed 8/10 choices correctly in the control group than in the blindfolded group (only 4). This may not be significant at the group level, but it would have been interesting to
compare the same dogs in the different conditions, or at least in the two extreme ones. In that way, individual dogs that DO use other cues could be “caught out”.

**ANSWER:** We agree that the proposed experiment (testing the same dogs in the different conditions) would be an interesting one. Of course, one would have to pay attention the order effect that is almost always an issue if repeated testing of the same subjects is involved.

Regarding the distribution of the individually successful dogs across the groups, there is an interesting change if we consider only those dogs ‘successful’ that found the indicated bowl 9 or 10 times of the 10. While the number of successful dogs were 7, 4, 6, 6 in the Control, Blindfolded, Passive CH, Active CH groups if the threshold is set at 8 correct choices, the numbers change to 1, 4, 5, 2 respectively, if the threshold is 9 correct choices. As a conclusion we can say that the proportion of the best performing dogs is very similar in each group – one would need to test a vast amount of dogs (as the power-analysis showed in the previous submission) for detecting the possible subtle differences among the groups.

The second is that the sessions only lasted 10 choices. I think this is too short for the dogs to learn to pay attention to other cues. It would have been interesting to take two groups and train them for a longer period: one using the blindfolded owner, the other using the control setup. Both groups could then be subjected to two tests: a blindfolded one, and a control test. The results of each of the individuals in both tests should then be compared (eg. using Wilcoxon signed rank test). If dogs developed any kind of CHE, the test results of the control group should show this by dogs performing less well in the blindfolded test than in the control test. The dogs in the blindfold group would not have developed a CHE.

**ANSWER:** Again, a very worthy idea for new experiments, we may even try to perform these in the future! In the present paper we tried to focus on the actual conditions as, for example, pointing tests are performed in not only our research group, but around the world in several laboratories. The usual number of trials in these experiments is between 10 and 20. We showed here that dogs do not respond even to the active ‘help’ or ‘influence’ of their owners during the normal length of such a test. Of course we agree with the Editor and the Reviewer that it should be emphasized in the article that these results should not be generalized to every kind of behavioural experiments on dogs. This is now discussed in the manuscript. However, as a recommendation, researchers should also considering an a-priori estimation for the likelihood of CHE in their planned experiment, and adjusting the methods accordingly.

The third is that it is my experience that the CHE effect really shows up when the cue/stimulus that the dogs should be responding to, becomes more ambiguous. In odour recognition, trained dogs respond easily to familiar odours in double blind trials. If the odour is unfamiliar but similar to the one they have been trained on (perhaps another batch), or the concentration goes down, they look for other cues - often at their handler. The pointing gesture may be so salient for dogs that the CHE never shows up.

**ANSWER:** Thank you for this comment, we agree that dogs seek other cues, most importantly some kind of reference from their owner/ handler, when they are facing a difficult/ ambiguous task. This issue is now discussed in the Introduction and in the Discussion section, too.

I like the topic of the paper and the results are worth publishing. I understand the motivation of the authors for this paper: the CHE has been a valid point raised in criticism of many of the "pointing" papers published to date. But to prevent misconceptions, I think the title should be changed, and the authors should stress the limitations of their study both in the abstract and in the discussion. The CHE effect does occur in dogs and we've known so for a long time (for a beautiful example, see Becker, Markee and King,
1957, Studies on olfactory acuity in dogs (1): discriminatory behaviour in problem box situations, The British Journal of Animal Behaviour, V, 3, pages 94-103. The authors could perhaps address more differences in experiments where a CHE is found, and their own. In all experiments with dogs we need to be extremely careful in experimental design. In testing trained dogs used for security and law enforcement we also need to be very critical of the protocols used to ensure the dogs are responding to the trained stimuli. The way this paper reads now could throw us back to the stone age of experimental protocol, and I feel strongly that this should be prevented.

ANSWER: Thank you for the suggestion and for the interesting literature. Now these concerns and limitations of the scope of our study are discussed in a more detailed manner across the paper.
Owners fail to influence the choices of dogs in a two-choice, visual pointing task

Short title: Clever Hans effect in dogs

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Summary

Experiments that use human pointing gestures in two-way object choice tests are popular for studying visual communication and referential understanding but results may be influenced by involuntary cues from handlers or experimenters (i.e., ‘Clever Hans Effects’). In this paper we investigated whether such cues from a dog’s owner affected performance of dogs during momentary distal pointing trials. Dogs were tested in four groups. In the ‘Blindfolded Owner’ group, the owners did not see the experimenter’s pointing gestures because they wore opaque glasses. In the ‘Passive Clever Hans’ group, owners were told before the test that if their dogs performed without error, they would receive a gift and their dog would be recorded in the ‘smartest dogs registry’. In the ‘Active Clever Hans’ group, owners were instructed to help their dogs to the correct side by pushing them gently in the correct direction. The fourth group served as a control and owners did not wear a blindfold or receive any specific information. We found no influence of cues from the owners in any of the experimental groups. In contrast to studies based on olfactory cues, this suggests that momentary pointing gestures from a human experimenter can be a reliable communicative cue for adult companion dogs, even when dog owners are present and provide additional voluntary or involuntary cues. We suggest that for short-term studies of visual communication, where individual dogs have little opportunity to learn their owners’ cues in the experimental context, the presence of owners may not necessarily distort results.

Keywords: dog, human pointing, Clever Hans effect
A standard protocol for testing social cognitive abilities in various animals is the two-way object choice paradigm based on human pointing gestures (see Miklósi & Soproni, 2006; Mulcahy & Hedge, 2012). Dogs are able to use human pointing gestures under a wide range of conditions that vary in their degree of cognitive challenge (e.g. momentary distal pointing, or the momentary distal cross-pointing (Miklósi and Soproni, 2006; Lakatos et al., 2009)). Successful performance emerges relatively early during development and dogs as young as two to five months old can follow human pointing signals (Riedel et al., 2008; Gácsi et al., 2009b; Dorey et al., 2010).

Despite procedural variation (see Pongrácz et al., 2012 in press), performance of companion dogs is relatively stable across testing procedures and laboratories. Dorey et al. (2009), for example, performed a meta-analysis on experimental results from a multitude of studies and found no breed-related differences in performance of companion dogs in pointing experiments. Gácsi et al. (2009b) tested almost two hundred companion dogs of various ages (between two months and adulthood), and found no effect of age, training history, housing conditions, or repeated testing on dogs’ performance although they did detect effects head morphology and selective breeding. Despite these differences, performance of companion dogs is surprisingly robust across studies. Pooled across breeds and categories, dogs choose correctly in about 70% of experimental trials, significantly better than chance.

Although the effect of human pointing on success rates of dogs in these studies is usually analyzed as a group performance, many researchers have noted within-group variation among individual dogs (see, for example, Gácsi et al., 2009b; Pongrácz et al., 2012, in press). Some
individuals perform only at chance level in two-way choice tests, while others perform almost without error. Gácsi et al. (2009b) accounted for this phenomenon as being the consequence of “alternative decision-making rules” because particular dogs may show, for example, strong side-bias during two-way object choice tests. However, other explanations cannot be ruled out, such as unwanted cueing from the persons involved in the experiments (i.e., ‘Clever Hans Effect’).

Responses to unintended cueing in behavioural experiments have been referred to as ‘Clever Hans effects’ (CHE) (Pfungst, 1911). The origin of this term goes back to the beginning of the 20th century, when a German mathematics teacher, Wilhelm von Osten, had a horse (Kluge Hans – in English ‘Clever’ Hans) that became widely known for spectacular performance at arithmetic and other intellectual tasks. Audience members or von Osten himself, would ask mathematical questions (such as subtraction, multiplication etc.), and the horse would ‘answer’ by tapping his hoof. The secret of this performance was revealed by Pfungst (1911), who found out after meticulous testing that the horse reacted (by stopping tapping with his hoofs) to subtle, involuntary signals of the human who asked the question (normally the horse’s owner). As the human knew the answer to the question, when the horse completed the required number of hoof taps, the human gave a subtle movement that Hans detected. Since the investigation of Pfungst, involuntary cueing of research subjects resulting in experimental artefacts is called the ‘Clever Hans Effect’ in the behavioural sciences. Some researchers consider ‘any human effect’ (including intentional cueing for example) on the subject’s behaviour as CHE (for review see Rosenthal, 1964; Umiker-Sebeok and Sebeok, 1981) but the CHE is mostly regarded as a methodological error which deceives the researcher in regard to the behavioural or mental mechanism currently under investigation.
In contrast to captive or free-ranging individuals of most animal species, most dogs rely heavily on human behaviour cues and signals throughout their lives. In this regard, dogs share many common features with preverbal human children (Topál et al., 2009). Dog’s reliance on human behaviour emerges in several contexts, for example, looking for human eye contact (Miklósi et al., 2003), paying attention to ostensive communication (Topál et al., 2009) and reacting to the attentional state of humans (Call et al., 2003). Companion dogs in these studies did not receive any task-specific training prior to the test, nevertheless they showed high levels of performance. A clear demonstration of CHE was provided by Prato-Previde et al. (2008) who tested dogs in a series of two-way choice tests, providing dogs a choice between one versus eight pieces of food. Most dogs chose the larger number of treats on their own, but if a human turned his/her interest toward the smaller reward, pretending to eat it and expressing joy over the quality of the food, many dogs changed their original preference and chose this smaller reward in the next trial. In another two-way choice task the human experimenter could direct dogs to the empty bowl by pointing, even though the dogs had olfactory experience that the other bowl contained some food (Szetei et al., 2003). It is important to note that even trained dogs are subject to CHE. Lit et al. (2011) investigated the joint work of scent detection dogs and their handlers. In this task the dog signals briefly when it finds a hidden (scented) target, and the handler has to notice this signal. When the handlers were provided a-priori information about the locations of hidden targets, this improved the performance of handlers at recognizing the dogs’ signals about presumably found target items. As there were no scent marks hidden at any of the locations, all the alerting signals made by the dogs were either incorrect, or only imagined by the handlers.

In both of the previously mentioned studies (Szetei et al., 2003; Lit et al., 2011), the CHE appeared in dogs that had to solve a somewhat difficult task with only subtle olfactory cues
available for decision making. Although dogs have an unquestionably superb sense of smell (Walker et al., 2006), and people commonly believe that dogs solve most tasks via olfactory cues, there are convincing experimental results that in many cases dogs opt for other senses than their noses. For example, Pongrácz et al. (2004) tested dogs in a detour task, where a human demonstrator showed the subjects how to get around a transparent V-shaped fence and obtain the reward placed inside the corner. In this case, dogs could not detour successfully when they were provided only the scent trail left by the demonstrator’s steps around the fence – however they made the detour successfully when they could see the demonstrator. In an earlier study, Becker et al. (1957) found that dogs easily base their decision on other-than-olfactory cues in a problem box task based on olfactory discrimination abilities. Dogs had to choose either to find a reward, or find their escape route with the help of olfactory cues, however as this study showed, they were prone to CHE when their handler was present, or some other visual cue from the environment was available to support dogs’ learning. CHE therefore seems to be a real problem for professionals in dog training and researchers who conduct ethological experiments on dog behaviour, especially when dogs are facing difficult or unsolvable problems (see Miklósi et al., 2003), as dogs try to rely on additional information, which is unsuitable for the testers initial goals.

One way of dealing with CHE is to exclude potential cues from the owners. Some experimenters make owners wear sunglasses during experiments preventing dogs from seeing the glances of their owner, and/ or preventing the owner from seeing the dog (e.g. Pattison et al., 2010; Horn et al., 2012). Others run the tests in the absence of the owner (e.g. Kaminski et al., 2009). This practice reduces the potential for CHE but because of strong bonds between dogs and their owners (Topál et al., 1998) this could increase anxiety for the dog and reduce
performance. For example, Topál et al. (1997), tested two groups of dogs in a problem solving
task. Dogs were either kept in the garden or lived in the apartment of their owners. Without the
owner’s contribution (encouraging the dog during the task), the garden dogs were much more
successful in the task than the house dogs. However, if the owners were allowed to help with
verbal reinforcement when their dogs had difficulties with the task, both groups performed
equally. This study shows that the effect of the presence and help/assistance of the owner
depends not only on the difficulty of the task, but also on the intensity of the everyday
relationship between dog and owner.

To date, no study has specifically tested the effect of CHE on results for a two-way visual
choice task. We tested the hypothesis that performance by dogs in two-way choice tasks could be
influenced by unintended human cues from the dog owner and/or the experimenter. We
compared the performance of three groups of dogs to a control group that was tested in the usual
way. In the experimental groups the owners were blindfolded, highly motivated, or requested to
help their dogs. We predicted that, if the CHE is an important influence on two-way choice
responses of dogs, then performance would decline for the blindfolded owner group and increase
for groups in which the owners could help their dogs follow the pointing cues.

**Materials and methods**

We adhered to the ASAB/ABS Guidelines for the Use of Animals in Research, the legal
requirements of Hungary about protecting animal welfare, and the ethical guidelines of the
Eötvös Loránd University. During the experimental work the owners of the dogs were present and they were informed about the aims and circumstances of the investigation.

Subjects

Subjects were recruited from dog training schools, where they were attending basic obedience courses (Table 1). Before the tests we explained to the owners what to do and how to behave during the experiment. There were no specific requirements for participating in the tests, but the dogs had to be older than one year. Additionally, dogs were not tested if they were not motivated enough to accept food in the experimental room (see pre-training phase below).

All experiments were performed indoors, between February and May of 2012. Each subject was tested only once, and it took approximately 20 min to test a subject. Subjects were tested in an empty experimental room (4 m x 6 m), which was unfamiliar to them. During the tests only the dog, the experimenter and the owner of the dog were present. Each test was recorded using digital video cameras mounted on the ceiling and the footage was analyzed later.

Pre-training phase

The pre-training phase served a dual purpose: (a) to familiarize the dogs with the place and the experimental setup; and (b) to test whether the subjects were motivated to eat food at the test location. At first we asked the owner to unleash the dog and allow it to explore the experimental site for 1.5-2 minutes. Then the owner moved to the start point, restrained the dog by its collar and positioned the dog on the start point 2.5 m from the experimenter. The experimenter placed
two identical brown bowls (plastic, round flower pots, 20 cm tall and 20 cm wide) on the floor, 1.5-1.6 m away from each other. The experimenter stood in the middle between the two bowls, and dropped a small piece of food into one of the bowls, conspicuously enough so that the dog observed this action. After the experimenter dropped the food into the bowl, the owner let the dog free and encouraged it to eat the food. If the dog ate the food from the bowl, the experimenter immediately put another piece of food into the other bowl, and the dog was again encouraged to eat it. Between two such trials the dog was not called back to the owner and the experimenter remained in the middle between the two bowls. This pre-training was repeated by dropping food into both bowls one more time.

We used the same brand of commercially available sausage (i.e., deli meat) cut into small cubes (5 mm x 5 mm) as a reward for all trials. If a dog failed to take food from the bowls and/or did not eat more than one piece of food during the pre-training phase, we excluded that individual from the experiment as non-food motivated. Only one dog failed to pass this criterion.

**Pointing Procedure**

Experimental trials began immediately after the pre-trial phase for each dog. At the beginning of each trial the dog's owner held it by the collar on the start point with the experimenter 2.5 m away. The type and arrangement of the two plastic bowls was the same as during the pre-training phase. To reduce the possible influence of odour cues, the inside of both bowls was smeared with a piece of food prior to each test. The experimenter stood 20-30 cm behind an imaginary line between the two bowls, an equal distance from both bowls.
In both experiments we used the so-called momentary distal pointing (Soproni et al., 2002; Gácsi et al., 2009a; Lakatos et al., 2009; Pongrácz et al., 2012 in press). At first the experimenter held both bowls in her hands in front of her body, then she put a piece of food conspicuously into one of them, then she exchanged the two bowls between her hands a few times in order to confuse the dog about the exact location of the food. After this the experimenter crouched down and with stretched arms put the two bowls simultaneously to the floor on her left and right side. The experimenter stood up and while holding her two hands bent in front of her chest, attracted the dog’s attention by calling its name. Once the experimenter established eye contact with the dog, she pointed with her index finger in the correct direction toward the baited bowl. The distance between the end of the pointing finger and the bowl was 1 m. The cue was displayed for approximately 1s, and then the experimenter took back her hand in front of her chest. During the pointing gesture, the experimenter kept looking at the dog. If the dog did not leave the start position within 3s after the pointing gesture was finished, the experimenter repeated the pointing gesture one more time.

During the pointing gesture, the owner restrained the dog by the collar and released it only after the experimenter’s hand was again in front of her chest. If the dog approached the baited bowl first it was allowed to consume the food. Regardless of which bowl the dog visited first, as soon as it did visit one bowl, the experimenter quickly picked up both, preventing the dog from examining the other. Once the experimenter picked up both bowls, the owner called the dog back to the start point and the next trial began. If the dog did not choose one of the bowls, but for example sat down in front of the experimenter, or went back to the owner, no score was given, but the trial was repeated once more. If the dog did not choose again, the trial was recorded as a failure and the next trial started.
The testing for each dog in each experiment consisted of ten consecutive pointing trials. An equal number of pointing trials were performed to the right and the left side and the order of left and right pointing was semi-random. No more than two consecutive pointing trials were performed to the same side (to avoid the development of a side bias) and the experimenter did not start the session with two pointing trials to the same side (to avoid the tendency to commit perseverative errors). Five dogs were excluded from further analysis because they stopped choosing after a few trials during the tests.

Testing for the Clever Hans Effect

In this experiment we tested whether owners can influence the choice behaviour of their dogs during the two-way choice test based on human pointing gestures. Four experimental groups were formed. In each case the dogs received ten momentary distal pointing trials. In one group we prevented the owners from seeing the pointing signals, based on the assumption that the blindfolded owner would not be able to influence his/her dog to choose. In two other groups we tried to enhance CHE by either motivating the owner to desire his/ her dog’s excellent performance, or instructing them to actively direct the dog towards the indicated bowl. The fourth, ‘Customary’ group, served as a control. Here we followed the typical protocol of such studies where momentary distal pointing was used, but they did not give the owners any of the above mentioned specific instructions and the owners were not blindfolded (see for example Soproni et al., 2002; Gácsi et al., 2009a; Lakatos et al., 2009; Pongrácz et al., 2012 in press).

Blindfolded Owner group (N=15)
Owners had to wear non-transparent glasses that we provided to them before the test (for similar method, see Pattison et al., 2010). The glasses prevented the owners from seeing the gestures of the experimenter. According to the general procedure, dogs had to be released after the experimenter pulled back her arm from the pointing posture. Because the owner did not see the pointing gesture, the experimenter gave a simple “Now” verbal command to the owner when she/he was supposed to release the dog.

Passive Clever Hans group (N=15)

Owners wore the same kind of non-transparent glasses as in the BO group, but in this case a small (1 mm diameter) hole was made on both ‘lenses’ of the glasses. These holes were large enough for the owner to see the experimenter’s actions, but they were technically invisible from any distance farther than a meter (this means that the manipulated non-transparent glasses did not differ from those glasses used in the BO group if a dog looked back to the owner during the test).

Before the test the experimenter explained to the owner that we were looking for the ‘smartest’ dogs with this experiment. The experimenter assured the owner that if his/her dog performs 10/10 correct choices, their dog will be recorded on the list of the ‘smartest’ subjects for later corresponding tests. Additionally, the owner was shown a collection of gifts (dog toys, books, dog collars etc.), and the experimenter noted that if the dog succeeds in 10/10 correct choices the owner can pick a gift from the inventory. One weakness of this kind of motivation is that if the dog misses one trial, the owner’s motivation may diminish quickly because the dog definitely failed to perform 10/10 trials correctly but this approach provided initially strong motivation to owners.
Active Clever Hans group ($N=15$)

Owners again wore the manipulated non-transparent glasses, as in the PCH group. Before the test the experimenter explained to the owner that he/she will need to help the dog go to the pointed bowl. The owner had to remain on the start location, but at the moment of releasing the dog she/he was allowed to push gently his/her dog to the direction of the bowl the experimenter pointed at. No additional verbal commands were allowed to be given to correct the dog’s behaviour.

Customary group ($N=15$)

The procedure was the same as in the BO group, with the exception that here the owner did not wear any kind of glasses. Before the test the owners were informed when to release the dog and the experimenter did not give the “Now” command after she finished the pointing. This procedure is the same as the pointing experiments that were performed in many of the previous studies, e.g. Gácsi et al., 2009a, b; Lakatos et al., 2009; Pongrácz et al., 2012 in press).

Data collection and analysis

We tabulated the following parameters from the video recordings: number of successful choices (i.e., when the dog went to the bowl indicated by the experimenter); the number of dogs that performed above the chance level; and the pattern of approach to the chosen bowl. Pattern of approach was categorised as follows: straight (i.e., during its approach, the dog always remained on the side where the chosen bowl was; ambiguous (i.e., the dog first approached an imaginary mid-line connecting the start point with the experimenter, then turned towards the chosen bowl);
curved (i.e., the dog first approached one bowl, but then crossed an imaginary mid-line between the start point and experimenter, and went to the other bowl).

As the data conformed to a Gaussian distribution and error variances were equal across groups based on Levene’s test for homogeneity of variance, we used ANOVA with Bonferroni post-hoc tests (in the case of comparing the number of successful choices among multiple groups, and in the case of comparing approach patterns to the bowl among multiple groups), or one-sample t-tests (in the case of comparing the number of successful choices to the chance level within a particular group). The ratio of dogs that performed individually over chance level was compared among the experimental groups with Chi-square tests. An individual was considered as having performed at a better than chance level if it was correct 8 times out of 10 trials (binomial test $p<0.055$). Statistical analyses were performed using SPSS 16.0 and InStat.

Results

The mean number of correct choices was above the chance level in each group (one-sample t-test, Customary Group $t_{14}=3.85; p<0.01$; Blindfolded Owner: $t_{14}=2.62; p<0.05$; Passive Clever Hans: $t_{14}=5.15; p<0.001$; Active Clever Hans: $t_{14}=5.39; p<0.001$ – see also Figure 1). However, there was no difference among groups (one-way ANOVA: $F_{3,56}=0.56; p=0.64$). The ratio of individually successful dogs (those that chose correctly eight or more times: Blindfolded Owner=4 dogs; Passive Clever Hans=6 dogs; Active Clever Hans=6 dogs; Customary=7 dogs) did not differ among groups ($K^2=4.13; p=0.25$).

There was also no difference among experimental groups in the number of ‘straight’ ($F_{3,56}=1.24; p=0.30$) and ‘ambiguous’ ($F_{3,56}=2.20; p=0.10$) approaches to the bowls. However, in
the case of the ‘curved’ pattern, there was a significant difference among the groups ($F_{3,56}=5.55; p<0.001$). Dogs in the Active Clever Hans group followed a curved route much more often than in the other groups where this pattern of approach was only sporadic (Figure 2). Interestingly, for the Active Clever Hans group, whenever a dog approached the chosen bowl via a curved path the final choice was always incorrect. That is, the dog started to approach the bowl which was indicated by the experimenter, but then changed its selection to the other bowl.

Dogs looked back to their owners very rarely during the tests. The number of dogs that looked back was the following in the groups: Blindfolded Owner (1 dog, only one occasion); Passive Clever Hans (8 dogs, group average 1.6); Active Clever Hans (2 dogs, group average 0.13); Customary (3 dogs, group average 0.26).

**Discussion**

We found no evidence of the Clever Hans effect in any of our experimental groups, despite the fact that in one group the owners were strongly motivated to augment their dogs’ performance (‘passive Clever Hans’ group) and in another group the owners actively helped their dogs towards the indicated bowl (‘active Clever Hans’ group). In this group the owners pushed their dogs towards the indicated bowl, but several of these dogs still changed their direction and chose the other (not-indicated) bowl. Additionally, there was no deterioration in the performance of dogs if the owners wore a blindfold. These results are consistent with our previous work demonstrating that the experimenter involved in a given task has the strongest effect on the dog’s behaviour (e.g. pointing task: Szetei et al., 2003; social learning task: Pongrácz et al., 2004).
We assume that during these choice tasks, the (unfamiliar) experimenter and the dog become involved in a communicative interaction in which the experimenter displays ostensive behaviour cues in order to make the situation comprehensible for the dog. These include: (1) calling the dog by its name or using other attention seeking tactics; (2) making eye contact; and (3) providing a signal (i.e., pointing). Several previous studies have shown that this type of ostensive communication has a significant influence on canine choice behaviour (e.g. Erdőhegyi et al., 2007; Prato-Previde et al., 2010) and some have argued that dogs may have been selected for their sensitivity to this type of communication (Topál et al., 2009). However, the presence of the owner can be important as the owner often serves as a 'secure base' for many companion dogs (Topál et al., 1998). For example, when dogs are faced with ‘unsolvable’ tasks, they quickly refer back to their owner (Topál et al., 1997; Pongrácz et al., 2001; Miklósi et al., 2003) and some individuals exhibit signs of distress if they are isolated from their owner.

The results of this experiment do not mean that, in general, CHE does not affect the behaviour of dogs. There are convincing examples in literature, especially when using/learning olfactory cues was confronted with learning visual cues, that dogs easily rely on involuntary or voluntary signals from their human handlers or the experimenter (Becker et al., 1957; Szetei et al., 2003). We can only say that CHE is unlikely to happen in pointing tasks, as we found that owners could not influence their dogs’ performance even if they wanted to. One could argue that 10 trials were not enough for the dogs to learn how to use the owner-given help to find the correct bowl more often. We think this is unlikely because in the group where the owners actively pushed their dogs towards the indicated bowl the physical effect of this kind of ‘help’ was directly visible on the curved trajectory with which the dogs approached the bowls. Another alternative explanation why we could not detect CHE in this experiment is that the cues given by
the experimenter (pointing) are too easy to follow, therefore dogs were not faced with an overly
difficult task and they did not need to rely on the possible signals from their owners. This
hypothesis may be supported by the fact that very rarely the dogs looked back to their owners
during their approach to the bowls, and we know that looking back is a sign that dogs have a
problem with solving a task (Miklósi et al., 2003; Pongrácz et al., 2004). Furthermore, the design
of the experiment only allowed dogs to have their backs toward their owners which made it
difficult for the subjects to refer back to their owners. However, as the dogs were held by their
owners until the pointing cue was finished, it is easy to imagine that owners could ‘fine tune’ the
exact release time of the dog, and they could (as in the Active Clever Hans group was done) also
influence the initial direction of their dogs by physical contact.

Pointing tasks are hardly unsolvable for any dog, but most companion dogs may show
more natural behaviour if their owner is present (Topál et al., 1997). Our results show that during
the two-way object choice test, the presence of the owners did not influence the dogs’
performance which might indicate that they do not contribute to the ‘Clever Hans effect’. The
main conclusion of this study is that researchers should take into consideration the type and
difficulty level of the planned experiment before taking measures against CHE and deciding to
include or exclude dog owners in the experiment. While tests with olfactory tasks or problem
boxes seem to be more prone to CHE, straightforward experimental designs with direct visual/
acoustic communication between the experimenter and the dog may give less opportunity for
CHE to develop. Interestingly, as our tests showed, CHE may depend more on the ‘need for
help’ of the dog than on the actual ‘helpful interventions’ of the dog owners. As most family
dogs show their natural behaviour in the presence of their owners, experimenters should restrict
the natural interaction of the dog-owner dyad only when and where the development of CHE is truly expected.

Acknowledgements

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References


**Table 1.** General data of the dogs used as subjects. Abbreviations: BO (Blindfolded Owner Group), PCH (Passive Clever Hans Group), ACH (Active Clever Hans Group), C (Customary Group).

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Figure 1. The mean number (+SE) of correct choices (N=15 in each group). The horizontal line shows the chance level. There was no significant difference among the groups (one-way ANOVA). Markings within the bars show the results of one-sample t-tests: *= p<0.05; **= p<0.01; ***= p<0.001.

Figure 2. Comparison among the occurrences of different approach patterns to the bowls. ‘Straight’ = the dog walked to the chosen bowl in a straight line. ‘Ambiguous’ = the dog at first walked on the mid-line, then turned towards the chosen bowl. ‘Curved’ = the dog at first walked towards one of the bowls, but then changed direction and went to the other bowl. Different letters over the bars show significant differences among the experimental groups (one-way ANOVA, Bonferroni post-hoc test). NS= non-significant.
Figure 1

![Graph showing mean correct choice (+SE) for Customary, Blindfolded Owner, Passive Clever Hans, and Active Clever Hans. The graph includes error bars and significance levels (*, **, ***).]