Response to Comments on "Differential Sensitivity to Human Communication in Dogs, Wolves, and Human Infants"

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Response to Comments on "Differential Sensitivity to Human Communication in Dogs, Wolves, and Human Infants"

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The comments by Fiset and Marshall-Pescini *et al*. raise important methodological issues and propose alternative accounts for our finding of perseverative search errors in dogs. Not denying that attentional processes and local enhancement are involved in such object search tasks, we provide here new evidence and argue that dogs' behavior is affected by a combination of factors, including specific susceptibility to human communicative signals.

We recently reported that dogs, like 10-month-old infants, will persistently search for a hidden object at its initial hiding place even after observing it being hidden at another location (a perseverative search error known as the A-not-B error) (*1*). The comments by Fiset (*2*) and by Marshall-Pescini *et al*. (*3*) raise methodological questions about our study and propose alternative explanations for our finding of perseverative search errors by dogs in the A-not-B object search task. We contend that dog behavior is affected by a combination of factors, including specific susceptibility to human communicative signals.

Fiset (*2*) claims that our results (*1*) contradict Gagnon and Doré (*4*), who reported that dogs do not commit the A-not-B search error if they face a human who provides ostensive-referential signals. He suggests that dogs' perseverative search bias observed in our study (*1*) arises instead from the use of an "atypical" and mistakenly designed testing procedure and not from the dogs' specific susceptibility to human communicative signals. According to Fiset, our procedure deviates from the "typical" test because (i) the experimenter is sham baiting location A during the B trials, (ii) the experimenter provides communicative signals for the subject while hiding the target object, and (iii) the roller-coaster trajectory of the target object distracts the dogs, making the object search task attentionally more demanding in the social-communicative context as compared to the nonsocial hiding condition. Fiset also claims that dogs show a higher tendency to commit context-specific A-not-B errors in comparison with wolves because the latter possess better skills of attention.

First, we do not share Fiset's opinion that the experimental condition in the studies of Gagnon and Doré (*4*, *5*) constituted a social context similar to the social-communicative (SocCom) condition of our study (*1*). In these earlier studies, the target object was not manipulated directly by the human, but instead was remotely moved by a 1.25-m transparent nylon thread. Moreover, the experimenter avoided as much as possible providing any communicative cues to the dog and attracted the dogs' attention in a noncommunicative manner (by moving the target object in the dogs' immediate visual field). We did not find any indication of using eye contact or verbal command in the written procedure. In contrast, they reported that care was taken that the dog looked at the object and ignored the human during the procedure. Thus, the method reported by Gagnon and Doré was not truly social and was explicitly noncommunicative. Their procedure was therefore unsuitable for testing the effect of human ostensive-communicative signals on the search behavior of dogs. Although Gagnon and Doré's studies are similar to the noncommunicative trials of our study, considerable procedural differences preclude any direct comparison of the dogs' performance.

Second, we agree with Fiset (*2*) that tracking the object can be attentionally more demanding in the communicative and noncommunicative social conditions than in the nonsocial trials. To see whether this point would account for the increased search errors in the B trials, we observed 12 naïve dogs in a less demanding version of the social condition. The procedure was identical to that of the SocCom condition in (*1*) except that during the B trials, after the experimenter had picked up the object (and attracted the dog's attention by communicative signals), she did not bend her upper body behind screen A with the toy in hand but rather walked to screen B while keeping the toy object on the same level in her hand. That is, the object did not shuttle between the shoulder height of the experimenter and ground level at location A and was constantly visible until she placed it behind screen B. In contrast to Fiset's prediction, we could not find significant improvement in dogs' performance compared with our original results in the fully communicative task [mean percentage of correct choices: 27.7% versus 22.2% in the SocCom condition in (*1*); $t_{22} = 0.467$, $P = 0.645$; groups were matched for age, gender, and breed category].

Third, we believe that Fiset's discussion of wolf-dog differences (*2*) needs some complementary notes. To date, there is no supporting evidence for wolves' greater attention span (as compared with dogs), and the reference cited by Fiset as a support for the relatively "short and variable attention span for social cues" in dogs is not relevant in this context. That study (*6*) tested subjects' willingness to "eavesdrop" in a noncommunicative context, not the amount of time a dog is able to concentrate on a communicating human without becoming distracted.

Fourth, we strongly disagree with the notion that wolves would outperform dogs in pointing tasks. In those studies in which subjects were tested with an attentionally highly demanding signal (momentary distal pointing), in contrast to dogs, wolves could use this cue only after extensive formal training (*7*, *8*), or at least after extensive experience with humans (*9*). We argue that wolves are not merely "less prone to interference from social cues" than dogs but that dogs' higher susceptibility to human social signals is the key factor in wolf-dog differences (*10*).

Finally, the finding that dogs showed similarly high performance in the A trials of both social and nonsocial conditions (mean percentage

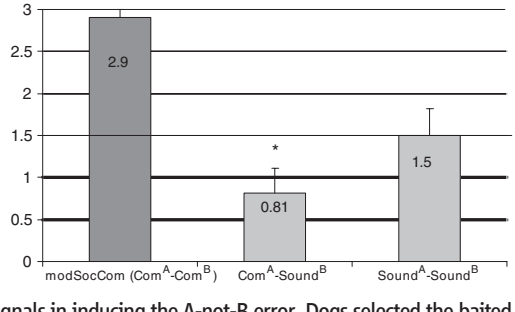

Fig. 1. Scores of correct responses (mean + SE) in the B trials in the modified versions of the social-communicative condition in (*1*). After the experimenter had repeatedly hidden the toy using ostensive-communicative signals in the A trials, she enhanced both barriers (A and B) in the B trials by using either the same communicative (Com) or nonsocial sound signals (Sound). Different cuing patterns leads to a significantly different search response, providing evidence for the differential role of ostensive and nonostensive signals in inducing the A-not-B error. Dogs selected the baited B location in the balanced communicative cuing (Com^A-Com^B) condition [data from Marshall-Pescini *et al*. (*3*)], whereas they showed random search in the balanced nonsocial cuing context ($Sound^A$-$Sound^B$, n = 16) and significant search bias toward the empty A location if the experimenter enhanced the A location communicatively and then recalled the dogs' attention by squeezing the toy before hiding it in the B location (Com^A-$Sound^B$, n = 16). *, $P < 0.05$.

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of correct choices were 94% and 98%, respectively) seems to confute Fiset's hypothesis that the experimenter's movements (walking behind position B after hiding the object at location A) worsened the performance of dogs in social conditions as compared to the nonsocial context. We do not see any reason to accept that a short attention span explains dogs' performance in these versions of the task better than the theory that we advanced in (*1*).

Marshall-Pescini and colleagues (*3*) agree with the general notion that ostensive-communicative cues have a strong influence on dogs' behavior but challenge our proposal and claim that the dogs' A-not-B errors observed in our particular experiment stem from the unbalanced cuing procedure of the social-communicative (SocCom) hiding context and do not indicate unique susceptibility to human communication. That is, although in the B trials of the noncommunicative (NonCom) context, the experimenter used sound stimuli (squeezing a toy) before the toy was hidden behind both the A and the B screens, subjects were not provided communicative signals adjacent to the B screen in the SocCom condition. In their study (*3*), Marshall-Pescini *et al*. therefore reversed the situation such that the cuing procedure was balanced in the SocCom condition (communicative signals were provided at both A and B locations) and unbalanced in the NonCom (sound stimuli were used only at the empty A location). Dogs' better performance in the balanced (modified or mod SocCom) as compared with the unbalanced (mod NonCom) cuing context led the authors to conclude that local enhancement can account for A-not-B errors and question that the context-specific changes in dogs' tendency to commit A-not-B error would have any relevance to their sophisticated understanding of human communication.

Although we agree that our findings open the door for alternative explanations and that the underlying cognitive processes of the A-not-B error in dogs call for further studies, we are not convinced that Marshall-Pescini *et al*. could provide convincing evidence for local enhancement as an alternative to our hypothesis. In our view, Marshall-Pescini *et al*.'s modified SocCom condition is not fully suitable for making distinctions between these accounts. Namely, the local enhancement account, as well as our hypothesis, predicts that applying verbal attention-attracting signals at location B during the B trials will eliminate the perseverative search error because these cues not only enhance the saliency of the B barrier but also can be interpreted by the dogs as a novel imperative order that overrides the former instruction ("Go to the A barrier!") and urge the dogs to redirect their approach to the B barrier.

We agree that their unbalanced version of the noncommunicative condition (mod NonCom) is a more suitable control for studying the biasing effect of the ostensive-communicative signals in our original unbalanced SocCom condition than the balanced NonCom procedure we used (*1*). Unfortunately, however, Marshall-Pescini *et al*. fail to replicate the SocCom and NonCom conditions of our original study, and thus their conclusions are limited to the comparison of a balanced (mod SocCom) and an unbalanced (mod NonCom) condition—a similar technical problem to our original study. Therefore, we have only indirect evidence that balanced social cuing in the mod SocCom condition eliminates the robust A-not-B error of the SocCom condition, whereas there is no similar difference between the balanced NonCom condition and the unbalanced mod NonCom conditions. This provides some evidence that the unbalanced nature of the cuing between location A and B is not sufficient for triggering perseverative search at the A barrier. Instead, the factor that matters is the communicative nature of the signals provided by the human.

We do not agree with the notion that the unbalanced nature of the social-communicative hiding context is a methodological failure. In contrast, as in our infant study (*11*), it was an important design feature of our procedure. Regarding that study, Marshall-Pescini *et al*. mistakenly claim that "procedures followed in studies with human infants did not differentially enhance the two locations" in the SocCom condition. In fact, the experimenter employed strong ostensive-communicative signals adjacent to location A during the A trials, and she also used social cues in the B trials to attract infants' attention at the starting position (adjacent to location A), but she recalled the infants' attention using nonsocial noise effects adjacent to location B. This procedure was specifically designed to test the prediction that perseverative search bias can be triggered by differential communicative cuing of the two hiding locations in infants and is not simply a matter of attention. Admittedly, in our dog study (*1*), the cuing procedure in the SocCom condition was more unbalanced because the experimenter did not recall the dogs' attention using any conspicuous noise.

We therefore conducted an experiment in which naïve dogs participated in one of two novel versions of the SocCom condition of Topál *et al*. (*1*). In the Com^{A}-$Sound^{B}$ condition, the cuing procedure corresponded to that of the infant study (*11*): strong communicative cues adjacent to barrier A (Com^{A}) in both A and B trials, and conspicuous nonsocial sound signals before hiding the object behind the B barrier in the B trials ($Sound^{B}$). That is, in the B trials, before hiding the toy at location B, the experimenter recalled the dog's attention by squeezing the toy (with her back turned toward the dog).

In the $Sound^{A}$-$Sound^{B}$ condition, dogs participated in the very same procedure as in the Com^{A}-$Sound^{B}$ except that during the B trials, the experimenter used the same nonsocial cuing at locations A and B. Our results (Fig. 1) show that in contrast to the nonsocial sound stimuli by which the experimenter recalled the dogs' attention before hiding the toy behind screen B (thus making the B location salient), dogs performed below the success rate expected by random search (mean percentage of correct choices for the Com^{A}-$Sound^{B}$ condition was 29.3%, $t_{15} = -2.248$, $P = 0.04$). If, however, after social-communicative A trials the experimenter enhanced both A and B locations equally, dogs selected randomly (mean percentage of correct choices in the $Sound^{A}$-$Sound^{B}$ condition was 50%, $t_{15} = 0.0$, $P = 1.0$) (Fig. 1). This finding provides further support for the notion that social and nonsocial cues are not equally effective in inducing A-not-B errors in dogs.

In conclusion, we persist in our view that an important causal factor leading to perseverative search errors in dogs is not the mere amount of attention but the informational selectivity of attention. That is, dogs might have extracted different kinds of information to be learned from the communicative versus noncommunicative demonstrations, and this is modulated by social cognitive processes. Nevertheless, we agree with both Fiset (*2*) and Marshall-Pescini *et al*. (*3*) that attentional processes are involved in such object search tasks and that local enhancement learning may also influence performance. Although the social hiding context represents a more complex and attentionally more demanding situation, we conceive attention and local enhancement not as alternatives to social cognition but as processes by means of which social cognitive phenomena, like susceptibility to communicative signals, are implemented. Dogs' behavior in the A-not-B error task is probably driven by a combination of factors, including sensitivity toward human ostensive signals.

References and Notes

1. J. Topál, G. Gergely, Á. Erdőhegyi, G. Csibra, Á. Miklósi, *Science* **325**, 1269 (2009).
2. S. Fiset, *Science* **329**, 142 (2010); www.sciencemag.org/cgi/content/full/329/5988/142-b.
3. S. Marshall-Pescini, C. Passalacqua, P. Valsecchi, E. Prato-Previde, *Science* **329**, 142 (2010); www.sciencemag.org/cgi/content/full/329/5988/142-c.
4. S. Gagnon, F. Y. Doré, *J. Comp. Psychol.* **108**, 220 (1994).
5. S. Gagnon, F. Y. Doré, *J. Comp. Psychol.* **106**, 58 (1992).
6. F. Range, L. Horn, T. Bugnyar, G. K. Gajdon, L. Huber, *Anim. Cogn.* **12**, 181 (2009).
7. Á. Miklósi *et al*., *Curr. Biol.* **13**, 763 (2003).
8. Z. Virányi *et al*., *Anim. Cogn.* **11**, 373 (2008).
9. M. Gácsi *et al*., *PLoS ONE* **4**, e6584 (2009).
10. M. Gácsi *et al*., *Dev. Psychobiol.* **47**, 111 (2005).
11. J. Topál, G. Gergely, Á. Miklósi, Á. Erdőhegyi, G. Csibra, *Science* **321**, 1831 (2008).

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