only other relevant study, children less than 2 yrs 11 mth failed the implicit measure [13]. It could be that methodological differences account for the different ages children pass implicit tasks compared with the Onishi and Baillargeon task.

Leslie suggests that younger children (below 2 yrs 11 mth) fail implicit measures because of the verbal demands of the implicit tasks. Yet these tasks follow the same sequence of events as in Onishi and Baillargeon's study. Even without understanding the narrative, the visual details of the events should enable correct eye gaze, provided that infants understand the eye gaze prompt (e.g. '*I wonder where he'll look*?'). Importantly, 2-year-olds do look correctly in response to this identical prompt in other social understanding tasks [15], and ironically also in a study cited by Leslie (Waskett *et al.*, unpublished), demonstrating the verbal demands are within their grasp.

In our view, current data indicate that infants understand much about behavior but whether it includes an understanding of belief is still a wide open question.

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Letters

Is there a simple recipe for how to make friends?

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As an answer to their own question (where do dogs' unusual social skills come from?) Hare and Tomasello [1] argue that 'domestication' might have paved the way for the emergence of human-like abilities in dogs. They suggest that in the course of 'domestication' dogs have been selected for systems that mediate fear and aggression towards humans and social skills surfaced as a 'by product' of this 'tame' behaviour.

Their approach presents an interesting contribution to the recent expansion of comparative social cognition in which the traditional ape–human comparison is being extended to a wider range of species [2,3]. Hare and Tomasello sense very clearly that there is a need for novel hypotheses to explain existing data, as well as for more productive research in future. However, certain limitations of their proposal should to be considered in order to judge the feasibility of their 'emotional reactivity' hypothesis.

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The first issue concerns the problem of whether domestication alone can account for the social skills observed in dogs. We think that there are at least two reasons why this might not be the case. First, although domestication is often viewed as directional selection against aggression and fear, the actual process was likely to be influenced by the type of interaction between humans and the species in question. Second, any emergent social skill towards humans in domesticated animals is probably a function of the social behavior exhibited by the wild ancestor. This is clearly reflected in the divergent performance of domesticated species in the 'cueing-task'. Whereas goats show some evidence of finding hidden food on the basis of observing human communicative cues [3], horses seem to perform poorly ([4], Maros *et al.* unpublished data). In addition, we have recently found with pet dogs and cats growing up in the same human families, that although both species were more or less equally skillful in using various human

pointing cues, cats were less likely than dogs to look towards a human when facing an insoluble problem situation [5]. This result with cats is even more interesting if one considers that the social structure of their ancestors was most probably more similar to that of foxes than dogs.

In support of their hypothesis, Hare and Tomasello have suggested that there might be a relationship between 'emotional reactivity' and social skills at the individual level. It is well known that 'taming' or 'socializing' animals can decrease 'emotional reactivity'. Interestingly however, some recent studies suggest a dissociation: although socialized wolves seem to approach the performance level of dogs in the cueing task after extensive human contact, they are not facilitated in cases requiring *initiation* of communication with humans [6]. Further, some of our large-scale observations (N=160) on dogs of different breeds suggest that there is no relationship between aggressiveness and performance in the 'cueing-test'; dogs that are aggressive towards a threatening human are just as successful as friendly ones (J. Vas, unpublished data).

Taken together these data suggests that the reduction of 'emotional reactivity' alone (either by genetic selection or by experience and learning) is not enough to explain dog behavior. Therefore it seems inescapable that we must look for behavioral changes that might have emerged as a result of selection in social domains other than aggression and fear. At the moment we have three candidates.

First, recent observations have shown that 4-month-old dogs but not wolves fulfil the criterion of attachment to humans even if members of both species have been socialized to similar levels [7]. Second, there is evidence that over the course of domestication, dogs' vocalization has changed fundamentally in comparison to that of wolves: dogs 'invented' barking in fearful situations and, unlike wolves, they seem to be able to modify the frequency and pulsing of barking [8,9]. Third, we suggest that by having more flexible looking (gazing) behavior dogs can also use it for communication of affiliative intent [6]. Interestingly, as looking behavior is mainly associated with agonistic behaviors in wolves, selection for animals with extended looking/gazing behavior without displaying aggression or fear [10] could also have resulted as a 'byproduct' of the reduction of aggressive and fearful behavior.

Finally, there might be a methodological point to be considered that makes the fox-experiment difficult to interpret. It is very likely that foxes have 'inadvertently' been selected for basically the same behavior as they actually showed in the cueing test (i.e. approach human or hands providing food). Namely, when the experimenter extended his arm to the bowl containing the hidden food in the cueing test, performance of tamed foxes can be attributed to their selected preference for approaching humans or parts of the human body. As such cueing was also relatively easy for socialized wolves to rely on, without further control experiments the relevance of the fox study on the origin of social skills in dogs is disputable.

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Letters Response

The emotional reactivity hypothesis and cognitive evolution

Reply to Miklósi and Topál

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In our review of dog social problem-solving abilities we proposed the 'emotional reactivity hypothesis', which suggests that selection on social-emotional systems could have provided an initial catalyst for wider social cognitive evolution in dogs, other non-human species and perhaps even in human evolution [1].

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