



Forum

Dogs imitate selectively, not necessarily rationally: reply to Kaminski et al. (2011)

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Range et al. (2007) provided the first evidence that animals imitate in an inferential, selective manner. Rather than emulating by using their preferred method or (blindly) copying an alternative method that a conspecific demonstrated to solve an instrumental task, dogs selectively re-enacted the demonstrated action depending on the constraints of the situation of the demonstrator. When the model demonstrated a paw action instead of the usually preferred mouth action, observer dogs imitated the paw action only if the demonstrator did not have an obvious reason to do so (i.e. nothing prevented her from using the mouth). However, when the model demonstrated the paw action with her mouth 'occupied' (carrying a ball), the observer dogs predominantly used the mouth. The authors interpreted these results in terms of dogs being sensitive to the efficiency of goal-directed actions. Before this study, this sensitivity was considered a human-specific feature of cultural learning.

Of course, alternative interpretations of the study are possible. For instance, the dogs may have acted differentially across conditions based on the presence or absence of the ball. The mere presence of a ball may affect the observers' behaviour by distracting them or by priming their tendency to grasp objects with their

mouth. Range et al. (2007) have acknowledged this, but on the basis of various behavioural measurements they considered it very unlikely. A recent study by Kaminski et al. (2011) set out to replicate the experiment of Range et al. (2007) and to control directly for the effect of the presence of the ball. The study failed to show selective imitation in dogs, questioning the conclusion of the Range et al. (2007) paper. In our opinion, however, this attempt at replication is invalid because important elements of the procedure, the analysis and the statistics, as well as the interpretational assumptions, differed between the two studies. This article summarizes and explains these important differences.

DIFFERENCES IN PROCEDURE AND ANALYSIS

Multiple differences in the procedure make comparisons across the two studies difficult. Kaminski et al. (2011) acknowledged the possibility that the criteria for the inclusion of dogs in their study were stricter, which may have led to a higher drop-out rate. Therefore the pretraining was extended, with both actions being extensively trained, which then may have led to the convergence in the probability of usage of mouth and paw to operate the rod. A further important difference was in the analysis of the test performance. It is a common feature of imitation studies that emphasis is laid on the performance in the first trial after observation. Only initial, spontaneous performance can tell us how the

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observer's behaviour (choice of actions) has been affected by witnessing a demonstration. To be fully comparable to Gergely et al.'s (2002) study on children, our original study determined the proportion of dogs using the demonstrated action (the paw action) to manipulate the rod in the different groups in the first trial (see Table 2 in Range et al. 2007). In contrast, Kaminski et al. (2011) used the first successful action as the critical variable, irrespective of whether it appeared in the first or a subsequent trial.

When an action appears later, however, it is clearly possible that the subject has learned from the previous attempts and so the observational effect was overshadowed by trial-and-error learning.

Even more importantly, it appears that Kaminski et al. (2011) used inappropriate statistics. To test for an influence of multiple predictor variables on one response variable, they used multiple simple tests (Fisher tests, *t* tests) instead of one overall model (analysis of variance or a generalized linear model, GLM). First, they tested for the effect of demonstration and found no (strong) effect ($P = 0.128$). Then they used the same data and tested for the effect of the presence of the ball. Here, they found a significant effect ($P = 0.029$). However, if one uses, more appropriately we believe, a binomial GLM model with the method used in the first successful attempt (Paw/Mouth) as a binary response variable and Demonstration (Yes/No) and Ball presence (Yes/No) as two predictor variables, Ball presence appears to have no significant effect when the effect of demonstration is held constant ($P = 0.12$; data from Kaminski et al.'s Table 2). This means that, in contrast to their main conclusion (page 200: 'our findings suggest that ball presence strongly affected dogs' behaviour and thus may explain Range et al.'s (2007) results'), Kaminski et al.'s own results do not support this argument.

INTERPRETATION OF DATA

Kaminski et al. (2011) concluded that their results suggest that dogs do not distinguish rational from irrational actions, rejecting the conclusion imputed to our original study. They correctly note that the seminal study with human children (Gergely et al. 2002) has been interpreted as evidence that children from an early age evaluate the 'rationality' of others' actions. Furthermore, they refer to studies with enculturated chimpanzees, *Pan troglodytes*, conducted in their own laboratory (Buttelmann et al. 2007, 2008) by also suggesting that chimpanzees are able to interpret the rational dimension of others' actions. In these papers the authors claimed that chimpanzees imitate rationally (Buttelmann et al. 2007) and use tools rationally (Buttelmann et al. 2008). By then making reference to Range et al. (2007) they characterized our study as finding that 'dogs copy others' means to achieve a goal more often when those means are the rational solution to a problem than when they are irrational' (Kaminski et al. 2011, page 195). However, we, the authors of the cited study, have purposefully never used the attribute 'rational' in our paper when interpreting the dogs' behaviour. Instead, we concluded that the clear divergence in the performance of the two experimental groups suggests an ability to imitate 'selectively'. As explained in more detail in Huber et al. (2009; not cited in the article), these results fit into a larger view of how animals copy behaviour that varies according to the matching fidelity and types of re-enactment in social learning.

Kaminski et al. (2011) not only failed to acknowledge this important difference in the interpretation of human children and chimpanzee studies on the one hand and our dog study on the other (as well as other selective imitation studies, such as Horner & Whiten 2005), but also failed to appreciate the reason for using the attribute 'rational' in Gergely et al.'s (2002) paper. As laid out in much more detail by Gergely & Csibra (2003; not cited), teleological reasoning in infancy can be framed in terms of a 'naive theory of rational action' insofar as in humans this nonmentalistic teleological interpretational

system of infants is related to a fully fledged mentalistic stance. Since teleological reasoning is computationally easier than inferring and attributing beliefs, desires and intentions to the actor's mind, it also might be available for nonhuman animals. Still, we may want to differentiate its nonhuman forms from humans' teleological reasoning that is linked to a 'mentalistic stance', especially if there is no other evidence that the nonhuman species is capable of mentalizing.

Range et al. (2007) clearly stated (in the opening paragraph of our paper) that the ability to predict the most efficient action to achieve a goal within the constraints of a given situation does not require the attribution of mental states to others, but may rely simply on the evaluation of observable facts: the action, the goal state and the situational constraints. We further emphasized that dogs, like other animal species, optimize their behaviour on the basis of efficiency, for instance choosing the shorter route instead of a detour to reach a reward (Pongracz et al. 2003). Thus, the aim of the study was to examine whether dogs automatically copy a demonstrated action (in whatever situation) or selectively re-enact the demonstrated action depending on the constraints of the situation. We did not claim, and do not believe, that our study demonstrated 'rational imitation'.

DIFFERENCE IN BASELINE DATA

The principle of action efficiency is likely to manifest at the behavioural level as a preference of most subjects to use one method over another formed by action selection during the course of evolutionary or learning processes. The selective imitation task crucially rests on the assumption that a nonpreferred or peculiar action is copied (imitated) only in a causally opaque situation, that is no constraints were present to explain the demonstrator's ineffective choice. If the observer understands how to solve the task (and achieve the desired goal), and the demonstrated action is not justified by the constraints of the situation, he/she would rather emulate by using their own preferred method to achieve the goal in the easiest way. A test for selective imitation thus requires that observers have two (or more) actions, with clearly different preferences, at their disposal. Although Kaminski et al. (2011) attempted to replicate our findings, the performance of the dogs in their control group clearly failed to fulfil this conceptual requirement. While the dogs in Range et al.'s study had a significant preference for the mouth action (84.6%), dogs in Kaminski et al.'s study chose randomly between the two actions, showing, if at all, a reversed tendency (37.5%) resulting from a slight preference for the paw action. This difference between the control groups is curious, but needs to be explained, not overlooked. This significant difference between the two studies renders a comparison with the other (experimental) groups invalid, because one cannot test whether observers give up a preference (because of a demonstration), if there is no clear preference in the control sample. Kaminski et al.'s results raise the question of whether the preference for the mouth is a robust phenomenon or is susceptible to procedural differences (e.g. stronger pretraining as discussed by Kaminski et al.). But this core difference between the two samples does not render our conclusion about selective imitation invalid.

PRIMING VERSUS SELECTIVE IMITATION

Altogether, it seems that the goal of Kaminski et al.'s study, to test the 'distractor hypothesis', that is whether a ball near the demonstrator's head has distracted the observer's attention away from the situational constraints of the demonstrator and has instead 'primed' the observer's tendency to grasp things with their mouth, could not be reached because of theoretical, methodological and statistical

problems. Although we agree that inclusion of such a control condition is worthwhile in studies about action understanding and efficiency-driven imitation/emulation, we do not think that priming could account for our original results. Note that both experimental groups used their mouth in the first attempts to manipulate the rod (Range et al. 2007, page 870), but many more subjects in the Mouth Free condition than in the Mouth Occupied condition used only the mouth. The critical elevation in the selective imitation task occurred for the demonstrated (paw) action in the Mouth Free condition, when the model's paw use was not justified by any constraints on using the mouth.

In conclusion, we are not surprised that Kaminski et al. (2011) failed to replicate the findings of Range et al. (2007). Whether the findings of Range et al. (2007), that dogs are able to choose selectively whether to imitate or emulate a demonstrated transitive action, are robust and can be extended to a broader dog population or different experimental approaches remains an open question and requires further experimentation. We are pleased that Kaminski and colleagues found our results of such interest, and appreciate several valuable innovations of their similar study. But the many differences in methodology, analysis and interpretation in their study invalidate it as an attempt at replicating our original study.

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