Learning & Behavior (2023) 51:3–4
https://doi.org/10.3758/s13420-022-00559-9

OUTLOOK

"Monkeying around" together facilitates problem solving

Jennifer Vonk[1]

Accepted: 5 December 2022 / Published online: 16 December 2022

Summary
Sehner et al. (*PNAS Nexus*, 2022, 1–14) report that groups of common marmosets solve problems more frequently and faster than individuals working alone. This result is partially explained by greater persistence at the task in the group context and may have important implications for the evolution of cognition and culture.

Keywords Cooperative breeders · Problem solving · Group

Sehner et al., (2022) take an innovative approach to address a theoretically significant question. They provided common marmosets—a cooperatively breeding primate—with the opportunity to solve a series of tasks that escalated in difficulty, either alone or in small groups. To assess potential benefits of working in groups while controlling for the number of individuals working, they pooled the performance of individuals operating alone into so-called virtual groups. They measured success as latency to solve the task as well as proportion of successes. Importantly, they took the extra step to determine factors predicting success, such as perseverance, neophobia, and opportunities to observe others' success. Perseverance was greater in groups, which is important, as it has been shown to be one of the strongest predictors of problem solving in a task designed to measure inhibition and innovation in carnivores, along with low levels of neophobia (Johnson-Ulrich et al., 2018). Here, however, although neophobia was reduced in the group context, it did not contribute significantly to the marmosets' success, but this may be a function of the familiar testing environment.

This work is important because it provides a test of commonly held assumptions about the potential benefits of group living and cooperative breeding for the evolution of primate cognition. Although it is not possible to determine causal factors in the evolution of cognition post hoc, comparative researchers typically compare the performance of species that experienced different selection pressures in their evolutionary past, or that are experiencing different ecological factors in the present day, to lend credence to speculation about selection pressures that may have driven evolution. Sehner et al.'s (2022) approach, in contrast, is to manipulate a factor related to one of these presumed selection pressures in extant primates; in this case, the opportunity to solve problems as a group or individually. Their study tests the assumption that group members are likely to receive more rewards when working together compared to alone. If the assumption were false, then it would cast doubt on the hypothesis that one of the major selection pressures for problem-solving ability is group living. Such doubt would have the potential to minimize the influence of the social intelligence hypothesis (Humphreys, 1976), which has dominated the field of comparative psychology and motivated researchers interested in complex cognition to focus almost solely on social rather than nonsocial species (Vonk, 2022). However, Sehner et al., (2022) find support for the hypothesis in that groups solve the problems more frequently and more quickly (for three of the four tasks) relative to the pooled average performance of individuals acting alone. Critically, the advantage for working as a group is strongest for the most difficult task. This advantage was obtained even when comparing group performance to the performance of only the "best" individual that operated alone. This support does not, of course, suffice to validate the social intelligence hypothesis, but it does help validate an important, and previously untested, assumption of the hypothesis.

It is important to note, on the other hand, that only a small number of tasks were presented here to a single species of primate that is unique in its cooperative breeding strategy. It is possible that selection has worked against traits that promote independent problem solving in cooperative breeders but not in non-cooperative breeders. The authors recognize

✉ Jennifer Vonk
vonk@oakland.edu

[1] Oakland University, Psychology, Rochester, MI, USA

the possibility that a group context could hinder problem solving, particularly if individuals are competitive, but they did not examine the effect of competitive behaviors. Thus, extending this paradigm to more competitive rather than cooperative species will be interesting. This is where the standard approach of comparing performance across species that differ in social and foraging ecologies will be very useful. Sehner et al.'s (2022) approach is likely to inspire important extensions in other species.

Of particular interest would be observations that marmosets prefer social partners that contribute positively to group welfare by provisioning groups through their own problem-solving prowess. If monkeys recognize these capacities in others and attribute reputations to the successful monkeys accordingly, they should confer rewards and protections selectively on these individuals, bestowing status through prestige rather than dominance. Effective problem solvers may thus receive more reproductive access and experience greater reproductive success, passing on the genetic determinants of the problem-solving capacity, whether it be a cognitive ability specifically or a disposition such as social tolerance, for example. Demonstrations of such effects would be highly relevant to showing that nonhuman primates, like humans, may benefit from reputational effects of prestige as well as dominance. This would be important from an evolutionary perspective, as it would establish a continuity in the ability to reason about strategic social relationships beyond the recognition of physical strength and power. The current understanding of social asymmetries and status in nonhumans rests almost entirely on constructs about dominance despite some controversy as to the application of this construct and its limited utility in some species. Although social exchange and "information goods" theories for prestige are established within the human literature (Henrich & Gil-White, 2001), Sehner et al.'s (2022) work could form a foundation for bridging the comparative and evolutionary models of cultural transmission.

An unfortunate aspect of the paradigm is that it will be difficult, if not impossible, to implement in asocial species that will likely direct aggression at conspecifics if placed in a group situation. However, many species that are relatively solitary in the wild (e.g., orangutans, bears, tigers) are often housed in small social groups in zoological settings and could be presented with a version of the paradigm whereby they interact through adjacent, transparent chambers rather than directly. Zoos provide the best opportunities for this type of research, in which analogous tasks can be presented in contexts that would be difficult to obtain in natural settings. Such tests are important because they help to determine the possible causal relations between social structure and cognitive ability. If it is the nature of being a cooperative breeder that allows one to excel in group problem-solving contexts, then it is unlikely that similar results would be obtained in non-cooperative breeders or less social species. On the other hand, if group contexts facilitate problem-solving success for even asocial species, then the capacity for problem solving is unlikely to have evolved out of a group-living context.

Despite the overall strengths and value of the research reported by Sehner et al., (2022), the procedure and analyses contain a lot of noise. It is difficult to determine which individuals contributed to data in more than one condition or whether the conditions were conducted entirely between subjects. A preferable approach would be to control the pairings so that all individuals are presented with a task alone and with a previously successful or naïve partner(s), counterbalancing the order in which these conditions are given across tasks and analyzing the data at the level of the individual subject. Individual traits such as boldness could then be factored in as predictors of individual performance in the different contexts. The authors analyzed factors such as whether a previously unsuccessful individual increased their exploration time after watching another individual solve the task in a post hoc manner, but future studies might build on these findings to test these effects in a more controlled manner. It is unclear whether individual performance as well as group-level performance was considered in analyses and how the authors accounted for the ratio of the distribution of apparatuses/rewards to group size. It is also unclear how the dependencies between individual success in the group context were adjusted for. Despite the complexity of the experimental design, it holds much promise to increase our understanding of how cooperation, culture, and cognition evolved.

References

Humphrey, N. K. (1976). The social function of intellect. In P. P. G. Bateson & R. A. Hinde (Eds.), *Growing points in ethology* (pp. 303–317). Cambridge University Press.

Henrich, J., & Gil-White, F. J. (2001). The evolution of prestige: Freely conferred deference as a mechanism for enhancing the benefits of cultural transmission. *Evolution and Human Behavior, 22*(3), 165–196.

Johnson-Ulrich, L., Johnson-Ulrich, Z., & Holekamp, K. (2018). Proactive behavior, but not inhibitory control, predicts repeated innovation by spotted hyenas tested with a multi-access box. *Animal Cognition, 21*(3), 379–392.

Sehner, S., Willems, E. P., Vinicus, L., Migliano, A. B., van Schaik, C. P., & Burkart, J. M. (2022). Problem solving in groups of common marmosets (*Callithrix jacchus*): More than the sum of its parts. *PNAS Nexus, 1*(4), pgac168.

Vonk, J. (2022). What laboratory and field approaches bring to bear for understanding the evolution of ursid cognition. In M. A. Krause, K. L. Hollis, & M. R. Papini (Eds.), *Evolution of learning and memory mechanisms* (pp. 359–374). Cambridge University Press.