Innovation and the grain problem

Anne Russon,[a] Kristin Andrews,[b] and Brian Huss[c]

[a]*Department of Psychology, Glendon College, York University, Toronto, Ontario M4N 3M6, Canada;* [b]*Department of Philosophy, York University, Toronto, Ontario M3J 1P3, Canada;* [c]*Department of Philosophy, SUNY–Potsdam, Potsdam, NY 13676.*

ARusson@gl.yorku.ca

andrewsk@yorku.ca

http://www.yorku.ca/andrewsk

hussbd@potsdam.edu

Abstract: Our concern is with the authors' method for identifying innovation. We show that either it yields false positives or the authors offer insufficient guidance for its application. To avoid these results, the authors need to modify the key or offer better guidelines for delineating input. Either choice requires addressing the processes that generate a behavior.

Ramsey, Bastian, and van Schaik (RBS) have made a valiant effort to identify innovations in nature. As their theoretical perspective on innovation as a product largely conforms to Reader & Laland (2003), their novel contribution is epistemological. They may well have considered as much information as possible on the ecological, individual, and historical factors that suggest innovations in nature. However, their method does not

incorporate all the factors discussed in the text. For this reason, we believe that RBS face a dilemma. If their key takes any behavior as input, many behaviors that are not innovations will be identified as such. Alternatively, if it takes only behaviors that count as potential innovations, then the grain problem looms large. We conclude that the solution requires information on the innovation process.

To demonstrate, consider an unusual orangutan behavior seen in nature: leaf carry (LC), the collection of nest materials before reaching the nest site instead of afterward (Russon et al. 2006). Prevalence patterns suggest LC may be a candidate for innovation It is patchily distributed, rare at Tuanan (wild), and cultural at Kaja (rehabilitants). At Tuanan, only three orangutans LC using leaves from a single species; the key identifies Tuanan LC as probably an innovation, which is potentially correct (van Schaik et al. 2006). At Kaja, LC probably originated in excaptives during cage life, where leaves for bedding must be collected before going to a nest site. That is, it was ecologically induced elsewhere and introduced to Kaja by immigrants, so by RBS's standards it is not an innovation. LC did not transfer immediately from cage to Kaja life; it lay dormant in some orangutans for over 18 months. We tried the key for Kaja LC. Q1 asks whether long-term field data are available, that is, longer than the behavior's mean latency. Available data included 7 months of observation at Kaja, earlier records for Kaja and prerelease, and background knowledge on rehabilitation and captive living. LC latency is unknown, so the conservative answer to Q1 is "F." Q1(F) leads to Q19(T), Q26(F), Q40(T), Q41(F), Q43 (probably an innovation), which is probably incorrect. If we accept these data as long-term, the key sequence is Q1(T), Q2(F, cage learned), Q14(T), Q15

(probably an innovation) or Q1(T), Q2(T, first Kaja occurrence observed), Q3(T), Q4(T), Q5 (probably an innovation). RBS's example of Eureka's stone tool use meets the same fate if Eureka returns to her original community, introduces stone tool use, and stone tool use subsequently attains cultural status. This is not an innovation by RBS's standards, but of the five plausible routes through the key, all but one identify it as probably an innovation; furthermore, only one of these paths suggests that considering behavior in other populations would strengthen the conclusion. We found similar problems with other behaviors.

In addition to highlighting several points about innovation (e.g., cultural behaviors introduced by immigrants may not represent innovations; dispersal, migration, and dormancy seriously confound the behavior's origins), these cases suggest that if any behavior can be entered into the key, false positives will be common. The only way to deal with this horn of the dilemma is to take process into account, because it is knowledge of generative processes that suggests these key decisions are false positives.

The other horn of the dilemma raises two problems with specifying inputs to the key: how we determine that behavior is novel and how we delineate behaviors. Both issues concern grain—the level(s) at which an actor acquires and organizes its behavior. Grain reflects the steps an actor takes in acquiring behavior, hence the shape and pace of innovation. RBS raise the grain issue but develop it only briefly.

In that few if any behaviors are entirely novel, delineating inputs entails

determining what components of a behavior are new to the actor (Byrne 2003). Not only does this require evidence of what the actor already knows, it also depends on the steps the actor uses in acquiring behavior. To delineate behaviors, RBS suggest assessing whether behaviors are functionally different. Functional differences should reflect the actor's point of view, so again we need to know how actors delineate their own behaviors. It is then not possible to determine what behavior to enter into the key without knowing what grain the actor uses.

In our view, resolving the grain issue is critical because grain can vary between and (developmentally) within taxa. To illustrate, consider the great apes. Mature great apes seem to organize their behavior at multiple levels that have been characterized as action elements (behavioral detail, e.g., target items, motor actions), procedures (regularly used combinations of components that achieve a specific goal, e.g., using a wiper to clean something), and programs (combinations of procedures and action elements organized to achieve larger goals, e.g., stone nut cracking) (Byrne et al. 2001a, 2001b). Currently, proposed innovations for wild orangutans are inconsistent for grain (van Schaik et al. 2006). *Leaf napkin for wiping latex off chin*, for example, delineates wiper tools by behavioral detail (material—leaf, target—chin), but *erotic tool* does not and even ignores tool type. Evidence suggests that great apes probably innovate at the procedure level, programs are probably socially acquired, and action elements are ecologically induced (Byrne et al. 2001a, 2001b). Programs are probably acquired piecemeal, because great apes' low cognitive ceilings and slow cognitive development suggest that advances are made by small, hard-gained steps (Russon 2003). Taken

together, this suggests that both *erotic tool* and *leaf napkin* may be inappropriate entries for the innovation key because of errors of grain—the former is too grossly defined (potentially underestimating the number of innovations), the latter too finely (potentially overestimating).

RBS think that focus on the products of innovation will help shape the research program on the cognitive factors underlying innovation. Given the potential for false positives and the difficulties associated with the grain problem, we suggest that the relationship is reversed. Only once we understand the cognitive faculties of a taxon and the processes that generate a behavior can we begin to determine whether that behavior is an innovation.

ACKNOWLEDGMENT

Thanks to Laura Adams for helpful discussion.

References

Byrne, R. W. (2003) Novelty in deceit. In: *Animal innovation*, ed. S. M. Reader & K. N. Laland, pp. 237–59. Oxford University Press.

Byrne, R. W., Corp, N. & Byrne, J. M. E. (2001a) Estimating the complexity of animal behaviour: How mountain gorillas eat thistles. *Behaviour* 138:525–57.

Byrne, R. W., Corp, N. & Byrne, J. M. E. (2001b) Manual dexterity in the gorilla: Bimanual and digit role differentiation in a natural task. *Animal Cognition* 4:347–61.

Reader, S. M. & Laland, K. N. (2003) Animal innovation: An introduction. In: *Animal innovation*, ed. S. M. Reader & K. N. Laland, pp. 1–35. Oxford University Press.

Russon, A. E. (2003) Innovation and creativity in forest-living rehabilitant orangutans. In: *Animal innovation*, ed. S. M. Reader & K. N. Laland, pp. 279–306. Oxford University Press.

Russon, A. E., Handayani, P., Kuncoro, P. & Ferisa, A. (2006) Orangutan leaf-carrying for nest building: Unravelling cultural processes. *Animal Cognition* (online: DOI 10.1007/s10071-006-0058-z).

Van Schaik, C. P., van Noordwijk, M. A. & Wich, S. A. (2006). Innovation in wild Bornean orangutans (*Pongo pygmaeus wumbii*). *Behaviour* 143:839–76.