COMMENTARIES


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Boesch (2007) criticizes research comparing ape and human cognition on the basis of both internal and external validity. The authors show here that most of those criticisms are not valid because: (i) most threats to internal validity (e.g., conspecific experimenters for humans but not apes) are controlled for experimentally; (ii) externally, there is no empirical evidence that captive apes have fewer cognitive skills than wild apes and indeed some evidence (especially from human-raised apes) that they have more; and (iii) externally, there is no empirical evidence that Western middle-class children have different cognitive skills from other children at very early ages in basic cognitive domains. Although difficult, with appropriate methodological care, experimental cross-species comparisons may be validly made.

It is always good in science to reflect on methods, and so Boesch’s (2007) critical assessment of the methods used in comparative studies of apes and humans is welcome. Boesch claims that there are problems in such comparative studies with both internal and external validity. Internally, he claims that the comparisons are not valid because the experimental methods are different for the different species. Externally, he claims that captive apes are not representative of all apes, and that middle-class Western children are not representative of all children. These critiques contain some valid points, but at the same time they also contain some fundamental misunderstandings about both the methods and results of comparative studies. We would like to clear these up, focusing mainly on research from our laboratory as that is what we know best methodologically.

Internal Validity: Species Comparisons

Boesch criticizes comparative studies of apes and humans because they do not use identical methods with the species to be compared. But not only is this not possible, it is mostly not desirable, if identical means exactly the same in every way. As just one simple example, children are motivated in experiments to pursue small toys, but chimpanzees are not. We thus need something that is functionally equivalent in terms of motivation for apes, such as grapes. And most young children need their mother in the room to be as calm and secure as apes are in their testing rooms. The point is that we do not want situations and stimuli that are identical, but rather ones that are functionally equivalent for the different species involved, which we and other comparative experimentalists work very hard to achieve.

Nevertheless, it is possible that in any particular case our attempts at functional equivalence may not succeed. Therefore, in most cases we have control conditions for each species that have the same general task variables as the key experimental condition in terms of rewards, experimenters, housing situation, response requirements, and so forth—basically all of the variables Boesch identifies as problematic—and success with these control conditions is prerequisite for valid assessment in the experimental condition. In terms of species comparisons, it is only if both species pass these control conditions that the results comparing them in the experimental condition may be considered valid. Even so, recognizing the methodological differences, we mostly make our species comparisons not by statistically comparing the performance of the two species directly, but rather by statistically comparing the experimental and control conditions within each species separately and then comparing the pattern informally (e.g., one species is higher in experimental than control whereas the other is not).

As an example, we may focus on one of Boesch’s two content areas: understanding of others. To begin with, we should note that recent studies have shown that apes display many of the same skills as human children, even under the testing conditions that Boesch criticizes (see below). The one skill for which there is no convincing evidence is an understanding of false beliefs. A recent study demonstrates our general approach. In this study, chimpanzees competed with one another to obtain food hidden in buckets, with no human experimenter directly involved (Kaminski et al., submitted). The task for the subject was to determine which bucket might still contain food after the competitor had chosen a bucket for himself. In some cases, the subject saw that her competitor witnessed one of the two pieces of food being placed in one of the buckets, whereas the other piece only she, the subject, saw being placed in another bucket. Subjects then successfully knew that the piece the competitor had not seen being hidden was the one that was still available. But when the paradigm was changed only slightly so that now the subject had to understand that the com-
petitor thinks the food is in one bucket (because that’s where he saw it being hidden), but it is really in another bucket (because it has been moved while the subject, but not the competitor, watched) now they failed. Although, as always, there are multiple possible interpretations of these results, all of the general methodological factors that Boesch outlines are the same in the two conditions, and the apes pass one condition but fail the other (whereas children pass both).

We cannot eliminate the variables Boesch is worried about, but we do not ignore them either. In the language of experimental methodology, we control for them.

External Validity: Captive Apes

Boesch claims that captive chimpanzees live in an impoverished environment and that this adversely affects their cognitive skills; indeed, he thinks that data from captive individuals who have not grown up in family groups “should be discarded” (Boesch, 2007, p. 232). He supports this view by citing some studies from the 1950s and 1960s in which nonhuman primates were reared in complete social isolation. He equates this situation to that of many of the apes included in contemporary studies in captive settings, which is manifestly false.

It is not at all clear in Boesch’s critique what the specific failings of captive apes are supposed to be. Recent research has documented amazing cognitive skills in captive apes in many different domains. For example, in the social domain, great apes understand, among other things: goals (Call, Hare, Carpenter, & Tomasello, 2004), intentions as action plans to goals (Battelmann, Carpenter, Call, & Tomasello, 2007), perception (Tomasello, Hare, & Agnetta, 1999; Hare, Call, Agnetta, & Tomasello, 2000), and knowledge (Hare, Call, & Tomasello, 2001; Melis, Call, & Tomasello, 2006). In the physical domain, among other things, apes know what is where (Scheumann & Call, 2006), can track invisible object displacements of various kinds (Barth & Call, 2006), mentally compare things like tools and quantities (Mulcahy, Call, & Dunbar, 2005; Hanus & Call, 2007), solve inferential reasoning problems (Call, 2004, 2006), and engage in future planning (Mulcahy & Call, 2006; see Tomasello & Call, 1997; Tomasello & Call, in press; Call, in press; for reviews). In general, if we discarded all of these and other data from captive apes we would currently know next to nothing about the cognitive skills of great apes.

Whether wild chimpanzees also possess these skills is an open question because there are no systematic investigations. We think it is likely that they do possess them, although one has to be mindful of epigenetic factors and not automatically assume that wild chimpanzees will display every skill found in the captive chimpanzees without specific testing. Kummer (1995) in fact argues that captivity often places animals in especially challenging problem-solving situations that they would never encounter in the wild, which they then respond to with cognitive skills we would never see otherwise. Well-known cases in point are (i) tool use, which gorillas and bonobos do not engage in systematically in the wild but only in captivity (McGrew, 1989); and (ii) pointing for others gesturally, which apes in captivity do but apes in the wild typically do not (Tomasello, 2006). And this is not even to mention all of the cognitive skills displayed by apes “enculturated” by humans (e.g., “linguistic” skills; Savage-Rumbaugh et al., 1993), which are obviously not shown by apes in the wild.

But still in current research there are some demonstrable cognitive differences between apes and humans and these are consistent across a wide array of methodologies and ape rearing conditions. Thus, in a recent large-scale study, Herrmann et al. (2007) presented both apes and 2-year-old human children with a wide battery of cognitive tests. Every attempt was made to make the methods comparable, even testing the children mostly behind a plastic barrier to simulate the caging through which the apes were tested. On many of the tasks the apes were as skillful as the children, and on some even more skillful. These were all tasks involving their understanding of the physical world of space, quantities, and causality. However, on tasks using very similar methods but testing their skills of social cognition (social learning, communication, theory of mind), the children were more skillful. Even with highly similar methods across tasks, there was a different pattern of results for the two species. Of course, it might have been that if the apes had a conspecific experimenter, they would have performed above the children in the physical domain, and equal in the social domain, for example. But still there would be the species difference between the two domains, regardless of absolute level; the key is the pattern of results showing a difference in the physical and social domains. An interesting note: the chimpanzee individuals tested in this study had lived in social groups in a semi-free-ranging environment in African forests from a very young age (albeit without their mothers), and so should have had many of the requisite early learning experiences supposedly missing in typical captive populations.¹

This same basic difference is also apparent in “enculturated” apes. Boesch cites approvingly the work of some Japanese researchers with captive infant chimpanzees raised and tested in close proximity to both their mothers and humans (p. 229). About some other chimpanzees raised by humans, without their mothers in extremely species-atypical circumstances, Boesch says “the enriched captive conditions faced by cross-fostered chimpanzees were very favorable, and their development was in many ways similar to the wild . . .”; p. 233. But the central conclusion of the Japanese researchers who studied the social cognition of these special chimpanzees (Tomonaga et al., 2004; Boesch cites a review chapter summarizing this and other work by Matsuzawa, 2006) was that whereas the infant chimpanzees showed many of the same social-cognitive skills as human infants, they did not engage in the kinds of triadic joint attention and communication characteristic of human infants. From the abstract: “The development of triadic interactions, however, is rather different between these two species [that is, chimpanzees and humans]. The infant chimpanzee can follow another’s pointing or gaze at around 1 year, but even by 2 years old, does not ‘share’ attention with the others.”

¹ For more on the internal and external validity of this study, see the exchange in de Waal et al. (2008) and Herrmann et al. (2008). Because this study was a survey of skills, it did not have control conditions like most other comparative cognition experiments. But most of the tasks used came from previously published experiments that did have controls. Also, subjects’ shyness in the experiment (including to the experimenter) was measured and found to have little effect on performance for any of the three species.
This is the same conclusion reached by Tomasello and Carpenter (2005) in their study of three young chimpanzees raised by humans and tested longitudinally in direct contact with their most familiar human caretakers. It is true that even in these studies the apes were tested by humans; but on the basis of his review Boesch (p. 234 and Table 4) concludes that use of a human experimenter cannot be demonstrated to have an appreciable effect on performance (see also review in Herrmann et al., 2007).

There are no studies, to our knowledge, that systematically compare the cognitive skills of apes in the wild and apes in captivity using equivalent methods in any domain. Boesch implies that it is self-evident that apes in the wild should have more sophisticated cognitive skills than apes in captivity. But this conclusion is not based on data, and in fact the data reviewed above show that captive apes develop a wide array of cognitive skills—as sophisticated, or conceivably even more sophisticated, than apes in the wild—as they adapt to their own unique ontogenetic environments. The fact that these skills are not 100% human-like should not be surprising, as they are different species.

External Validity: Western Children

Of course there are many cognitive skills that differ among the peoples of different cultures, mostly due to differences in literacy and schooling (Cole, 2006). But probably no one would claim that the cognitive skills of 1-month-old infants are different in different cultures. And probably no one would claim that basic skills of perception and memory are different in human children at any age in different cultures. In each case it depends on what is being tested and the age it is being tested.

In most of the studies we have done in recent years, apes show cognitive skills very similar to those of human children before school age. Where we find systematic differences are in certain kinds of highly social skills such as social learning, cooperation, and communication, beginning at 1–2 years of age (see above). Given the complex cultures in which humans live, full of all kinds of symbolic artifacts, social institutions, and cultural norms, this seems not entirely unexpected. Humans have evolved specialized social-cognitive skills for living and exchanging information in cultural groups, and children begin to display nascent forms of these skills at around their first birthday. Although we certainly do not know for sure—there are no good cross-cultural studies on these kinds of skills at this early age—it would seem reasonable that very basic skills such as these at this early age will show only minimal cultural variation. This is an empirical question which we hope someone will investigate systematically.

But we also must point out that even for the false belief task that Boesch examines specifically in his paper, there is only one cross-cultural study using standardized methods across multiple cultures: Callaghan et al. (2005). This study found that virtually all children of five very different cultures mastered the false belief task between 4 and 5 years of age. The major conclusion of that study, completely ignored by Boesch, is (from the abstract): “With a standardized procedure, we found synchrony in the onset of mentalistic reasoning, with children crossing the false-belief milestone at approximately 5 years of age in every culture studied.” Again, this is as expected for a very basic social-cognitive skill on which so much of human social interaction and communication depends.

Conclusion

If our question is what animals do, then the best method is to systematically observe them in their natural habitats: spiders build spider webs and chimpanzees use tools to extract food from substrates. But the issue of cognition is that the exact same behavior may be underlain by very different cognitive mechanisms, and to discover these we need experiments. That is to say, to test the flexibility of some behavioral skill we need to expose individuals to new situations and see if they adapt their skills in flexible and intelligent ways for which they are not specifically adapted. Thus, when captive chimpanzees are confronted with a variety of novel tool using problems in experiments, they show us the amazing flexibility and intelligence—including causal knowledge—behind their termite fishing and nut cracking in the wild.

We have said before and we will say again, that in the study of primate cognition fieldwork is primary. It tells us what animals do; it sets the problem. But then if we wish to figure out what is the nature of the cognitive skill, if any, underlying some activity in the wild, we need experiments, as virtually any cognitive psychologist on the planet will attest. We thus do not think that there is a “debate on the relative importance of field observations versus controlled captive experiments” (p. 227). Both are necessary, and their functions are complementary.

Experiments on ape cognition may theoretically be done in the wild, though in practice this is often very difficult. Indeed, to our knowledge, the vocalization playback technique that Cheney and Seyfarth (1990, 2007) and others use to investigate the cognitive and communicative abilities of nonhuman primates is the only experimental methodology that has been widely and successfully used in the wild to test the social cognition of nonhuman primates (the examples of behavioral ecological studies on reproduction and feeding, cited by Boesch on p. 235 as examples of experiments in the wild, do not concern cognition, let alone social cognition). But since there is absolutely no evidence that apes in the wild have cognitive skills that apes in captivity lack, it is unclear why we should not do our studies with various different populations of a species, both wild and captive, to get the broadest possible picture.

Despite some disturbing misrepresentations in his paper (e.g., that we are genetic determinists, that we believe field studies are just anecdotes, etc.), Boesch has done the field a service by raising these methodological concerns. In particular, his critique has highlighted the need for more systematic research on the role of different physical and social environments in the ontogeny of great ape cognition, and on the role of different cultural environments in the ontogeny of human cognition. We hope that our response has helped to focus the direction that this research should take.

References


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