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Comment

Explaining the 'gigantic gulf': 'Sorta' cultures, cultural selection and compositionality Comment on "Blind alleys and fruitful pathways in the comparative study of cultural cognition"

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"...human culture clearly contains a number of unique elements: anyone looking for the full-blown phenomenon in other animals will come up empty handed" ([1]: 1).

"Nobody can dispute that a gigantic gulf exists between human CCE [cumulative cultural evolution] and any CCE operating in non-human animals..." ([2]: 211).

The quotes above point to both the progress in research and the limits of that progress over the past 20 years. The resulting discoveries and wealth of data from the field and the lab, have answered some questions while raising many others. Here, I hope to step back a bit and explore some questions which we have either taken for granted or have stopped caring about altogether, in the hope that highlighting these can re-awaken scientific interest and scrutiny.

1. From binaries to dimensions: do traditions and culture exist on opposite ends of a continuum?

In his target article, Whiten, like most of us, has settled upon the convention that group-specific traditions comprise a culture [2]. But how useful is such a conceptualization if fails to capture the "gigantic gulf" that is evident between human and non-human culture? In fact, the worry is that such an expansive concept of culture may be leading us into the type of blind alley Whiten warns us about; potentially confounding cultural simplification—efficiency—with cultural elaboration and complexity.

We can all agree that tradition and culture are conceptually related. But it seems problematic (or limiting) to treat them as synonyms. In fact, Fragaszy and Perry [3] argued that using the word 'culture' so broadly, obfuscated "functional, developmental, and evolutionary" explanations for animal behavioral traditions (p. xiii). In an article titled, Cultural Panthropology, Whiten et al. [4] quotes LeVine [5] stating that "No ethnographer has failed to find

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increasing connectedness and coherence in customs—particularly in their ideational dimensions" and that this has led to "the contemporary view [among cultural anthropologists] of culture as an organization of ideas rather than aggregate of independent traits" ([4]: 72). Perhaps the problem is thinking of culture as binary (a common feature of the social sciences) that's either present or absent. But such bald dichotomies are rare in biology (or psychology). Using Dennet's [6] "sorta-operator", for example, we can say that the platypus is a sorta mammal and a sorta bird. Likewise, we might say that some behavioral traditions are "sorta cultures", much like we must imagine that once upon a time there were sorta languages without grammar but with displaced reference, for example. So why not conceptualize traditions and culture as inhabiting endpoints of a continuum consisting of multiple, socially-transmitted, population-specific, trans-generational, behavioral traits; 'traditions' as operationalized by Fragaszy and Perry, [3]? At one end, there are behavioral traditions that are independent or loosely connected. At the other, there are highly inter-connected and modularized traditions that allow for the combination of two or more sub-cultures forming larger cultural clusters that evolve as nested sets. For example, work by Kamilar and Atkinson [7] exploring the degree of nestedness in the tradition repertoires of human, chimpanzee and orangutans may offer a way forward. Such an approach could be used to model possible causal relationships among traditions within nestings. It may also be used to explore how (or why) some nestings produce a socio-cultural ecosystem that structures and shape traditions while others do not.[1]

2. Simplification vs. accumulation: same or different evolutionary forces?

The structure of traditions—connectedness and inter-dependence—within a population leads us to the phenomenon of cumulative cultural evolution or CCE. Mesoudi and Thornton [8] have proposed the following core criteria for CCE: (1) changes to a behavioral trait; (2) social transmission of that altered trait throughout a population; (3) altered trait is associated with some benefit; (4) steps 1-3 are repeated. Recognizing these core CCE criteria makes an important contribution to the field but its open-endedness and agnosticism [8] on the force that structures or guides the behavioral change is problematic. For example, using these criteria, Gruber and colleagues [9] as well as Whiten in this target article [2] suggest that behavioral changes toward efficiency (or simplification) constitute an important (and surprisingly widespread) form of CCE. However, Gruber et al.'s review makes clear that such examples of CCE are driven primarily by external—environmental—factors rather than internal forces within the culture itself.

This begs the questions, does the causal force matter? On the one hand, if beneficial, socially transmitted changes in behavior are driven primarily by *external* (natural, environmental) forces, then traditional Darwinian evolution through natural selection can explain the phenomenon, consistent with work of ethologists at the turn of the twentieth century. These types of cumulative socio-behavioral changes may be described as cumulative behavioral evolution or more simply behavioral evolution. On the other hand, if beneficial, socially-transmitted changes in behavior are driven by *internal*—social-cultural—forces (i.e., other traditions), then such changes fall outside the traditional explanatory scheme of Darwinian evolution and are best explained by *cultural* selection (e.g., [10]). If correct, then CCE—if meant to represent a 'special' evolutionary case—should only apply to those instances of behavioral evolution that are shaped primarily by socio-cultural factors. Therefore, efficiency alone, is insufficient to establish CCE. Instead, existing examples of CCE towards greater efficiency are, really, instances of behavioral evolution by natural selection. If the field thinks a qualifier is merited because behavioral evolution is too generic, then, perhaps, we can say, cumulative behavioral evolution. Incidentally, the same would be true of cases where an individual tradition becomes more complex through external rather than internal forces. This brings me to my final question. . . .

3. Is compositionality a unique feature of cumulative cultural evolution?

Animals combine responses all the time. But very few—mostly humans and, perhaps, some language-trained apes and parrots—evidence *compositionality*. That is, the ability to regularly combine different bits of information across domains–whether actions, sounds or beliefs—in an open-ended but rule-governed manner. Compositionality is more than combination in the context of exploration or problem-solving. In a cultural context, compositionality should evidence nestedness and open-endedness guided by an internally driven structure (i.e., socio-cultural ecosystem). Compositionality should operate on cultural representations across domains (not just within them), whether they are

[1] Kirby (2017) summarizes similar work on the evolution of linguistic structure.

discrete or continuous. In humans, the compositional nature of our cultural cognition is evident anytime we generate a response to a new question or attempt to diagnose and fix a malfunctioning artifact. In these cases, cultural knowledge (about words or artifacts) is not created but composed and structured in new ways. The product is new, but the individual elements are not. The compositional nature of human cognition means that, cultural learning—in contrast to the more generic 'social learning"—is inter-dependent, both within and between domains. As a result, "innovations" are difficult to isolate from related cultural knowledge. Even the processes of transforming and combining elements to derive new forms can themselves be culturally learned tools (e.g., deriving equations).

In the context of social learning, chimpanzees, for example, can learn to combine different socially learned elements. But only when both elements are demonstrated along with their effective combination [11]. This stands in contrast to preschoolers. For instance, in one study [12], children (between 4–6 years) observed one model stack cubes (tower base) and another link flat squares (tower apex). They were then given the cubes and the flat squares unassembled and instructed to build the tallest possible tower with *all* the pieces (cubes *and* squares). Children—like adults–reproduced the demonstrated responses (i.e., stacking cubes/tower base and linking squares/tower apex) and then spontaneously combined the two elements (i.e., placing linked squares atop stacked cubes), to produce a novel—and unobserved—tower. More recent work using this same paradigm shows that children when given extra cubes and extra squares, extend the demonstrated responses of stacking and linking to these new cubes and squares [13]. Harrison et al.'s [14] and Price et al.'s [11] approach which breaks down tasks into component features (e.g., using leaves to soak up water vs. sticks for reaching distant objects) provide a model through which we may explore this phenomenon in animals. One possible problem is whether those components represent 'latent solutions' that may be functionally fixed and, thus, less than ideal candidates for social learning [15]. Because of this, it is important for the behavior under study to be novel and socially learned. This almost certainly means using a behavioral response not evident in the wild, but within the behavioral competence of the primate concerned. An example might be a serial (among other possible conceptual or categorical) rule(s) on a touch-screen that can (a) be socially-learned [16,17], (b) combined (or nested) within a rule [18] and (c) generalized within and between domains.

This author enthusiastically agrees with Whiten [2] that we have spent too much time debating in binary terms whether imitation or culture is evident in animals [19,20]. Such debates distract us from a more nuanced understanding of the very thing we want to understand. Here, I propose that a dimensional conceptualization of traditions and culture—ranging from simple sorta cultures to full blown WEIRD cultures—is essential to explain the "gigantic gulf"; filling it with real and hypothetical intermediate forms. Intermediate—sorta cultures—should vary, not just by mode of transmission, but more importantly, by the compositionality and connectedness of the traditions that constitute it.

In sum, the more than 25 years of research summarized by Whiten [2] makes clear that despite the observed differences, it's undeniable that components of culture are evident in non-human animals in the wild. Better characterizing those shared components and their role in cultural evolution should be a focus in the next 25 years.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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