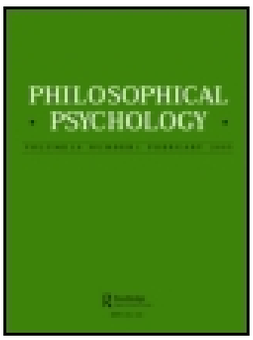

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How to create a cultural species: Evaluating three proposals

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ABSTRACT

This paper summarizes, contrasts, and reviews recent accounts of cultural evolution in our species offered by Cecilia Heyes in *Cognitive Gadgets*, Kevin Laland in *Darwin's Unfinished Symphony*, and Michael Tomasello in *Becoming Human*. Our critical discussion focuses on the authors' accounts of social learning, and the relationship each hypothesizes between cultural evolutionary and biological evolutionary processes. We find that both Laland and Tomasello seek to explain cultural evolution in humans as reliant upon processes of joint attention and shared intentionality (the development of which is largely the focus of Tomasello's book). Heyes' account of social learning, in which no particular role is assigned to human intersubjectivity and the same basic associative learning mechanisms of nonsocial learning are also invoked to explain social learning, stands apart. As to the relation of cultural and biological evolution, Laland offers readers a thorough account of the two with detailed analyses of social learning across various non-primate species, and uniquely, among these authors, attends to the influence of genes on social learning. For his part, Tomasello provides readers with a richly detailed experimental accounting of human-unique forms of social learning using Great Apes as points of contrast.

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A flurry of recent books enters into the explanatory space of cultural evolution in one way or another. Among these are books by Cecilia C. M. Heyes (2018), Kevin Laland (2018), and Michael Tomasello (2019). All three authors highlight humans' cognitive distinctness and seek to determine what cultural evolutionary forces and events led to this distinctness. An emphasis is placed by all three on the importance of social learning for the accumulation and evolution of culture. In Section 1, we briefly summarize the three books. In Section 2, we make critical observations

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about the authors' accounts of social learning and their discussions of the relation between biological and cultural evolution. We conclude with summary comments about pressing issues facing this field that are not broached in these books.

1. Summaries

Heyes on cognitive gadgets. Cecilia Heyes motivates her *Cognitive Gadgets* (C. M. Heyes, 2018) with the unveiling of what she calls "cultural evolutionary psychology" (13) by stating that extant theories of cultural evolution–she principally has in mind the population models familiar from Boyd and Richerson (1988)–are "mindblind" (1) and neglect what "goes on between the ears" (85). (For evaluation of her presentation of these theories, see Nichols et al., 2019, 484–5.) She proposes to cure cultural evolutionary theories' mindblindness with insights from cognitive science. The guiding idea throughout the book is that social learning early in human ontogeny shapes not only our thoughts and actions but the whole mental machinery with which we think. By interacting with other humans, every generation of children culturally inherits "pieces of mental technology" (22), which she calls "cognitive gadgets". These gadgets are both the products and drivers of cultural evolution, and include such mechanisms as imitation, mindreading, language, and metacognitive social learning strategies.

Gadgets are discussed in individual chapters wherein Heyes attempts to establish how they arise in individuals' minds in childhood (22), and how they accelerated the accretion of culture. Heyes rejects nativist accounts of these gadgets' origins and thus argues against neonatal imitation (Meltzoff & Moore, 1997), an inborn mind-reading module (Baron-Cohen, 1997), innate universal grammar (Chomsky, 1957) and a "language instinct" (Pinker, 1994). But her explicit rejection of nativism is not thoroughgoing, as when she concedes that "At the core of human social learning and teaching are the same, basic mechanisms used by all vertebrates, and many invertebrates, to learn about predictive relationships between events [. . .] This implies that, in many cases, distinctively human ways of thinking are not as brand new and shiny as we thought; they are made of old parts and, therefore, tweaking by genetic evolution, rather than heavy lifting, would be enough to get their development going" (19). Heyes' anti-nativism is thus a "soft" anti-nativism, for she suggests that genetic evolutionary processes and products supply the basis for the socio-cultural fabrication of gadgets.

Despite her avowal that gadgets are assembled through social interaction in early childhood, Heyes does not side with socio-cultural accounts that stress the necessity of intersubjectivity and shared agency for cognitive

development. She herself explains most gadgets by appeal to low-level, subpersonal mechanisms. For example, imitation and language are grounded in basic forms of associative learning that also explain non-human cognitive capacities.

Heyes adopts mentalistic vocabularies in her explanation of two other gadgets: mindreading and "metacognitive learning strategies," by which we prescribe rules for ourselves, such as "copy the boatmaker with the biggest fleets." She believes that humans need to acquire these gadgets through teaching, just as they need to be taught that 2 + 2 = 4. In an argument by analogy, she likens mindreading to printreading (Ch. 7), claiming that both require "derivation" of meanings from signs; develop slowly; are neurally specialized; and show specific impairments and cultural variability in subpopulations (148–155). Print reading is taught, and thus, she infers, mindreading must be taught, too. Teaching thus plays an important role in her theory; it is a gadget that is responsible for the formation of other gadgets–a meta-gadget, we might say.

Heyes classifies her theory as a "force theory", which, unlike a "narrative theory", is committed to specifying the particular evolutionary forces (e.g., gene-culture coevolution, natural selection, genetic drift) that led to the creation of gadgets. Heyes takes the idea of *homo faber* to a new level: humans do not just shape the world according to their needs, they even shape their own minds, not just in its contents but in its form. In the final chapter readers learn what other (biological) evolutionary forces come into play. Here, late in the game, she commits to natural selection both at the level of the individual and the group. She claims, plausibly, that gadgets like imitation are adaptive because they promote bearers' abilities to acquire food, build shelter, and defend against predators (201).

Laland's Darwinian account of social learning. Kevin Laland opens *Darwin's Unfinished Symphony* (Laland, 2018) with the claim that understanding cultural evolution, i.e., the process by which "competition between cultural traits generates changes in behavior and technology", first requires an understanding of how the mind evolved. To better understand the evolution of mind, he draws on a panoply of methods and approaches, including computer simulations and mathematical models (Ch. 3), studies of animal behavior, including experiments with fish (Ch. 4), cognitive psychology (Ch. 6), genetics (Ch. 9), and historical analyses of the arts (Ch. 12). Laland's discussion of copying and social learning (which are sometimes treated as interchangeable terms) spans many chapters. The origins of copying vary greatly across species, and have roots in a variety of different forms of social learning. This is not quite the master class of clarity and detail that Hoppitt and Laland present in their taxonomy of social learning mechanisms (Laland & Hoppitt 2013, Ch. 4), but the

discussion of copying in *Darwin's Unfinished Symphony* is up to date and will please newcomers to the field.

In humans, social learning takes on a distinctive shape, as Laland shows. Studies of 'overimitation' indicate that human children readily copy irrelevant and causally ineffective behaviors of other humans, a phenomenon found in no other animal species. Humans tend to find environmental optima for the ratio of asocial to social learning. Specifying the conditions under which learning takes on an individual or a social form was the goal of a programming tournament Laland organized, which pitted computer simulations of social and asocial learning against one another. The agents represented by each submitted algorithm could deploy one of three possible moves: *innovate* (representing asocial learning), *observe* (representing social learning), or *exploit* (representing the performance of a previously learned behavior). The tournament revealed that "the strategy that eventually dominates will be the one that can persist with the lowest frequency of asocial learning" (73).

Laland carves out a special role for biology, including brain evolution, in the emergence of social learning and demonstrates how a species' biological make-up impacts social behavior. For example, different degrees of physical vulnerability in two species of stickleback fish lead to different learning strategies, with the more vulnerable species relying mainly on observational social learning and the less vulnerable species relying mainly on "first hand" experience through exploration. Laland discusses the dialectical process in which a species' genetic endowment shapes its social behavior and intelligence while cultural transmission and innovation at the same time shape genetic evolution. Gene-culture coevolution, genetic mutation, adaptation and natural selection are concepts that inform the entire book, making his enterprise truly (Neo-)Darwinian, and setting his approach apart from both Heyes' and Tomasello's. Laland writes, "A consistent finding of these models is that cultural processes can dramatically affect the rate of change of gene frequencies in response to natural selection, sometimes speeding up genetic evolution, and other times slowing it down" (215; see also 234). Laland draws *Darwin's Unfinished Symphony* to a conclusion with thoughts on human civilization, culture and dance. He discusses the evolution of civilization by illuminating complex interactions among agriculture, methods of food processing, the accelerated growth of the early human brain, and the origins and transmission of social norms.

Tomasello on origins of human cognition and sociality. Michael Tomasello's *Becoming Human: A Theory of Ontogeny* (Tomasello, 2019) has two parts. The first is devoted to the ontogeny of cognition, the second to the ontogeny of sociality. Each chapter addresses the pathways and milestones of their development in our species, drawing on comparisons with analogous developments in the Great Apes. Many features of

Tomasello's theory are familiar from his numerous prior publications. Most central to his theory is a two-step development of shared intentionality. As a first step, 9-month-old infants' minds undergo a social-cognitive revolution culminating in joint attention. This refers to the ability of an individual to share attention to an object with another human, so that the object is experienced together. Joint attention is the seedbed of "perspectival cognitive representations and socially recursive inferences" (17; see pp. 53ff). Apes do not possess the capacity for joint attention and thus do not develop perspectival cognitive representations and their inferences are not recursive. A second social-cognitive revolution takes place in humans at around age 4, propelling children to a higher level of shared intentionality. Children now do not just engage in joint attention one-on-one, with particular others, but have become group-minded in a way that makes them feel part of a collective or "we". Tomasello refers to this as "collective intentionality" (38), an ability essential for normative self-governance. Children have now become fully normative agents who not only conform to and internalize the norms of their group, but also actively enforce these norms and rebuke those who fail to abide by them. By knowingly sharing the common ground of their cultural group and distinguishing in-group from out-group, children come to "self-regulate collectively and normatively – that is, in terms of the internalized voice of the cultural group as a whole" (152–3).

Tomasello's book brims with granular detail. To convey this, consider Chapter 6, "Cooperative Thinking". The chapter opens with a survey of Great Ape capacities for individual thinking, only to show how humans match and then exceed these individual cognitive capacities at an early age. Children solve problems and learn collaboratively. More than that, they engage in cooperative cognition in the form of giving and asking for reasons when actions stand in need of justification (171–173, with reference to Mercier & Sperber, 2011; see, 2018). These processes of cooperative thinking mark the dawn of the "age of reason", which coincides roughly with elementary school entry. Children have become "cognitively reasonable" and "morally responsible" agents, who hold others accountable for their actions and can be held accountable for theirs as well. Tomasello concludes that "any answer to the fundamental question of the origins of uniquely human thinking will have to invoke something like the evolution and ontogeny of shared intentionality theory in the context of a cooperative social ecology" (184–5).

In the final chapters, Tomasello classifies his account as Neo-Vygotskian and sets it apart from a variety of broadly Piagetian accounts that are unified by their penchant to favor the role of individual learning, exploration, and hypothesis-testing. What makes this latest of his books stand out against its predecessors is Tomasello's extension of the developmental analysis to school age, his attention to self-regulatory capacities, and his recognition

that shared intentionality is "transformative" in the sense that it restructures individuals' cognition at large (Kern & Moll, 2017). In a book less explicitly about cultural evolution than the other two, it is this final point, that shared intentionality shapes the entire species' cognition, which should awaken the interest of scholars of cultural evolution.

2. Critical remarks

We turn now to discuss two issues represented by the following questions:

> 1) *Social Learning*. What are the roles of social learning in the three authors' accounts of culture? What role do these accounts ascribe to intersubjectivity?
>
> 2) *Evolution*. What are the explanatory relationships between processes of cultural evolution and processes of biological evolution, according to the authors?

We take the two questions in turn, briefly report our authors' responses to them, and raise what we hope are constructive criticisms.

§2.1Social Learning. Social learning forms a focus of attention for all three authors for the reason that it is regarded as perhaps the single most important causal factor responsible for human cultural evolution. Most animals learn asocially or individually. Many others learn socially in a broad sense: the animal's behavior is somehow affected by the presence or behavior of a conspecific. But there are presumably forms of social learning that make the "cultural difference" between humans and their dynamic and "cumulative" cultural traditions, and the Great Apes, with their locally distinct but less dynamic behavioral repertoires. The three authors offer different causal explanations of social learning in humans.

According to Heyes, social learning "underwrites a whole new inheritance system: cultural evolution" (p. 79). The implication is that social learning, rather than individual learning, niche construction, or genetic selection, is the most important pillar in the development of human culture. According to her broad definition, learning is social as soon as one individual's behavior is somehow influenced by the presence, behavior, or products of another individual. A snail following another's slime trail engages in social learning according to this definition. In most cases, Heyes claims, human social learning is of the same quality as animal learning. But sometimes human learning behavior is guided by the deliberate use of metacognitive strategies. The agent applies a set of context-specific rules such as "copy digital natives" when trying to navigate new technology (111). This deliberate rule-following is of great importance, as it forms a building block of our powerful, species-unique cultural inheritance system, which facilitates the high-fidelity acquisition of cultural traits. Social learning is also

what allows humans to acquire Heyes' other important gadgets, such as imitation, mindreading, and language.

But what is it that gives rise to social learning in the first place? Heyes emphasizes the continuity between individual and social learning. In a précis of her book she writes "the same computations [. . .] are involved in processing information from social partners (social learning) and personal experiences of reward (asocial learning)" (C. Heyes, 2019, p. 7). In the book she put it thus: most social learning "depends on the same set of cognitive mechanisms as individual learning" (C. M. Heyes, 2018, p. 88). Consider imitation, the topic of Chapter 6. Heyes discusses how infants overcome the "correspondence problem," i.e., the problem of topographically matching one's own body parts to the analogous body parts of a demonstrator (118). Citing failures to replicate findings of neonatal imitation, Heyes rejects the appeal to innate or instinctive imitation mechanisms familiar from Meltzoff and Moore (1977). Instead Heyes argues that mechanisms of associative learning, by which sensory signals (e.g., vision of others' movements) and motor signals (proprioceptive feedback about the spatial positioning and movement of one's own body parts) become coupled, are sufficient to explain infants' triumph over the correspondence problem. Heyes admits that a small number of associations might be innate, like smiling and frowning, but adds that "the vast majority are forged by sociocultural experience" (127), including the experience of mirrors. In sum, Heyes' explanation of social learning skills is generally reductive insofar as she explains the development and execution of social learning by subpersonal learning mechanisms familiar from experiments with pigeons and rats.

What stands out about Heyes' account of social learning is the inconsistency between her explicit avowal to cure the mindblindness of extant cultural evolutionary theorizing on one hand and her anti-mentalistic account of social learning on the other. She argues that her cultural evolutionary psychology approach is unique insofar as competing theories fail to accord the mind any appropriate explanatory force. But Heyes herself offers a deflationary account of human cognition and rejects mentalistic interpretations. She argues that social learning is "just a label" we apply to instances of learning that somehow point to the presence of another agent, but the mechanisms are the same as those governing individual learning (see Heyes, 2012). Instead of appealing to intention reading, shared intentionality, or shared agency, as does Tomasello in his rich, mentalistic account of human cognition, she insists that social learning is explained by subpersonal processes involving learning spatial patterns of light (face recognition), or temporal patterns of sound (language). In her individualistic, basic-learning account, Heyes dismisses the importance of a constitutive element of social learning in humans: the other person (model) from whom the child learns

and whose actions she faithfully copies with the goal to acquire knowledge through the other. Consequently, Heyes also downplays the role of joint attention as a difference-maker, both in human phylogeny and ontogeny. This is evident not only in her general neglect of the phenomenon, but also in the small role she assigns it where she does discuss it: "joint attention behaviors further increase the precision of social learning" and make "infants more teachable" (63). This goes against accounts that see joint attention as foundational for human-unique social learning and for the development of perspective-taking and theory of mind (Moll & Meltzoff, 2011b, 2011a).

In contrast to Heyes, Laland recognizes the causal role of shared intentionality in generating human culture and, in particular, the cooperation by which it is distinguished. Laland writes,

> Large-scale cooperation commonly requires coordinating the actions of many individuals. Such organized action among pairs and groups of contemporary humans typically involves shared intentionality and goals; and joint attention, perspective-taking, and commitment. Here again, teaching is relevant. Teaching another individual how to prepare food, build a fire, or make a tool requires both joint attention and joint commitment, as well as shared intentions and goals. (268)

Furthermore, Laland enters into a brief yet important discussion of the emergence of shared intentionality. Language evolved in humans and only in humans because only human infants acquired abilities for joint attention. Infants' joint attentional skills, which they exhibit in acts of other-directed pointing, gaze alternation, and social referencing mark an important mental development that enables one-on-one and, later, one-to-many teaching, including the teaching of language (187). In contrast to Heyes, Laland openly affirms the importance of intersubjective phenomena like joint attention for children's further cognitive development. The social foraging behavior of other primates brims with competition for food, while acts of offering or sharing food are virtually nonexistent. In contrast, early humans are known to have cooperatively foraged. Laland "strongly suspects" (276) that this prompted changes in social temperament and tolerance, and that substrates for these social behaviors were selected by biological evolution, and perhaps by cultural group selection. This is a pleasing, detailed, and appropriately tentative explanation of the causal origins of key differences in social learning between primate species.

On Laland's account, joint attention and shared intentionality were transformative for cognition and culture at large. He writes, "We humans appear unusually inclined and able to share experiences with others … Humans have not just evolved advanced levels of individual cognition, but also extensive skills and motivations for shared cognition (where knowledge is constructed through dialogue between individuals)" (276). It appears that

shared intentionality catalyzes some forms of social learning, including teaching, that feed processes of "cultural drive," where that term is understood in terms of Allan Wilson's hypothesis that cultural traits transmitted over time led animals, humans in particular, to "exploit the environment in new ways, and thereby increased the rate of genetic selection" (115). At some point in the Paleolithic, the *social* environment overtakes the physical ecology in its influence on our fitness, leading to selection of a suite of genes for brain development.

Laland admits that he had never found persuasive Michael Tomasello's theory of the "ratchet effect" (see just below), according to which high-fidelity imitation permits cultural traits to be passed along and innovated upon, leading to innovations and "cumulative culture," until he encountered the results of a mathematical modeling experiment carried out by Enquist et al. (2011). The experiment showed that small increases in the fidelity of a cultural trait's transmission resulted in exponential increases in the trait's longevity in a population (151). The longer a trait survives, by way of faithful copying in a population, the more opportunities there are for copiers to innovate and build upon the trait, thus preserving and refining the trait and creating cumulative culture. Thus, for Laland, explanations at the level of physical changes to our ancestors' genomes sit side by side with explanations that appeal to social cognition and shared intentionality to account for the transformation of our species and human uniqueness.

Like Heyes and Laland, Tomasello acknowledges that social learning is present in many non-human animal species. He himself was at the forefront of developmentalists offering a taxonomy of different kinds of social learning (Tomasello et al., 1993). Emulation, for example, is a form of behavioral copying seen in apes when they reproduce the outcome or effect of another agent's activity. However, one particular kind of social learning is human-unique and taken by Tomasello to be the major mechanism responsible for cultural transmission and ultimately cultural evolution: imitation. Imitative learning involves paying close attention to the method or technique a model uses. Imitative learning is crucially important for language learning, and both are grounded in the fundamental capacity of joint attention because they require the child to form shared goals and shared intentions with others. Thus, imitation is a manifestation of infants' broader capacity for shared intentionality and is responsible for the "ratchet effect" whereby human cultural innovations and modifications accumulate over historical time (Tomasello et al., 1993; for a comprehensive review of research on cumulative culture and its supposed mechanisms, see; Caldwell et al., 2020).

2.2. Cultural and biological evolution

Perhaps the major problem stunting progress in cultural evolution remains systemic confusion about the explanatory relationship between biological and cultural evolutionary processes. This problem looms large in the books under discussion.

Heyes presents us with the greatest difficulties on this score. Her book opens with a distinction in Chapter 1 between "force" and "narrative" theories. Force theories are "concerned with the processes involved in human evolution," which include "cultural inheritance", "genetic drift" and "natural selection" (9). Narrative theories are by contrast "high on the historical dimension" (8) and are explanatorily inferior to force theories. This distinction serves Heyes poorly, not least because, for both cultural and biological evolution, it appears to be a false dichotomy. Evolutionary explanations appealing to variability, inheritance, and differential fitness are omnivorous, and draw their component parts from historical facts about the fossil record as well as from studies of gene transfer. For example, explanation of the selection of high repeat polymorphisms of the DRD4 gene responsible for dopamine regulation in humans qualifies as "high on history," since human migratory patterns are essential in this explanation (Chen et al., 1999). Yet this explanation also involves appeal to "forces" of natural (and, as it happens, cultural) selection. So what kind of explanation accounts for the dispersal of different polymorphisms of DRD4 in our species across the globe? Clearly one must appeal to both evolutionary forces *and* events.

It is not surprising that the relationship of Heyes' explanations of cognitive gadgets to genetic evolution is difficult to understand. This is for a few reasons. First, Heyes identifies her theory of cultural evolution as "selectionist." She means that cultural traits respond to forces of natural selection. For example, Heyes writes that selection "makes people with one habit (for example, making four-knot fishing lines) more likely to survive and reproduce than those with an alternative habit (for example, making three-knot fishing lines)" (34). Knot-tying isn't one of Heyes' cognitive gadgets, making this a strange example in context, but the general thought still makes sense. Consider the gadget of mindreading. Toddlers in the history of our genus who failed to develop mindreading aptitudes were less likely later in life to reproduce. Nonetheless, on the following page we learn that cultural evolution operates, according to Heyes, "without influencing or being influenced" by genes (36). The ideas that capacities like making complex fishing lines or mindreading affect reproductive fitness but that, at the same time, this fitness has no effect on genetic transmission are hard to reconcile.

Unlike Heyes, many in the field not only recognize mutual influence between genes and cultural traits, but go so far as to say that this interaction

is a major source of human culture in particular. Wilson (1991) famously refers to this dynamic, loop-like process as "cultural drive". Examples make clear just how "cultural" traits influence our genes. Early humans' ability to tame fire rewrote our genes and our ancestors' body plans, changing the digestive tract and more (Wrangham, 2010). The ability to tame fire is a culturally evolved capacity insofar as we have no instincts to use or tame fire; knowledge of fire work must be taught and passed down through learning. Perhaps most relevant is the fact that neurogenetic studies of diachronic genetic change using multiple species document that genes for *human* brain function have been subjected to extreme selection as compared to other genes in the human genome, and as compared to genes for brain function in other species (Doruset al. 2004). Surely these findings have explanatory relevance for understanding the development and acquisition of Heyes' cognitive gadgets in humans.

Group cultural evolution presents a persistent stumbling block for researchers in cultural evolution. We make a final observation about Heyes on evolution and use it to transition to discussion of Laland on this topic. Heyes has identified her "cultural evolutionary psychology" as being "selectionist" (34) because acquisition of certain cultural gadgets made ancestors "more likely to survive and reproduce" than others (34). This is by implication an account of individualist selection. But a few pages later she states that "the fittest gadgets would be those that are *most effective in furthering the projects of the social group*" (41; our italics). This is by implication an account of group selection. Naturally, group and individualist selection can both be built into a theory of gene-culture co-evolution, but Heyes takes no explicit steps to do so, does not clarify how these explanations are related, and provides no context for conditions under which a gadget "furthers projects of the group."

Laland offers a more promising model for cultural evolutionary sciences to unify cultural and biological evolution, and serves up a corrective to Heyes' treatment of this interaction. He pauses to explain in some detail and with examples how the process of "cultural group selection" is hypothesized to operate on cultural traits, such as reliance on agriculture (272). Citing Richerson and Boyd (1985), Laland explains that group selection functions in contexts of between-group competition. Suppose among a competing set of groups, one develops sedentary agriculture. As a result, they have more offspring on average than other groups, and agricultural practices increase accordingly. Laland's key point is that "most of the fitness benefits associated with agriculture derive from group-level activities" (273). These "group-level activities" include irrigating land and often (as in rice farming) harvesting crops. These activities cannot be successfully performed by one person but are essential to the one group developing a significantly higher birth rate than the other.[1]

Tomasello's discussion of the ontogenetic development of human cognition and sociality is indebted to evolutionary reasoning. Tomasello devotes Chapters 1, 2 to a discussion of cultural and biological evolution, after which he is silent on those topics. One compelling observation made about culture is that it is best understood as having two distinct dimensions, one "coordinative"–it allows us to cooperate synchronically through trust, norms, and institutions–and the other "transmitive"–it is suited to diachronic transmission and innovation. Understanding the difference becomes essential for appraising Tomasello's success in spelling out developments at each ontogenetic stage in subsequent chapters. We find this distinction has not been appreciated in cultural evolutionary studies given the considerable misunderstandings promulgated there, and given the heterogeneous types of explanations used across its associated subdisciplines. Abundant work is already done under the rubric of studying cultural *transmission*, including for example, Richerson and Boyd's codification of "forces" of cultural transmission (2005, 69). We fear that preoccupation with issues of transmission has led many cultural evolution researchers to equate cultural evolutionary research with the study of *transmitive* processes at the cost of neglecting *coordinative* processes. If we're right, this is unfortunate, since Tomasello's theory of shared intentionality, the quintessence of a coordinative capacity, is virtually unparalleled in explaining cumulative culture.[2] He contends that it is "basic processes of shared intentionality" that are the "ultimate source of human uniqueness" (86).

Tomasello's Chapter 2, "Evolutionary Foundations", discusses the evolutionary context for cognitive adaptations in Great Apes and humans. The evolutionary tale begins around 6 MYA with the last common ancestor (LCA) of today's chimpanzees and modern *Homo sapiens*. The LCA is construed as similar to today's apes in its *physical cognition*, e.g., an understanding of space (for foraging) and application of object categories (to identify foods); in its *social cognition*, e.g., understanding of others as intentional agents and the capacities for mental simulation (12–13); and in its capacity for *self-regulation*, e.g., skills in delayed gratification and response inhibition. Just like today's apes, the LCA cooperated with and helped kin, but its "cooperation was grounded in competition" (13). In contrast, for several million years after the split from *Pan*, hominins were big-brained bipedal apes, until about 2 MYA when collaborative foraging and other collaborative practices came on the scene. "The radically new psychological process that emerged at this time was what we may call joint intentionality based on joint agency" (15). Communicatively, this included pointing and pantomiming and other joint attentional acts, which were understood from the internal perspectives of each participant (leading to the "the dual level structure" of sharedness with embedded individuality). This new way of being in a shared world led to a transformation of human

self-regulation, now involving considerations of how others think about a problem. About 150,000 YA, small-scale collaborative foraging no longer sufficed due to pressures for loosely organized bands to cohere into larger groups that defend themselves against competing groups. This led to a new suite of social cognitive skills, including socially recursive inferences, fairness norms, and role-specific ideals (16–17). Here "emerged modern humans' tendency toward active conformity to the group and its conventional cultural practices" (19). Tomasello states that "The key characteristic of individuals adapted for cultural life was thus a kind of group-mindedness" (19).

This discussion of the evolutionary ancestry of humans and Great Apes is foundational to the book since subsequent developmental differences (discussed in subsequent chapters) between humans and chimpanzees are attributed to differential adaptive pressures ancestrally emergent between the *Homo* and *Pan* lineages. For this reason we find this section lacking in relevant detail and based upon sources not entirely clear. As is customary in evolutionary speculations informed by comparative psychology, attributions of social and cognitive abilities to the LCA are projections based on experiments with living apes. It is less clear just why certain attributions are made of early *Homo*, at different stages of its development. Perhaps the discussion appears thin compared to the depth and profound reach of Laland's synthesis of information from a variety of fields. Tomasello does not include evidence from the fossil record pertaining to the origins of big game hunting (known as a key marker of cultural group selection), or of differences in cranial size over time across the two lineages in question, or from molecular clock studies pertaining to the onset of human-like perspective-taking or sociality.

3. Open issues in cultural evolution

We conclude with brief discussion of two sets of issues the clarification of which is vital for the future of cultural evolution research. These issues go unaddressed in these books.

First, there is the issue of shared intentionality, central to Tomasello's account, important to Laland's account (especially in Ch. 11 on cooperation), but largely sidelined by Heyes. The latter offers a deflationary account of how human beings bootstrap their way into joint attention by building on lower-level processes, such as gaze-following, but the resulting shared-intentional cognitive skill plays very little role in her account of human cognition. In a sense, then, and despite our various criticisms here, Heyes has thrown down a gantlet, demanding that Tomasello and similar thinkers show why we need their rich non-reductive accounts and why an

individualist account that makes parsimony its primary goal its goal would not be satisfactory.

Second, researchers across schools and methods face significant hurdles to integration of cultural evolutionary explanations with relevant information from other sources. For Tomasello and Laland, as perhaps for most researchers in this domain, humans have genetically evolved capacities for cognitive feats such as high-fidelity imitation and shared intentionality. For Heyes, the distinctively human "starter kit" encoded in our genes is much less elaborate, but it allows us to *learn* to imitate, acquire language and so on. Among books reviewed here, only Laland mentions any functional units of DNA by name. The utility of enhancing explanations of cross-species differences in social learning abilities within the Great Apes, the focal purpose of Tomasello's book, is appreciable. This is not least because of methodological problems that confound scientific understanding. Comparative biological research into social learning behaviors in primates provides an illustration. Whiten et al. (1999) used vast field observations to categorize an alleged "39 different behavior patterns, including tool usage" among chimpanzees. They reasoned from these aggregated data along with supplemental information about the lack of contact between various groups of these chimps to conclude that there exists widespread, socially learned and transmitted traditions in chimps. Laland and Hoppit subsequently argued to the contrary that "to our knowledge, in not one instance is there irrefutable evidence that a natural chimpanzee behavior is socially learned" (Laland & Hoppitt, 2003, p. 153). At an evidentiary and methodological juncture of such commanding importance to the field of cultural evolution, the timely use of knowledge about differences in functional polymorphisms linked to precursors of social learning across species would advance understanding of what has set our species apart.

Typically, genes are of theoretical relevance in an explanans, or genetic research is used for the sake of understanding phylogenies and ancestries rather than functional differences. Moreover the dominating interest in the role of genes in cultural evolution is to explain cultural sameness across our species. However, some cultural evolutionary researchers have written about cultural variations of functional polymorphisms (e.g., Richerson et al., 2010). Richerson et al. (2010) mention that among new genes selected in some cultures but not in others are "the HBB sickle cell gene, the G6PD malaria protection gene, and the LCT adult lactose secretion genes" (8990). They follow this comment with an exploratory discussion of genetic and cultural sources of social learning, which in turn leads Richerson, Boyd and Henrich to the following question: "*To what extent* are the genes that underlie behavioral variation in humans evolving mostly by drift and mutation because they are protected from selection by culture, and *to what extent* have they been under frequency-dependent selection to support

the division of labor in complex societies?" (8990, italics theirs). Cultural evolutionary theory has yet to reckon with that question significantly. To his credit, Tomasello peppers his chapters with remarks about alleged developmental differences between cultures, differences potentially relevant for joint attention or shared intentionality. Perhaps culture, ecology, and genes contribute to these differences and predict differences in social learning styles. Kagan and Snidman, developmental psychologists, foreshadow the explanatory utility of genes for precursors of social learning. In their many experiments, they discovered differences in many behaviors of infants across cultures, e.g., the rate of motor movement is significantly lower in East Asian babies in comparison to Caucasian babies. Clearly avoiding genetic determinism, Kagan and Snidman contend that it is likely that population-level differences in functional polymorphisms regulating serotonin partially explains some of the observed behavioral differences (2004, 227). It is likely they are correct in part because several of their experiments used exceedingly young infants as participants, infants not old enough to have been influenced significantly by culture. Neither implications of discoveries like this on cross-cultural differences in social learning, nor research showing that cross-cultural differences in neurohormone production appear to influence a society's organization (Chiao & Blizinsky, 2010) have been properly integrated into cultural evolutionary theory.

The three books discussed here push their own mechanisms, or their own versions of the same mechanisms, into the fray. All three of our authors, for example, agree that imitation (or copying) is central, but they do not all give or presuppose the same account of the phenomena and its effects. Related, most sets of mechanisms discussed in the field are mechanisms of *transmission* rather than *coordinative* mechanisms. Without a corresponding philosophy of explanation developed for the field of cultural evolution, researchers are often talking past one another, unable to identify the joints on which their disagreements hinge, and rarely using the same explanans and explananda for analysis. Can a model that synthesizes and/or reduces the raucous number of intractably distinct mechanisms used in cultural evolutionary explanations be developed? What would it look like?

Notes

1. In contrast to Heyes and Tomasello, Laland provides readers with an abundance of apt citations to substantiate claims he asserts across a huge variety of fields. We applaud this, though at inopportune times the scope of this gargantuan task gets away from him, leading to readers' frustrations. Explicitly mentioning Boyd and Richerson, Laland discusses the importance of producing "conformity" through social learning (273) and appends a note (note 58 in Chapter 11). In a fact-checking effort we attempted to source this claim but found the reference to be to "Tomasello (1999)". That this was a mistake is confirmed by the fact that Tomasello (1999) does not

contain the word "conformity". This is not the only case in which Laland's citations were inaccurate.

2. Within the extensive body of work on biological and cultural mechanisms of language evolution (a case of cumulative culture par excellence), see the focus on the human coordinative capacity for shared intentionality in Burling (2012), Hurford (2012), and Tallerman (2012). Arbib (2012) focuses on the role of imitation in the evolution of language. See Fitch (2017) for an overview of the language evolution field.

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