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# Rethinking Cultural Evolutionary Psychology

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## Abstract

This essay discusses Cecilia Heyes' groundbreaking new book *Cognitive Gadgets: The Cultural Evolution of Thinking*. Heyes' point of departure is the claim that current theories of cultural evolution fail adequately to make a place for the mind. Heyes articulates a cognitive psychology of cultural evolution by explaining how eponymous "cognitive gadgets," such as imitation, mindreading and language, mental technologies, are "tuned" and "assembled" through social interaction and cultural learning. After recapitulating her explanations for the cultural and psychological origins of these gadgets, we turn to criticisms. Among those, we find Heyes' use of evolutionary theory confusing on several points of importance; alternative theories of cultural evolution, especially those of the Tomasello group and of Boyd, Richerson and Henrich, are misrepresented; the book neglects joint attention and other forms of intersubjectivity in its explanation of the origins of cognitive gadgets; and, whereas Heyes accuses other theories of being "mindblind," we find her theory ironically other-blind and autistic in character.

## Keywords

cultural evolution – evolutionary psychology – cognitive psychology – joint attention – Cecilia Heyes

In Cecilia Heyes' new book, *Cognitive Gadgets: The Cultural Evolution of Thinking* (Heyes, 2018), she describes herself as founding a new approach to the study of human cognition and its emergence. This approach, which she calls "cultural evolutionary psychology", aims at explaining the cultural evolution of "mechanisms of thought" (p. 13; all undated page references are to *Cognitive Gadgets* unless noted otherwise). Trailblazing a new path is, according to her, necessary because existing research into cultural evolution has been "mind-blind" (Heyes, 2012, p. 1) and has neglected "what goes on between the ears" (p. 85). She proposes to interweave evolutionary psychological considerations with ideas about cultural evolution and to give a unified account of the operation of mental abilities and learning strategies, which she calls 'cognitive gadgets'. These gadgets are defined as distinctively human cognitive mechanisms or "pieces of mental technology that are not merely tuned but assembled in the course of childhood through social interaction" (p. 22). Despite the alleged relevance of social interaction for the "assembly" of these gadgets, the explanations Heyes offers are mostly mechanistic and reductive. She breaks this interaction down into stimulus-response sequences and subpersonal mechanisms operating in the individual mind. We find the book well worth careful consideration, rich in presentation of experimental results, but theoretically shaky. In this review we summarize each chapter then present some criticisms.

### 1 What is "Cultural Evolutionary Psychology"?

Heyes' new "cultural evolutionary psychology" theory is presented in two parts. In the first, consuming Chapters 1–4, Heyes positions her methods and conclusions in the increasingly crowded field of cultural evolutionary theory. In the second part, Chapters 5–9, Heyes presents a series of detailed discussions of cognitive gadgets.

Chapter 1 draws a distinction between *narrative* and *force* theories. Narrative theories give a chronology of particular events leading to the evolution of some trait. For example, an attempt to explain the evolution of humans' fully opposable thumbs by a chain of antecedent events involving increased terrestrial movement, followed by an upright bipedal gait, which rendered the hand

available for fine-motor development, would be such a theory. Force theories, by contrast, identify evolutionary forces like gene-culture coevolution, cultural evolution, and genetic drift etc. that operate and interact to produce some trait. While the ideal would be some kind of synthesis of narrative and force aspects, narrative theorizing is rarely sufficiently supported by empirical data, and so Heyes opts to give force explanations of cognitive gadgets. The main gadgets she hopes to thus explain are imitation, selective social learning, mindreading, and language. A key feature of Heyes' overall project is to contend that the force behind the emergence of cognitive gadgets is cultural, not genetic, evolution. In other words, human unique cultural mechanisms are handed down by cultural transmission. The upshot is that cultural evolution changes not only what we think, but how we think, as it designs humans' cognitive machinery.

Chapter 2, "Nature, Nurture, Culture", clears ground for articulation of her account of cognitive gadgets. Here Heyes adopts a "teleosemantic" approach to both biology and culture. "At its heart, the teleosemantic view suggests that, of all the factors that correlate with developmental outcomes ... the ones that *really* carry information (or "represent," "code" or "carry meaning") are those for which the correlation exists by virtue of a Darwinian selection process" (p. 28). This is alleged to avoid the problem of arbitrariness familiar from 'just-so' stories. Information-carrying features of our biology include our genes; epigenetic interactions between our genes and the environment; and culture. This leads to Heyes' discussion of cultural evolution, where she provides snappy names for groups of theories – the "California" school (Boyd, Richerson, Henrich), the "Paris" school (Sperber, Atran, Morin), and "High Church" evolutionary psychology (Tooby, Cosmides). Heyes defends a "selectionist" theory of cultural evolution whereby Darwinian laws of variation, selection, and inheritance are applied to cultural traits. She endorses the implication that cultural behaviors and cultural psychological processes make some people "more likely to survive and reproduce" than others (p. 34). She criticizes memetics on the grounds that it is not properly tethered to reproductive fitness outcomes. The remainder of the chapter is devoted to consecutive sections that helpfully illustrate how Darwinian processes of variation, inheritance (vertical, oblique, and horizontal), and selection operate on cultural components.

Chapter 3, entitled "Starter Kit", is unique as it marks a detour from Heyes' larger mission to show that human-unique thinking has evolved culturally, not genetically. Here she concedes that "genetic evolution tweaked the human mind" (p. 53) by endowing it with a set of innate emotional/motivational, attentional, and cognitive attributes that are highly similar to those of other Great Apes. To emphasize the relative unimportance of these attributes, she calls them "small ordinary attributes" (p. 53) and distinguishes them from the

evolutionary psychologists' "big special" attributes. Small ordinary attributes include 1) increased social tolerance and motivation, which lead to closer social proximity, an enjoyment of response-contingent stimulation and a greater openness for social influence; 2) an attentional preference for human faces and voices; and 3) powerful domain-general "central processors" that support associative learning, memory, and information storage. Social tolerance is a key precursor to social learning and teaching because it brings together non-kin, thus allowing for observational learning outside of parent-offspring relationships. Social motivation, Heyes argues, is mainly to be explained by humans' enjoyment of "response-contingent stimulation" (p. 58). We appreciate when our actions yield certain effects and responses (whether these are emitted by an animate or inanimate object) in a temporally contiguous manner. Infants' well-documented biases to attend to human faces and voices enhance associative and reinforcement learning in such a way that they allow for the construction of joint attention (p. 63). Heyes' point is to show that much of what has been presupposed to be specialized innate mechanisms or "instincts" are actually effects of learning facilitated by "small ordinary attributes". For example, infant-directed speech (commonly known as "motherese") is not, as usually thought, a biological adaptation (Csibra and Gergely, 2009) but the result of adults coming to learn that babies prefer high-pitched sounds. Heyes closes the chapter with the thesis that these genetically inherited features are "expanded and refined" (p. 73) versions of the same features we see in primates. These gradual improvements, however, impact our cognition of both System 1 (fast, automatic association mechanisms) and System 2 (slow, controlled executive functioning skills) in ways that evolutionary psychology has vastly underestimated.

Chapter 4 supports the assertion that "cultural inheritance has played the dominant role in shaping all or most distinctively human cognitive mechanisms" (p. 77). Heyes emphasizes that cultural learning stands apart from other forms of learning for the reason that it "underwrites a whole new inheritance system: cultural evolution" (p. 79). Cultural evolutionary science mustn't continue to be "mindblind", she urges, as is the "California school" represented by Henrich, Boyd, and Richerson. She criticizes Joseph Henrich's theory of social learning on the following accounts: it does not define the superordinate category of 'learning' (p. 82); it confuses *processes* with *effects* of learning (p. 83); and it employs the concept of "cultural learning" to do too much theoretical work (pp. 84–5). Heyes juxtaposes this with her own account of learning in which cultural learning is a subset of social learning, itself a subset of learning simpliciter (p. 86). Her distinction is made on the basis of *how* things are learned rather than *what* is learned. This chapter concludes with the claim that

most social learning “depends on the same set of cognitive mechanisms as individual learning” (p. 88).

“Selective social learning” is the title of Chapter 5 and the name of the first cognitive gadget to be discussed at length. Social learning is any learning that is in some way influenced by another agent or its products. Hence, even snails and sticklebacks perform social learning. Social learning is always selective because the degree to which the learner’s behavior is influenced by another varies depending on the circumstances and features of the demonstrator. These “inputs” are processed by domain-general mechanisms, not by evolved specialty modules, and the processes are typically low-level. Occasionally humans, and humans alone, are selective in their learning not at the *input stage* but at the *output stage*. What this means is that they deliberately shape their own behavior according to cultural norms. This selective imitation behavior is guided by rules, which humans are taught by others. Such rules include heuristics like “copy the boat builder with the biggest fleet” etc. By following them, learners deliberately hone their attention to who they view as the experts in a specific domain – whom they then copy with high fidelity and accuracy (111–113 citing Godfrey-Smith, 2012). Applying these metacognitive learning strategies is a cognitive gadget that leads to cumulative cultural cognition and significantly amplifies the social learning within parent-offspring relations. Apart from human learners’ meta-cognitive rule-following, however, social learning is qualitatively identical to asocial or individual learning. In her own words taken from the précis to her book: “the same computations [...] are involved in processing information from social partners (social learning) and personal experiences of reward (asocial learning)” (Heyes, 2018, p. 17).

Chapter 6 is about “Imitation”, a uniquely human form of social learning and thus a cognitive gadget. Heyes explains why the acquisition of imitative abilities in children is so special. To bodily imitate adults, children must solve the “correspondence problem”. This is the problem of “topographically matching” (p. 118) one’s body parts to the body parts of the demonstrators, even though we don’t experience other bodies the same way we experience ours (e.g., others’ limbs are seen but not felt). This leads to a pointed attack on the appeal to innate or instinctive imitation in newborns. In her discussion of Andrew Meltzoff’s (e.g., Meltzoff & Moore, 1977) famous hypothesis that humans innately grasp the likeness or equivalence of self and other, she claims that such an appeal to an innate cognitive mechanism is like furnishing the mind with a black box – it explains nothing (p. 119). Introducing the idea of mirror neurons, which have been considered to offer neurological support of the “like me” hypothesis, adds “just another black box” (p. 121). In the remainder of the chapter, Heyes articulates her own explanation of human imitation,

which appeals to a number of sub-personal learning mechanisms, e.g. associative learning, by which sensory signals and motor signals become interconnected. The granularity of this explanation is pleasingly detailed. She notes, for example, that by watching their hands in motion, infants learn that their performances of hand-moving actions correspond to sensory visual observations of their hands in motion (p. 124), a textbook case of associative learning. When the infants' motor movements are "vertically matched" to sensory observations, two streams of learning, perceptual and motor, become integrated (p. 126). Heyes admits that a small number of "vertically matched" associations might be innate, like smiling and frowning (p. 127), but adds that "the vast majority are forged by sociocultural experience" (p. 127). One kind of experience relevant for solving the correspondence problem is that of mirrors because only they provide total temporal contiguity between what is seen and what is felt. Just like a mirror is a cultural artefact, so is imitation: it is a cognitive gadget, not an instinct. Unlike other chapters, Heyes concludes this one with a discussion of criticisms of previous iterations of her ideas on imitation (such as Heyes, 2016).

Chapter 7 is about "Mindreading" and its relation to teaching. Mindreading presumably presents a challenge to the structure of Heyes' explanations of cognitive gadgets wherein input-output generalizations about low-level, sub-personal events form her explanans. Heyes asserts that most scientists conceive of mindreading as a "cognitive instinct" (Leslie, 1987) allowing even young infants access to the minds of others. Alternative accounts regard mindreading as the product of a conceptual change occurring in children's own minds around age 4 (Gopnik & Wellman, 2012) or as relying on processes of introspection and simulation (Goldman, 2006). Heyes, by contrast, puts forth the provocative claim that children are *taught* to mindread. Her argument is by analogy and comes in three steps. First she posits that mindreading and print reading share important features. Both involve "derivation" of meaning from signs (e.g., we infer embarrassment from blushing and semantic meaning from ink spots on paper); have regulatory and interpretive functions; are slow to develop and cognitively demanding; are neurally specialized; are impaired in certain developmental disorders (autism spectrum disorder and dyslexia, respectively); and show cultural variation (pp. 148–155). After listing these similarities, print reading is obviously taught, which leads Heyes to conclude – in a third step – that mind reading must therefore be taught also. Next Heyes adds a rearguard defense in which she argues that evidence in favor of mindreading as instinctual is poor. Early success on so-called mindreading tests in infancy can be explained by other, less demanding, skills and there is no noteworthy correlation between genetic relatedness and mindreading abilities. Instead,

and in favor of her own view, cross-cultural data suggest that the ability to mind-read varies with the extent to which the various societies discuss the mind.

The main conclusion of Chapter 8 about “Language” is that the evolution of language arises from a generalized ability for sequential processing rather than from instinctual or genetically-conferred abilities (p. 171). Her view contrasts with that endorsed by defenders of the “Universal Grammar” hypothesis according to which language learning is possible due to genetically inherited information about language (pp. 177–8). If language is supported by genetic endowments of some kind, then at least some structures in languages are by implication universal. In the wake of empirical studies of language, however, Heyes concludes that evidence for these universal structures is lacking. She adds that many commitments of the “language instinct” approach are scientifically untestable, e.g. claims about syntactic recursion (p. 180). Universal Grammar has difficulty explaining why learning second languages is so difficult, *pace* appeals to “critical periods” for language learning (which, she says, are misunderstood). In fact, language use and development across cultures can no longer be said to be neurally located in similar regions of the brain (p. 184). Heyes admits not to be an expert on the origins and development of language, but she uses this confession in her favor by emphasizing that, if even she, who only follows the debates “from over the fence” (p. 196) recognizes the implausibility of nativism, then surely linguists and psycholinguists should.

The book culminates in Chapter 9, about “Cultural Evolutionary Psychology.” This chapter makes a surprising (because delayed) theoretical commitment to group selection. Cognitive gadgets have evolved not through mere cultural evolution, but through cultural group selection. Heyes writes that a gadget “helps individual people to achieve some goal” and, when the fitness of individuals is increased, “the social group benefits, too, insofar as it is good for the group to have a greater number of members, or a greater number of descendant groups” (p. 201). How does this work? Here Heyes implies that the benefits are biological: cognitive gadgets are adaptive because they promote bearers’ abilities to acquire food, build shelter, and defend against predators (p. 201). Cognitive gadgets also “benefit the group by promoting both cooperation and the cultural inheritance of grist” (p. 202). Given her stance against narrative and biological evolutionary explanations of cognitive gadgets, we were surprised that Heyes states in this chapter that cognitive gadgets also affect our genes because their selection “will progressively favor genetic mutations that reduce the experience-dependence of the gadgets’ development, converting them into cognitive instincts (Henrich, 2015)” (207). She concludes with remarks about human nature and the role of “cultural evolutionary psychology” in our understanding of it.

## 2 Why Not Cultural Evolutionary Psychology?

We now offer critical reflections on the contents of the book. Among issues of special importance to us are the following: the status of the mind in Heyes' cultural evolutionary psychology; the accuracy of Heyes' positioning of cultural evolutionary psychology vis-à-vis other leading theories of cultural evolution; the fate of joint attention amidst her typically subpersonal explanans; and conceptual confusions pertaining to the relationship of Heyes' theory to mechanisms of biological evolution.

*Whose theory is "mindblind"?* Heyes believes that her account, by taking the mind into focus, improves our understanding of uniquely human cultural evolution. Alternative accounts, including the "California school," attempt to explain cultural evolution without appeal to the mind and its faculties and are thus, according to her, "mindblind" and "stuck in behaviorism" (p. 9). We find this way Heyes positions her theory vis-a-vis others' surprising since she consistently draws on behaviorist learning principles in her own explanations. Decision-making, understanding, reasoning, and the sharing of ideas or experiences, all of which are important to understand human agency, have almost no place in her account (with the exception of meta-cognitive rule-following; see also pp. 72–74 on System 2 "executive function"). As part of her reductionist program, Heyes insists that social learning is rooted in the same learning mechanisms as is asocial or individual learning and is nothing more than a causal chain of physical motions, auditory emissions etc. causing responses in the learner, often without the learner's awareness. For these reasons the status of the mind in Heyes' cultural evolutionary explanations of cognitive gadgets appears fragile and diffuse. Despite her avowal of guaranteeing mental terms like "see", "want", and "know" a firm place in her account (p. 10) and bringing the mind into cultural evolutionary theorizing, Heyes' account is more forgetful of the mind and more behavioristic than most, including those she critiques.

*Heyes' questionable representations of other cultural evolutionary theories.* Readers may find *Cognitive Gadgets* to underestimate and misrepresent the contents and achievements of extant theories. Heyes judges that cultural evolutionary theories other than hers only acknowledge that "*what we think*" but not that "*the way we think*" depends upon cultural learning (p. 18). This low estimation of the present scholarship leaves the informed reader scratching her head. One account she discredits is the "shared intentionality thesis" (e.g. Tomasello et al., 2005). But Tomasello (2014) makes explicit that "skills and motivations for shared intentionality thus changed not just the way humans think about others but also *the way they conceptualize and think about the entire world* (our emphasis), and their own place in it" (p. 144). Since then, other



advocates of the shared intentionality account have stressed that shared intentionality, understood in the right way, transforms human cognition as a whole (Kern & Moll, 2017).

*Heyes on prestige-bias and the California School.* We regard her discussion in Chapter 5 of selective social learning as important and warranting clarification for the reason that it is here that contrast of Heyes' theory with that of the California School is likely to yield key implications for an understanding of the emergence of uniquely human cumulative culture. Henrich and Gil-White (2001) have argued for the considerable importance of prestige-based learning bias. In short, prestige-bias is a mechanism put forward by members of the California School in which learners psychologically evaluate demonstrators and select amongst them those that are most successful for further behavioral copying. Prestige-bias is what Heyes calls a "high-level process" operating at the "output stage" rather than an "automatic process" that operates at the "input stage" because its operation presumes that individuals "voluntarily" endorse the learning strategy. She adds "The California School assumes that biases are cognitive instincts; social learning is made selective by genetically inherited cognitive instincts" (92). This description of the operation of prestige-bias is confusing for the reason that Heyes has wrongly attributed two incompatible properties to the prestige-bias mechanism. Prestige-bias cannot be both "high-level" and an "instinct". Heyes' description is well-suited to committing a straw man fallacy against the California School. Oddly, later Heyes replaces the California School's prestige-bias mechanism with one of her own, which she calls the "who selectivity" bias (101–103). While Henrich and Gil-White did not pause to discuss details of the sub-personal operation of prestige-bias in their unveiling of this important mechanism, Heyes' "who selectivity" appears to owe an enormous and poorly recognized debt to the work of Henrich and Gil-White.

*Heyes on evolution: the confusing relationship between biological and cultural evolution.* The explanations that Heyes provides for cognitive gadgets have a relationship to evolution that is difficult for readers to understand. Three problems lurk in this area, the first of which involves a pair of commitments that cannot be made consistent. Heyes calls her account of cultural evolution "selectionist", and says it has its basis in the work evolutionary social scientist Donald Campbell (33), to whom she dedicates the book. Campbell is famous for his advocacy of a "blind-variation-and-selective-retention" theory, which he applied broadly to creativity, knowledge, and culture in efforts at what he called "universal Darwinism" (Campbell, 1960). "Selection" refers to selection of cultural features and gadgets for their influence on biological fitness of organisms. Cultural attributes that differ between members of population are

biologically selected, e.g. an attribute may “make 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). This makes perfect sense. Toddlers who fail to acquire the cognitive gadget of mindreading or language would seem to be less likely than toddlers who do to pass on their genes to future generations. The problem is that Heyes’ affirmation that cognitive gadgets are adaptive products of natural biological selection is inconsistent with her additional commitment that cultural evolution operates “without influencing or being influenced” by genes (36). How she can endorse a biological selectionist account of cultural evolution while denying a correlation between genetic change and cultural change we do not understand.

*Heyes on evolution: What is the role of genetic evolution in cultural evolution?* For Heyes, genetic adaptations for social learning in our species do not figure in an explanation of human learning and cultural evolution. Cultural evolution is the only significant force in her force explanation of cognitive gadgets. Leaders in the field of cultural evolution disagree with Heyes by attesting to the special prominence and ‘boot-strapping’ function of gene-cultural *interactions*. That cultural evolution changes genes, which in turn change in cultural evolution, is described by Wilson (1960) “cultural drive”, by Tomasello, Kruger, and Ratner (1993), the “ratchet effect”, and by Henrich (2017), an “auto-catalytic” reaction. We find Heyes’ commitment obviously false. Among the most revolutionary cultural features in our phylogenetic ancestry are likely to be ancestors’ skills at controlling fire. This rewrote the early homo body plan, changing our digestive tract, musculature, jaw, and much more (Wrangham, 2010). Heyes might reply that taming fire has nothing to do with *cognitive gadgets*. We counter that any satisfying explanation of our species’ cultural evolutionary success as social learners must make reference to a suite of neurotransmitter genes that have been under intense selection during the Holocene. Bruce Lahn and colleagues’ study of over 200 genes for brain development included researching rates of selection on each of these genes across humans, macaques, rats and mice. He and colleagues showed that, in humans, genes pertaining to brain function have been under rapid and increasing rates of mutation and natural selection as compared to the same genes in these animals and as compared to other genes in our own genome (Dorus, Lahn, et al., 2004). Reading Heyes (or, to be fair, most other cultural evolutionary literature), one would not learn that these and other genes are inordinately relevant for explaining the biological evolutionary contribution to the development of our cognitive gadgets.

*Heyes on evolution: ‘fitness’.* The third and final problem we relate about Heyes’ use of evolution involves the nature of fitness. Heyes describes a kind

of biological selection in discussion of Campbell, a cultural selection in discussion of Dawkins' memes, and surprises the reader by describing a third form of selection, group selection. This harrowingly complex concept slips onto the page without introduction or explanation. She says in passing that "the fittest gadgets would be those that are *most effective in furthering the projects of the social group*" (41; our italics). Set aside that this commitment may be inconsistent with her heretofore individualist selectionism. This gloss on group selection is unusual insofar as it does not refer to the salience of *between-group competition* and instead only refers to the *within-group* selection of gadgets. Most models of multi-level selection depend upon between-group competition without which it is difficult to imagine how a group becomes a unit of biological selection. This major theoretical commitment hangs on the page, never to be used again in the book.

*Unclear boundaries between asocial and social learning.* Heyes defines social learning as any kind of learning that is in some way influenced by the presence of another agent or even just the presence of some product of another individual. This broad conception of social learning includes cases in which the learner and the other never cross paths – as long as the learner encounters something that another left behind. However, Heyes did not foresee the wide-ranging consequences of defining social learning this broadly, such as the little space it leaves for asocial learning. A result is that her definition confuses readers because she trips when using the terms 'social' and 'asocial' learning. When illustrating asocial learning with an example, she contradicts herself by mentioning an instance in which an individual learns how to use a turnstile by "solitary trial and error" (p. 87). According to her own definition, this does not qualify as asocial learning because the turnstile is, of course, a product of human culture. This is a case of *social*, not asocial, learning. Heyes' definition and use of concepts is thus internally inconsistent and creates problems for the distinction of asocial and social learning, particularly where it applies to humans.

*A fallacious argument from analogy about print reading and mindreading.* In a condensed version of an argument made elsewhere (Heyes & Frith, 2014), Heyes argues that "children are taught to read minds" in a process that analogically resembles how children learn to read print. Her conclusion from this inductive argument is that print reading and mind reading have the same source. They are produced by cultural evolution via teaching, not by biological evolution via instinct. Mindreading and print reading might share some features in common, but Heyes' emphasis of these similarities is misplaced for the reason that they are irrelevant to the justification of her conclusion. Let's reconsider three of Heyes' analogical observations: print reading and mindreading are

both slow to develop, neurally localized, and impaired in those with certain disorders. This would be relevant to her conclusion that mindreading is taught *only if it were also the case* both that only culturally evolved processes *do* possess, and biologically evolved instincts *do not* possess, this conjunction of features. This necessary condition on the success of her argument from analogy is patently false. Consider the capacity to perform what developmental physiologists refer to as ‘precision grip.’ Precision grip is slow to develop (Sacrey, Karl, & Whishaw, 2012), neurally specialized in the premotor cortex (Schabrun, Ridding, Miles, 2008), and missing in those with developmental disorders (e.g., cerebral palsy; Gordon, Bleyenheuft, & Steenbergen, 2013). If Heyes’ argument from analogy that mindreading is taught like print reading were sound, then it follows we are entitled to infer that the precision grip is, like mindreading and print reading, a product of teaching. Since this is absurd, it follows Heyes’ argument is unsound.

*The autistic character of Heyes’ theory of the mind.* While Heyes accuses others of advocating “mindblind” theories of cultural evolution, we find her own account autistic. This is because the ‘gadgets theory’ lacks proper recognition of the intersubjective and relational nature of humans and the profound role this plays in learning. In her attempt to plant the roots of human social learning in asocial mechanisms, she attributes no significance to humans’ unique intersubjectivity. That human interaction is, indeed, unique becomes visible from as early as two months of age when infants smile and coo at others in what has been called ‘primary intersubjectivity’ (Trevarthen & Aitken, 2001) and starts having momentous consequences for learning by the time it culminates in joint attention at around 1 year (Tomasello, 1999). Joint attention, which involves two persons directing their perception to the same object in mutual recognition that they are doing this together, has been shown to be a major hub from which various more demanding cognitive abilities originate, inter alia, language learning (Tomasello & Farrar, 1986), perspective-taking (Moll & Meltzoff, 2011), and mindreading (Tomasello, 2019). The importance of joint attention is also evidenced by the drastic effects that ensue when it is impaired, as in the case of autism. Those on the autism spectrum show impairments in all three areas mentioned.

And yet, joint attention is assigned no special place in Heyes’ theory. The little she has to say about it is that it is somehow built from infants’ preferences for faces and their abilities to forge associative links: “As long as gaze shifts after eye contact [...] are more likely to yield an encounter with an interesting object, and as long as pointing tends to make adults do what infants want, reinforcement learning can build joint attention on the foundation of a simple, genetically inherited face preference” (p. 63). For Heyes, joint attention is not a

phenomenon *sui generis* but something that is simply constructed from primitive “small ordinary” attributes of the human mind. But if this were so and if, as Heyes maintains, “there is no evidence to suggest that associative learning has undergone any major, qualitative changes in the recent past, and certainly not in the hominin line (p. 69), then one must wonder why apes lack the capacity for joint attention. It therefore seems that without an appeal to joint intentionality or some other difference maker having to do with intersubjectivity or cooperation, it remains unintelligible how uniquely human cognition can get off the ground.

Similarly striking is Heyes’ lack of a discussion of teaching, which is arguably the form of selective social learning that is most responsible for the oblique and vertical transmission of cultural knowledge and is most widely accepted as being human-unique. Unlike joint attention, whose role she diminishes, teaching plays an important role in her account because she takes teaching to be necessary for mindreading (p. 154). However, the reader does not learn what teaching, according to Heyes, is. We would argue that like joint attention, teaching is a cooperative process involving two or more individuals putting their heads together in a second-personal relation (this time for the sake that one learns what the other already knows). But again, the intersubjective dimension of human cognition is completely missing in the theory of cognitive gadgets, which is why we refer to the theory as autistic.

*Heyes’ metaphors work against her.* Remarks on her use of language conclude this review. Heyes’ deployment of neologisms and metaphors in the book is likely to grate on readers. There is for example the infelicitous reference to “grist” and “mills” (*passim*), “turnstile learning” (p. 87), and “planetary social learning” (which she follows on the same page with a cooking metaphor), and comparisons like “imitation is the Lamborghini of social learning” (p. 116). Befuddlement worsens when Heyes seems to misunderstand the literal meanings of her metaphorical terms, as is suggested by her questionable use of “mills” and “grist.” She says that cognitive gadgets are like “mills” and “cognitive products” are “grist” (p. 3) and adds later that she is concerned “not with the grist of the mind – what we do and make – but with its mills” (p. 14). But the Oxford English Dictionary Online’s first definition of “grist” is as the grain that enters the mill where it is ground to make flour. In contrast to its deployment by Heyes, in the most common use of the word, *grist is what goes into the milling process, not what comes out*. Similarly, by “mills”, Heyes means “cognitive processes” (see p. 37); however, mills obviously are machines and thus things, not processes. We correct Heyes on this point because she applies these and other metaphors not in passing to incidental features of her argument, but as shorthand for those phenomena that are most central to her theorizing.

(“Grist” appears on seventeen percent of the pages of the book, or thirty-eight times in a two hundred- and three-page text.)

Despite our vocal criticisms of the contents of this book, it is essential that we conclude by remarking that *Cognitive Gadgets* is nonetheless of genuinely exceptional value in the context of contemporary cultural evolutionary theory. Until this book, no one had provided an account of the *cognitive psychology* of human social learning that was pertinent to understanding the affordances of cultural evolution, let alone an account as rich and provocative, even if flawed, as Heyes'. We roundly applaud her for this work.

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