Beller, S., Bender, A., & Jordan, F. (2020). Editors' Review and Introduction: The Cultural Evolution of Cognition. *Topics in Cognitive Science*, *12*(2), 644-653. https://doi.org/10.1111/tops.12498

TOPICS
TOPICS IN COGNITIVE SCIENCE

Topics in Cognitive Science 12 (2020) 644–653

ISSN:1756-8765 online
DOI: 10.1111/tops.12498

This article is part of the topic "The Cultural Evolution of Cognition," Andrea Bender, Sieghard Beller, and Fiona Jordan (Topic Editors). For a full listing of topic papers, see http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1756-8765/earlyview

Editors' Review and Introduction: The Cultural Evolution of Cognition

Sieghard Beller,[a,b†] Andrea Bender,[a,b] Fiona Jordan[c]

[a]*Department of Psychosocial Science, University of Bergen*
[b]*SFF Centre for Early Sapiens Behaviour (SapienCE), University of Bergen*
[c]*Department of Archaeology and Anthropology, University of Bristol*

Received 18 September 2019; accepted 24 November 2019

Abstract

This topic addresses a question of key interest to cognitive science, namely which factors may have triggered, constrained, or shaped the course of cognitive evolution. It highlights the relevance of culture as a driving force in this process, with a special focus on social learning and language, conceptual tools, and material culture. In so doing, the topic combines two goals: to provide an overview of current empirical and theoretical work leading this field, tailored for a wider cognitive science audience, and to investigate the potential for integrating multiple perspectives across several timescales and levels of analysis, from the microlevel of individual behavior to the macrolevel of cultural change and language diversification. One key purpose is to assess the extent to which the different research approaches can cross-fertilize each other, thereby also contributing to the advancement of cognitive science more broadly.

Keywords: Cognitive evolution; Culture; Social learning; Language; Conceptual tools

Correspondence should be sent to Andrea Bender, Department of Psychosocial Science, University of Bergen, P.O.Box 7807, N-5020 Bergen, Norway. E-mail: andrea.bender@uib.no; or, Fiona Jordan, Department of Anthropology and Archaeology, University of Bristol, 43 Woodland Road, Clifton, Bristol BS8 1TH, UK. E-mail: fiona.jordan@bristol.ac.uk

[†]Deceased on October 24, 2018

1. What made human cognition special?

As humans, we share most of our biological makeup with our closest primate relatives, yet we stand out markedly not just from them, but from all other species with respect to our cultural diversity, our capacity for language, and the scope of our cognitive skills. The factors which give rise to human uniqueness are of prime interest for the field of cognitive science (Bender, 2019) but feature infrequently at its conferences or in its journals. A hallmark of humankind—our propensity to engage in highly social interactions and cultural transmission (Bender & Beller, 2019; Caldwell & Millen, 2009; Morin, 2015; Tomasello, 1999)—is likely one of the most essential pre-conditions of cognitive evolution, accompanied by both language (Christiansen & Chater, 2016a; Christiansen & Kirby, 2003) and material culture (Malafouris, 2013; Taylor & Gray, 2014). However, the relative contributions and evolutionary sequencing of these phenomena, their intersections, and their interdependence are still subject to debate (e.g., Christiansen & Chater, 2008; Coolidge & Overmann, 2012; Laland et al., 2014; Sterelny, 2006). Moreover, the emergence of language, symbolism, and other characteristics of modern human behavior is currently being re-assessed and re-dated by an order of magnitude (Brooks et al., 2018; Dediu & Levinson, 2013; Henshilwood et al., 2018). Accounting for evolutionary change in human cognition thus requires new and multidisciplinary conceptual frameworks that view our cognitive, behavioral, and material capabilities as interacting in a continuous process of coevolution (Richerson & Christiansen, 2013).

Although this line of research addresses a question of key interest to cognitive science —which factors have triggered, constrained, or shaped the course of cognitive evolution? —not many cognitive scientists are familiar with the contemporary extent of research in cultural evolution. Cultural evolutionary studies are pursued across a number of disciplines, and all are underlain with the assumption that socially transmitted information is subject to basic Darwinian evolutionary processes such as migration, innovation, drift, and selection: Cultural change in skills, knowledge, and beliefs can be modeled as inherited variation undergoing differential survival. With this *topiCS* issue[1] focused on the cultural evolution of cognition, we therefore pursue two goals.

First, since work on cognitive evolution itself is not generally published in cognitive science journals—despite its relevance for the field—this special issue aims to provide an overview of empirical and theoretical work on the topic from multiple perspectives and to call the attention of the wider cognitive science community to these lines of research. Our goal is to demonstrate that cultural evolutionary approaches not only draw upon ideas and methods from within different areas of cognitive science but also have to offer important theoretical contributions to key issues for debate in cognitive science such as the existence of "innate" properties. If, for instance, key aspects of linguistic structure can be explained as deriving from domain-general constraints, amplified by cultural transmission, then theories no longer need to appeal to particular biological adaptations or to postulate innate knowledge or mechanisms for explaining such structure. Research on those processes of cultural evolution that trigger, shape, and constrain the range of

cognitive abilities should therefore have an impact on theoretical debates at the heart of cognitive science.

Second, in highlighting the value of evolutionary approaches for questions central to cognitive science, as well as the crucial role of cognitive functions in processes of human evolution, we hope to encourage integration of the different theoretical perspectives across subfields of cognitive science in pursuit of a more comprehensive view on the subject, thereby also attracting disciplines not typically considered part of cognitive science such as archeology or evolutionary anthropology to engage in mutual exchange. Given the thriving activities in this field—represented by the highly multidisciplinary composition of the newly founded Cultural Evolution Society (https://culturalevolutionsociety.org/), including a number of psychologists and cognitive scientists—the time is ripe for such a synthesis, made available for a wider cognitive science audience.

The question of cognitive evolution has been addressed in the past years from a broad range of research traditions. Those approaches more deeply rooted in classical cognitive science employ and combine experimental methods, including so-called transmission studies, large-scale simulations, and computational models to unravel the cognitive processes involved, for instance, in the evolution, acquisition, and processing of language, supplemented by comparative research (e.g., on social learning) and neuroimaging studies (e.g., Caldwell & Millen, 2009; Christiansen & Chater, 2016b; Smith et al., 2017). The subfield of comparative psychology (understood in a broad sense as involving comparisons across species, cultural traditions, and ontogenetic development) focuses on identifying shared versus specific components of cognition and zooms in on conditions that trigger developmental as well as evolutionary changes (Haun, Jordan, Vallortigara, & Clayton, 2010; Liebal & Haun, 2012; Tomasello, Carpenter, Call, Behne, & Moll, 2005; Whiten, Caldwell, & Mesoudi, 2016). Parts of anthropology, linguistics, and related fields draw on cultural and linguistic variability in conceptual tools (e.g., Beller & Bender, 2008; Bender & Beller, 2014; Majid, Jordan, & Dunn, 2015) as well as on the mechanisms of cultural transmission (e.g., Kendal et al., 2018; Morin, 2013) and nowadays employ phylogenetic comparative methods from biology to reconstruct evolutionary processes as patterns of inheritance and diversification (e.g., Blute & Jordan, 2018; Dunn, Greenhill, Levinson, & Gray, 2011; Jordan, 2011; Levinson & Gray, 2012). Human prehistory and cognitive archaeology, finally, bring us back full circle by combining theoretical frameworks from cognitive science, such as distributed and embodied cognition, with material evidence of evolutionary changes to reconstruct the origins of human behavioral and cognitive modernity and to uncover the conditions that promote emergence and change of symbolism and other cognitive capacities (d'Errico & Colagè, 2018; d'Errico et al., 2003; Overmann, 2016).

Research traditions in cultural evolution tend to separate into approaches concerned with micro-evolutionary processes (individual social learning dynamics within populations) or macro-evolutionary processes (population-level adaptive-historical dynamics), reflecting to some extent the subdisciplinary divisions of labor, as well as methodological and theoretical tools, from the evolutionary biological sciences (Mesoudi, 2016). Much work has focused on the interface between culture and cognition at the individual level

and scale, most notably in terms of social learning (e.g., Heyes, 2018). While the driving forces of cognitive diversity and design at generational and larger timescales remain largely underexplored, cultural macro-evolutionary approaches such as phylogenetic methods can illuminate the patterns of coevolution or transformation at cross-cultural or cross-species levels. Being able to explain the emergence of and change in cultural traits and tools in terms of cognitive functions—and, conversely, the evolution of cognitive capacities as embedded in cultural practices—would therefore also improve our understanding of those forces that shape human cognition.

2. Cultural evolution as driving force

Human cognition is a product of biology in the sense that essential anatomical, neural, and physiological prerequisites underpinning cognitive abilities were delivered by biological evolution, and the same holds arguably for important prerequisites of human culture (as well as culture in other species, although this is beyond the scope of our collection). Yet, once in place, characteristics of hominin culture became powerful enough to drive cognitive evolution in *Homo sapiens*, and potentially other species in our hominin family tree (Colagè & d'Errico, 2018; Heyes, 2018; Thompson, Kirby, & Smith, 2016). The contributions to this selection describe the mechanisms by which cultural evolution operates, highlight the processes involved and the specific case of language both as a cognitive ability and a cultural tool, and discuss issues and potential solutions for investigating these.

Here, we briefly introduce the papers collected in this issue. A more in-depth treatment with critical appraisal and tentative synthesis is provided in the final commentary by philosopher of evolution Kim Sterelny (2020).

2.1. Mechanisms of cultural evolution: Cultural exaptation, cultural neural reuse, and cultural learning

According to the traditional view in evolutionary theory, a chain of dependence renders genetic changes the ultimate cause of, or at least necessary condition for, changes in brain anatomy and physiology. These, in turn, give rise to new cognitive skills, which then enable cultural innovations. This view (dubbed the "bottom-up-only" view by Colagè & d'Errico, 2020) has dominated evolutionary approaches and is still the prevailing perspective, for instance, in evolutionary psychology.

Based on the available archeological evidence, Colagè and d'Errico (2020) argue, by contrast, that major events in the evolution of both the genus *Homo* and the species *Homo sapiens* are upshots of cultural rather than genetic changes. The "top-down-also" view advocated by Colagè and d'Errico highlights culture not only as a driving force independent of biological evolution, but as the key driving force in human cognition. They emphasize that cultural innovations have the power (a) to scaffold further cultural innovations via cultural transmission and accumulation (Tomasello, 1999), (b) to shape,

trigger, and even generate cognitive capabilities of populations via cultural exaptation (d'Errico & Colagè, 2018), (c) to launch the formation of new brain networks in individuals via cultural neural reuse (Dehaene & Cohen, 2007), and (d) to exert pressure even on gene selection via gene–culture co-evolution (Laland, Odling-Smee, & Myles, 2010).

While Colagè and d'Errico (2018) elaborate on cultural exaptation and cultural neural reuse, the contribution by Caldwell (2020) addresses the mechanisms underlying the "ratchet effect" (Tennie, Call, & Tomasello, 2009; Tomasello, 1999), which is postulated to account for the accumulation of knowledge and skills by cultural transmission based on social learning and teaching. The defining criteria of this mechanism are that solutions to a given problem produced by later generations are quantifiably better than solutions of earlier generations because benefits from social learning stack up over multiple generations. The role of "cumulative cultural evolution" is central to contemporary debates in cultural evolution, particularly the extent to which it underpins the uniqueness of human culture and its existence in non-human animal culture (Mesoudi & Thornton, 2018). With a specific focus on the challenges and opportunities involved in investigating cultural evolution experimentally, Caldwell emphasizes how characteristics of cumulative culture can be operationalized. Studies adopting these design criteria demonstrate, for instance, that learning from social learners is more valuable than learning from naïve explorers, even when the information is transferred in a nonsocial context (Caldwell & Millen, 2008), and help to identify the conditions under which interactive teaching is more effective (Caldwell & Millen, 2009).

2.2. Language as a test case

While the language faculty is a key cognitive mechanism, grounded in biologically evolved capacities, the individual language(s) we speak are a product of social learning and hence a cultural phenomenon. This position at the intersection of culture and cognition renders language an ideal test case of cultural evolution. The remainder of the papers collected here therefore focus on language per se or on linguistic tools such as graphic codes or systems of kin terms. In the field of language evolution, the idea is gaining ground that, rather than brain mechanisms evolving to support language, it is language that evolves adapting to cognitive constraints (e.g., Christiansen & Chater, 2008; Christiansen & Kirby, 2003; Tamariz & Kirby, 2016). Two papers in particular address the question of which *specific* constraints drive the evolution of language, and how these drivers operate in language learning and in language use among individuals and over generations.

Smith (2020) gives an excellent overview on research in language evolution, in which he discusses several recent models of how linguistic systems and the cognitive capacities involved in language learning may have co-evolved. Studies using artificial miniature languages and transmission chains reveal that combined pressures on language learning (with a bias toward simplicity) and communication/use (with a bias toward expressivity) produce compositionally structured languages. A general implication arising from this work is that, once in place, a (culturally transmitted) communication system creates new

selection pressures on the capacity for acquiring these systems. Models differ, however, in the assumed scope, rigidness, and details of these constraints. The precise relationship between evolved individual biases and the structure of linguistic systems therefore depends on how strongly cultural evolution masks or unmasks cognitive biases from selection, and this relationship need not be identical for different aspects of the linguistic system.

The relevance of learnability-driven linguistic structure is also highlighted in the paper by Isbilen and Christiansen (2020). They focus on a fundamental challenge in language processing, namely the *Now-or-Never bottleneck* (Christiansen & Chater, 2016b), which arises from the transient nature of linguistic input. Since spoken language is sequential, fast, and short-lived, a listener needs to code and store incoming information immediately before it is overwritten by subsequent information. Rapid compression and recoding of incoming sensory information into discrete units or chunks, which are then passed on to the next higher level of representation, is the key mechanism helping the system to cope with this fundamental challenge. In so doing, *Chunk-and-Pass processing* also constrains the evolution of language: Linguistic structures evolve so as to become more easily chunkable, and the reuse of chunks increases their stability and proliferation (Isbilen & Christiansen, 2020).

2.3. Constraints on culturally evolved cognitive tools

Two papers in this collection focus on culturally evolved cognitive tools that display properties of cumulative cultural evolution: writing and kinship systems. Both are predicated on a capacity for symbolic language, and both display intriguingly bounded diversity cross-culturally and through history, hinting at constraints on forms that may be a product of cognitive processes.

The invention of writing, which is considered a paradigmatic instance of both cultural neural reuse and cultural exaptation (d'Errico & Colagè, 2018; Dehaene & Cohen, 2007; Dehaene, Cohen, Morais, & Kolinsky, 2015), also produced one of the most powerful tools boosting cumulative culture (Huettig & Mishra, 2014): the transmission of knowledge across space and time on a grand new scale. This specific function (i.e., asynchronous communication) is just one of several possible functions of graphic codes, as Morin, Kelly, and Winters (2020) state, yet the most challenging one. They propose a typology of graphic codes depending on how productive and how independent of natural language they are, in which writing is the only type of graphic code powerful enough to encode novel information in a productive way. While writing is necessary for achieving asynchronous communication, it is not sufficient. To compensate for the lack of common ground and of opportunities for repair in asynchronous communication, pragmatic skills on the part of the communicator are also required, and this may be one reason for the relatively slow evolution from the first graphic representations to full-fledged literacy.

The tools explored by Rácz, Passmore, and Jordan (2020) are the social and cognitive semantic systems that human societies use to organize kin relations: kinship terminologies. All societies have categories of kin relations that differ along dimensions of age,

gender, generation, and connecting relatives, and are potentially far more variable than yet observed ethnographically. The authors explore hypotheses about the constraints on the complexity of kinship categories from learning theories and social pressures. Using global cross-cultural data and methods that account for shared historical and neighbor influence, they test the impact of a community-size-driven learning bottleneck against the social coordination demands of different kinds of marriage and resource systems. While cognitive scientists have modeled the learnability frontier as a driver on kinship system diversity (Kemp & Regier, 2012), Rácz and colleagues probe the constraints on these semantic systems stemming from the social organization of the cultural group itself. Most variation in their measure of complexity is explained by shared language family history and marriage rules, and these "macro-evolutionary" drivers can be seen as placing different kinds of constraints on the shape of kinship systems.

3. Conclusion

In this special issue, we intended to bring to the attention of cognitive scientists the important complementary theories and methods developed and progress made in cultural evolutionary studies in recent years. While synthetic overviews of the field are available (for a recent overview written for psychologists, see Mesoudi, 2017), we solicited largely empirical studies that demonstrated the cultural evolution of cognition "in action." We are also grateful to Kim Sterelny, a philosopher of cultural evolution, for his commentary on the collection as a whole (Sterelny, 2020). Sterelny draws out common themes in the papers: coevolution, language, cumulative culture, and testability. He highlights, in particular, the growing body of evidence for a positive feedback phenomenon in hominin cultural evolution: Communities made up of individuals with increased cognitive capacities also create selection pressures for further cognitive sophistication. That said, Sterelny also identifies that progress on this issue is piecemeal and uncertain, potentially because (unlike, e.g., in social or developmental psychology) there has been little cross-border empirical work between cognitive psychology and research on cultural evolution. With the papers collected in this issue, we hope to have brought a thought-provoking set of studies to the table.

Acknowledgments

This work was supported by the Research Council of Norway through the SFF *Centre for Early Sapiens Behaviour* (SapienCE), project number 262618. The special issue began life as a symposium for the 38th Annual Conference of the Cognitive Science Society 2016 in Philadelphia and was subsequently elaborated into a proposal for submission to *Topics in Cognitive Science.* Sieghard Beller was one of the initial organizers, and active both in launching the special issue and as an editor for submissions. Although he did not live to see it completed, his thoughtful insight on the project was invaluable, and we hope he would have been pleased with the collection.

Note

1. The topic emerged out of a symposium for the *38th Annual Conference of the Cognitive Science Society* (Beller et al., 2016).

References

Beller, S., & Bender, A. (2008). The limits of counting: Numerical cognition between evolution and culture. *Science*, *319*, 213–215.

Beller, S., Bender, A., Caldwell, C. A., Christiansen, M. H., Overmann, K. A., & Smith, K. (2016). The cultural evolution of cognition. In A. Papafragou, D. Grodner, D. Mirman, & J. C. Trueswell (Eds.), *Proceedings of the 38th annual conference of the Cognitive Science Society* (pp. 43–44). Austin, TX: Cognitive Science Society.

Bender, A. (2019). The role of culture and evolution for human cognition. *Topics in Cognitive Science*, https://doi.org/10.1111/tops.12449 [online publication ahead. of print].

Bender, A., & Beller, S. (2014). Mangarevan invention of binary steps for easier calculation. *Proceedings of the National Academy of Sciences*, *111*, 1322–1327.

Bender, A., & Beller, S. (2019). The cultural fabric of human causal cognition. *Perspectives on Psychological Science*, *14*, 922–940.

Blute, M., & Jordan, F. (2018). The evolutionary approach to history: Sociocultural phylogenetics. In R. Hopcroft (Ed.), *Oxford handbook of evolution, biology, and society* (pp. 25621–25642). New York: Oxford University Press.

Brooks, A. S., Yellen, J. E., Potts, R., Behrensmeyer, A. K., Deino, A. L., Leslie, D. E., . . . Whittaker, S. (2018). Long-distance stone transport and pigment use in the earliest Middle Stone Age. *Science*, *360*, 90–94.

Caldwell, C. A. (2020). Using experimental research designs to explore the scope of cumulative culture in humans and other animals. *Topics Cognitive Science*. https://doi.org/10.1111/tops.12391

Caldwell, C. A., & Millen, A. E. (2008). Experimental models for testing hypotheses about cumulative cultural evolution. *Evolution and Human Behavior*, *29*, 165–171.

Caldwell, C. A., & Millen, A. (2009). Social learning mechanisms and cumulative cultural evolution: Is imitation necessary? *Psychological Science*, *20*, 1478–1483.

Christiansen, M. H., & Chater, N. (2008). Language as shaped by the brain. *Behavioral and Brain Sciences*, *31*, 489–558.

Christiansen, M. H., & Chater, N. (2016a). *Creating language: Integrating evolution, acquisition and processing*. Cambridge, MA: MIT Press.

Christiansen, M. H., & Chater, N. (2016b). The Now-or-Never bottleneck: A fundamental constraint on language. *Behavioral and Brain Sciences*, *39*, e62.

Christiansen, M. H., & Kirby, S. (2003). Language evolution: Consensus and controversies. *Trends in Cognitive Sciences*, *7*, 300–307.

Colagè, I., & d'Errico, F. (2020). Culture: The driving force of human cognition. *Topics Cognitive Science*. https://doi.org/10.1111/tops.12372

Coolidge, F. L., & Overmann, K. A. (2012). Numerosity, abstraction, and the emergence of symbolic thinking. *Current Anthropology*, *53*, 204–225.

Dediu, D., & Levinson, S. C. (2013). On the antiquity of language: The reinterpretation of Neandertal linguistic capacities and its consequences. *Frontiers in Psychology*, *4*(397), 1–17.

Dehaene, S., & Cohen, L. (2007). Cultural recycling of cortical maps. *Neuron*, *56*, 384–398.

Dehaene, S., Cohen, L., Morais, J., & Kolinsky, R. (2015). Illiterate to literate: Behavioural and cerebral changes induced by reading acquisition. *Nature Reviews Neuroscience*, *16*, 234–244.

d'Errico, F., & Colagè, I. (2018). Cultural exaptation and cultural neural reuse: A mechanism for the emergence of modern culture and behavior. *Biological Theory*, *13*, 213–227.

d'Errico, F., Henshilwood, C., Lawson, G., Vanhaeren, M., Tillier, A. M., Soressi, M., … Julien, M. (2003). Archaeological evidence for the emergence of language, symbolism, and music: An alternative multidisciplinary perspective. *Journal of World Prehistory*, *17*, 1–70.

Dunn, M., Greenhill, S. J., Levinson, S. C., & Gray, R. D. (2011). Evolved structure of language shows lineage-specific trends in word-order universals. *Nature*, *473*, 79–82.

Haun, D. B. M., Jordan, F., Vallortigara, G., & Clayton, N. S. (2010). Origins of spatial, temporal and numerical cognition: Insights from comparative psychology. *Trends in Cognitive Science*, *14*, 552–560.

Henshilwood, C. S., d'Errico, F., van Niekerk, K. L., Dayet, L., Queffelec, A., & Pollarolo, L. (2018). An abstract drawing from the 73,000-year-old levels at Blombos Cave, South Africa. *Nature*, *562*, 115–118.

Heyes, C. (2018). *Cognitive gadgets: The cultural evolution of thinking*. Cambridge, MA: Harvard University Press.

Huettig, F., & Mishra, R. K. (2014). How literacy acquisition affects the illiterate mind: A critical examination of theories and evidence. *Language and Linguistics Compass*, *8*, 401–427.

Isbilen, E. S., & Christiansen, M. H. (2020). Chunk-based memory constraints on the cultural evolution of language. *Topics Cognitive Science*. https://doi.org/10.1111/tops.12376

Jordan, F. (2011). A phylogenetic analysis of the evolution of Austronesian sibling terminologies. *Human Biology*, *83*, 297–321.

Kemp, C., & Regier, T. (2012). Kinship categories across languages reflect general communicative principles. *Science*, *336*, 1049–1054.

Kendal, R. L., Boogert, N. J., Rendell, L., Laland, K. N., Webster, M., & Jones, P. L. (2018). Social learning strategies: Bridge-building between fields. *Trends in Cognitive Sciences*, *22*, 651–666.

Laland, K. N., Odling-Smee, J., & Myles, S. (2010). How culture shaped the human genome: Bringing genetics and the human sciences together. *Nature Reviews Genetics*, *11*, 137–148.

Laland, K., Uller, T., Feldman, M., Sterelny, K., Müller, G. B., Moczek, A., … Odling-Smee, J. (2014). Does evolutionary theory need a rethink? *Nature*, *514*, 161–164.

Levinson, S. C., & Gray, R. D. (2012). Tools from evolutionary biology shed new light on the diversification of languages. *Trends in Cognitive Sciences*, *16*, 167–173.

Liebal, K., & Haun, D. (2012). The importance of comparative psychology for developmental science. *International Journal for Developmental Science*, *6*, 21–23.

Majid, A., Jordan, F., & Dunn, M. (2015). Semantic systems in closely related languages. *Language Sciences*, *49*, 1–18.

Malafouris, L. (2013). *How things shape the mind: A theory of material engagement*. Cambridge, MA: MIT Press.

Mesoudi, A. (2016). Cultural evolution: Integrating psychology, evolution and culture. *Current Opinion in Psychology*, *7*, 17–22.

Mesoudi, A. (2017). Pursuing Darwin's curious parallel: Prospects for a science of cultural evolution. *Proceedings of the National Academy of Sciences*, *114*, 7853–7860.

Mesoudi, A., & Thornton, A. (2018). What is cumulative cultural evolution? *Proceedings of the Royal Society B: Biological Sciences*, *285*(1880), 20180712.

Morin, O. (2013). What does communication contribute to cultural transmission? *Social Anthropology*, *21*, 230–235.

Morin, O. (2015). *How traditions live and die*. Oxford, UK: Oxford University Press.

Morin, O., Kelly, P., & Winters, J. (2020). Writing, graphic codes, and asynchronous communication. *Topics Cognitive Science*. https://doi.org/10.1111/tops.12386

Overmann, K. A. (2016). The role of materiality in numerical cognition. *Quaternary International*, *405*, 42–51.

Rácz, P., Passmore, S., & Jordan, F. M. (2020). Social practice and shared history, not learning biases, structure cross-cultural complexity in kinship systems. *Topics Cognitive Science*. https://doi.org/10.1111/tops.12430

Richerson, P. J., & Christiansen, M. H. (Eds.) (2013). *Cultural evolution*. Cambridge, MA: MIT Press.
Smith, K. (2020). How culture and biology interact to shape language and the language faculty. *Topics Cognitive Science*. https://doi.org/10.1111/tops.12377
Smith, K., Perfors, A., Fehér, O., Samara, A., Swoboda, K., & Wonnacott, E. (2017). Language learning, language use, and the evolution of linguistic variation. *Philosophical Transactions of the Royal Society B*, *372*(20160051), 1–13.
Sterelny, K. (2006). The evolution and evolvability of culture. *Mind and Language*, *21*, 137–165.
Sterelny, K. (2020). Afterthoughts. Tough questions, hard problems, incremental progress. *Topics Cognitive Science*. https://doi.org/10.1111/tops.12427
Tamariz, M., & Kirby, S. (2016). The cultural evolution of language. *Current Opinion in Psychology*, *8*, 37–43.
Taylor, A. H., & Gray, R. D. (2014). Is there a link between the crafting of tools and the evolution of cognition? *Wiley Interdisciplinary Reviews: Cognitive Science*, *5*, 693–703.
Tennie, C., Call, J., & Tomasello, M. (2009). Ratcheting up the ratchet: On the evolution of cumulative culture. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *364*, 2405–2415.
Thompson, B., Kirby, S., & Smith, K. (2016). Culture shapes the evolution of cognition. *Proceedings of the National Academy of Sciences*, *113*, 4530–4535.
Tomasello, M. (1999). *The cultural origins of human cognition*. Cambridge, MA: Harvard University Press.
Tomasello, M., Carpenter, M., Call, J., Behne, T., & Moll, H. (2005). Understanding and sharing intentions: The origins of cultural cognition. *Behavioral and Brain Sciences*, *28*, 675–691.
Whiten, A., Caldwell, C. A., & Mesoudi, A. (2016). Cultural diffusion in humans and other animals. *Current Opinion in Psychology*, *8*, 15–21.

Papers in this topic

Beller, S., Bender, A., & Jordan, F. (2020). Editors' review and introduction: The cultural evolution of cognition. *Topics Cognitive Science*, *12*(2), 644–653.
Caldwell, C. A. (2020). Using experimental research designs to explore the scope of cumulative culture in humans and other animals. *Topics Cognitive Science*, *12*(2), 673–689.
Colagè, I., & d'Errico, F. (2020). Culture: The driving force of human cognition. *Topics Cognitive Science*, *12*(2), 654–672.
Isbilen, E. S., & Christiansen, M. H. (2020). Chunk-based memory constraints on the cultural evolution of language. *Topics Cognitive Science*, *12*(2), 713–726.
Morin, O., Kelly, P., & Winters, J. (2020). Writing, graphic codes, and asynchronous communication. *Topics Cognitive Science*, *12*(2), 727–743.
Rácz, P., Passmore, S., & Jordan, F. M. (2020). Social practice and shared history, not learning biases, structure cross-cultural complexity in kinship systems. *Topics Cognitive Science*, *12*(2), 744–765.
Smith, K. (2020). How culture and biology interact to shape language and the language faculty. *Topics Cognitive Science*, *12*(2), 690–712.
Sterelny, K. (2020). Afterthoughts. Tough questions, hard problems, incremental progress. *Topics Cognitive Science*, *12*(2), 766–783.