Archetypes are a poor primitive for a theory of mental representations

Ryutaro Uchiyama & Michael Muthukrishna

Department of Psychological and Behavioural Science, London School of Economics and Political Science, London, United Kingdom

Few thinkers have entered our collective consciousness as much as Freud and Jung. Most modern psychologists could only dream of such staying power. Becker and Neuberg argue that Jung's plumbing of the human mind and his description of archetypes may be more than Western woo. They draw on cognitive, evolutionary, and developmental science to make their case. Here we tackle two questions: (1) Were Jung's archetypes correct in some way? And (2) Are Jungian archetypes a useful theoretical approach? Our answer to the first is possibly, and the second, probably not. To this end, we present an alternative approach to developing a theory of mental representations.

Jungian archetypal representations such as the Child and the Caretaker or Leaders and Followers do seem to prima facie map onto fundamental adaptive motivations of mating, childcare, and social status. And some archetypes are more relevant than others during different stages of development, such as the Caretaker during infanthood and the Mate and Rival post-puberty. As Becker and Neuberg argue, such archetypes are useful labels for these cross-cultural, and even cross-species, aspects of life. Various subdisciplines in the psychological, behavioural, and biological sciences have uncovered details about these developmental domains and stages that may have led to reliably developing representations for various roles, relationships, and patterns of behaviour that match these particular challenges. So in some sense, Jung was onto something in his suggestion of fundamental archetypes, and these arguably map onto our emerging scientific understanding. What is less clear is whether Jung

was somehow more perceptive in his identification of these patterns compared to other philosophers and cultural commentators. Can a Jungian approach provide more insight or are the archetypes themselves tapping into something more fundamental than Seneca (Seneca & Campbell, 1969), Marcus Aurelius (Aurelius, 1942) or other Stoics on moral psychology or the psychology of relationships? Or Sun Tzu (Tzu, Giles, & Evans, 2017) or Machiavelli's (Machiavelli, 2018) discussions on cooperation and conflict? Or in modern times, Tobias' (1993) 20 Master Plots or even the crowd-sourced and eerily accurate TV Tropes (tvtropes.org) that pervade our modern storytelling? One could make a similar case that these examples also provide a window into human life with an ontology that maps onto our scientific understanding. But while Jung and these other thinkers may provide inspiration or even insight, they are an unprincipled and poor primitive for developing a theory of mental representations. This is especially apparent when compared to alternative approaches that build theory from first principles.

The idea that genetically evolved biases channel our mental representations toward particular forms that correspond to recurring socio-ecological challenges is a reasonable proposal. Particularly so if the alternative is a 'blank slate' argument that insulates learning processes from any content-biases that can be shaped by forces like natural selection. However, there are many theories that explain the same phenomena, including the recent cognitive, evolutionary, and developmental approaches that Becker and Neuberg map onto the Jungian archetypes. It's not clear what a Jungian perspective predicts on top of these theories, beyond identifying some ambiguously specified psychological domains with little precision, or merely suggesting the existence of reliably emerging motifs.

As an example of an alternative, more mature theoretical approach that goes beyond the Jungian thesis, consider Dual Inheritance Theory (Boyd & Richerson, 1985a; Cavalli-Sforza & Feldman, 1981; Chudek, Muthukrishna, & Henrich, 2015; Henrich, 2016; Russell &

Muthukrishna, 2018). As Muthukrishna and Henrich (2019) argue, the use of formal theory and theoretical frameworks that connect and build on other theories, themselves built from first principles and grounded in the models of evolutionary biology, allows for more precise predictions and additional constraints on both the questions we ask and the way we answer them. They allow us to tackle science as an abductive challenge and move toward more general theories of human behavior.

A seminal theory in the Dual Inheritance Theory framework is captured by a model of when natural selection favors social learning over both genetically encoded solutions and trial and error learning (Boyd & Richerson, 1985a; expanded and built on by others, including Aoki & Feldman, 2014; Hoppitt & Laland, 2013; Nakahashi, Wakano, & Henrich, 2012). This autocorrelational model explores how the strength of environmental similarity between generations affects the solution space. To summarize the gist of the predictions, when the environment is highly stable, phenotypes encoded in genes provide the most efficient solution to these long standing problems. These solutions may take the form of instincts, cognitive biases, or physical phenotypes. For example, skin color is a genetically specified phenotype that correlates highly with your ancestors' exposure to sunlight. The UV radiation in sunlight is necessary for synthesizing Vitamin D, but it also causes skin cancer. Darker skin lowers the risk of skin cancer and lighter skin increases Vitamin D synthesis; the optimal skin color depends on the amount of sunlight, which correlates with geographic latitude (Jablonski & Chaplin, 2010). Because latitude is an environmental variable that was more or less stable for your ancestors generation-to-generation, a genetic solution was the best solution to sunlight[1]. At the other extreme, when the environment is highly unstable and there is little correlation across generations, each generation is left to fend for itself and discover new solutions through

[1] The modern mismatch through increased migration leads to cultural solutions such as sunscreen among fairer skinned Australians and Vitamin D supplementation among darker skinned Europeans.

individual trial and error learning. Imagine that the food your parents ate is no longer available to you and you had to discover a whole new diet. However, between these extremes lies a 'Goldilocks' zone of environmental variability, where the changes are correlated with generations. In this intermediate zone, parents and grandparents tend to possess knowledge from the past that is applicable to the present. Here cultural learning from previous generations is favoured over both genetic solutions and individual exploration (and indeed these were the conditions in which our ancestors emerged; Martrat et al., 2007; Richerson & Boyd, 2000a, 2000b).

An extended network of connected formal theories has underscored not only learning from cultural models, but also the importance of having multiple cultural models from which to learn. These models have focused on the effect of the number of models on the cultural transmission process (Enquist, Strimling, Eriksson, Laland, & Sjostrand, 2010; Henrich, 2004; Muthukrishna, Shulman, Vasilescu, & Henrich, 2013; Powell, Shennan, & Thomas, 2009) and the many social learning biases that affect how to select among these models (for a review, see Chudek et al., 2015; Kendal et al., 2018; Rendell et al., 2011). New theories building on others have connected these learning processes to brain evolution and life history (Muthukrishna, Doebeli, Chudek, & Henrich, 2018; and tested these predictions among other taxa: Fox, Muthukrishna, & Shultz, 2017). As part of the model of the Cultural Brain Hypothesis, Muthukrishna, et al. (2018) have argued that a cooperative breeding social structure with many alloparents caring for children may have been an ideal environment for the evolution of social learning biases. Such an environment would provide easy access to multiple cultural models from whom to learn. Children could select cultural models based on skill rather than availability and thus begin to develop a suite of strategies to distinguish more and less skilful individuals.

It is entirely plausible that children have a reliable mental representation of a caretaker, and that as they reach puberty they have an unlearned desire to find a mate and fight off rivals. Jungian archetypes may suggest this much, but don't offer much more. Based on the predictions of the previously discussed formal models under a dual inheritance theoretical framework, we may predict that children are prepared to mentally represent not just a Caretaker but an entire village of alloparental caretakers, including their relative skills or success. Or that while parental investment theory's (Smith, 1977; Trivers, 1972) logic for sex differences in mating may in fact lead to representations of Mates and Rivals, we may also expect that same logic to interact with our norm psychology (Chudek & Henrich, 2011) and allow for mental representations that correspond to a variety of mating structures, from polygyny to monogamy (Henrich, Boyd, & Richerson, 2012) to polyandry, the latter perhaps with partible paternity (the belief that a child may have multiple fathers through multiple acts of sexual intercourse; Walker, Flinn, & Hill, 2010) or even more unusual arrangements that rely on care by uncles, but not fathers (Hua & Stainton, 2003). We may predict the conditions and the evolutionary processes that can lead to these different solutions, as well as how the multiple constraints imposed by the logic of parental investment theory and other selection pressures (such as resource availability or competition with other groups) shape the mental representations of mates and rivals within these societies. That is, fundamental motivations linked to parental investment theory and the resulting representations of mates and rivals still play out, but cultural evolution can find novel solutions within these constraints and in turn shape our mental representations. And these cultural solutions can have deep implications (e.g., testosterone regulation—reducing male testosterone among married men in a normatively monogamous society, but less so in a normatively polygynous society; Muller, Marlowe, Bugumba, & Ellison, 2009).

Jung's theory of archetypes was proposed as an explanation for, among other things, the enigmatic recurrence of motifs in the mythology and artwork of diverse, geographically isolated groups. Jung's explanation was based on common phylogenetic origin: he believed that particular mental representations are shared among human groups due to their emergence in a common ancestor far back in prehistory. He was quite explicit in his attribution of this continuity to something akin to genetic inheritance, for example when he discusses how archetypes are "'primordial' images in so far as they are peculiar to whole species, and if they ever 'originated' their origin must have coincided at least with the beginning of the species… This specific form is hereditary and is already present in the germ-plasm." (Jung, 2003, p. 11). Like Freud, Jung was interested in the deep historical trajectory of human mental organization, and so both these figures were in some sense early investigators of cognitive evolution and pioneers in considering evolutionary history within the psychological domain (e.g., Freud, 1938). But neither of them understood anything close to what we know today about evolution, both genetic and cultural.

A mental representation that corresponds to a persistent socio-ecological challenge, need not necessarily arise from genetic selection. To make this case, one would need to know more about the phylogenetic history of the challenge. Culture can generate and disseminate adaptive solutions at a more rapid pace than genes are able to (Boyd & Richerson, 1985b), and unless one chooses to adhere to a strict nativist view of the mind (Fodor, 1975)—which is for the most part incompatible with many of the recent theoretical advances that Becker and Neuberg marshal for support in any case—there is no reason to assume that some archetype-like mental representations cannot be inherited through cultural transmission. In humans, cultural transmission is responsible for much of the psychological variation that we observe across societies (Henrich, Heine, & Norenzayan, 2010; Muthukrishna, et al., 2018), but may also be responsible for commonalities.

Various domains of human psychology demonstrate cross-cultural variation and commonalities, including susceptibility to visual illusions (McCauley & Henrich, 2006; Segall, Campbell, & Herskovits, 1966), spatial distribution of visual attention (Masuda & Nisbett, 2001, 2006), color perception (Regier & Kay, 2009) and patterns in color classification (Gibson et al., 2017), mental coding of spatial coordinates (Majid, Bowerman, Kita, Haun, & Levinson, 2004), folk-biological reasoning (Atran et al., 2001; Medin & Atran, 2004), theory of mind (Heyes & Frith, 2014; Lillard, 1998), and interpersonal causal attribution (Choi, Nisbett, & Norenzayan, 1999). Many of these examples are 'low-level' psychological domains that had previously been assumed to be innate and universal, but this theoretical position has been to a large extent the consequence of sweeping inferences that were made on the basis of experimental samples that have usually been limited to university students in Western, educated, industrialized, rich, democratic ('WEIRD') countries, thereby resulting in failure to detect the significant psychological variation that exists around the world (Henrich et al., 2010). Cultural evolutionary theories offer a better explanation for this range of psychological variation than a purely genetic account, though of course genes may be shaping the fitness landscape in which culture is evolving.

One example of a prevalent mental representation that is culturally acquired is the written word: orthographic symbols were invented within just the last 5000 years or so and are thus believed to be too recent an invention for their cognitive processing to be a genetically encoded trait, despite there being a patch of neocortex that selectively responds to them (the 'visual word form area' (VWFA); McCandliss, Cohen, & Dehaene, 2003). Orthographic representations end up in the brain because this area of higher-order visual cortex—which in non-human primates and illiterate humans selectively encodes things like configurations of lines in natural scenes—learns to respond to written symbols as a result of being systematically bombarded by this class of stimuli in literate societies (Stanislas Dehaene & Cohen, 2007).

Learning to read even affects the functional and topological organization of other cortical representations such as faces (Dehaene et al., 2010), because competition for neural real estate leads to emergent developmental outcomes that are impossible to predict with intuition alone.

There is evidence from writing systems around the world that the shape of graphemes like Roman letters and Chinese logograms have adapted to match the visual statistics of natural environmental scenes (Changizi & Shimojo, 2005; Changizi, Zhang, Ye, & Shimojo, 2006). So due to a combination of cultural evolution of written symbols, innate cortical response biases in the VWFA, and domain-general cortical mechanisms of experience-dependent plasticity, mental representations of orthography are able to take shape. In this example, culture appropriates genetically inherited phenotypic traits (e.g., the innate response profile of VWFA), expanding the space of their functional possibilities into a novel domain of use (i.e., reading). The orthographic representations supported by the VWFA are socio-ecologically adaptive, at least within the societies that use them, but they are not genetically inherited. These representations do rely on genetically specified traits, but culture rather than genes is the primary domain in which the relevant phenotypic variation is generated, tested, and transferred across generations. It is cultural evolution rather than genetic evolution that is responsible for driving the new function from potentiality into existence. This is similar to the extended mating and parental investment systems that we had discussed above, but orthography is an example that gives us some amount of neurological and developmental tractability.

Mental representations for written language are flexible, adaptive, developmentally sensitive, and seemingly universal (at least when we disregard cultural sampling bias). This profile is entirely congruent with how Becker and Neuberg describe archetypes, and there is nothing about this suite of properties that we should expect to be unique to written symbols. Indeed, even for the kind of socio-cognitive representations that Becker and Neuberg endeavour to explain, there is no principled reason to assume that genetic inheritance is primary.

In the case of written symbols, cultural transmission is easy to recognize, as contemporary humans in literate societies are inundated with text—in school, in the workplace, and through various media in both our professional and private lives. The cultural source of archetype-like representations is less clear, but one possibility is through narrative. Reviewing female characters in modern horror films and ancient myths from around the world, King (2015) argues that particular character-types tend to recur, and that they embody themes and concerns that have been relevant for females at varying life historical stages over evolutionary history. He even labels these "archetypes", although not in direct reference to the work of Jung, and they include the 'Scary Young Girl', the 'Vengeful Mother', and the 'Postmenopausal Machiavellian Manipulator'. Recent analyses show us how powerful cultural transmission in the narrative domain can be: specific information or structural features in narratives can be preserved through oral retelling for durations on the order of 5000 years or so (da Silva & Tehrani, 2016; Nunn & Reid, 2016; Tehrani, 2013). This work also demonstrates the immense geographical range over which narratives can disseminate, although this may not be surprising given the time span and the human proclivity for migration. Additionally, recent ethnographic work in forager societies hints the extent to which our ancestors may have devoted their time to storytelling, which among the !Kung occupies up to 80% of their night-time conversations, typically around a fire (Wiessner, 2014). Storytelling remains a core aspect of life in most societies (Gottschall, 2012). Thus archetypes require a theoretical explanation that considers genetic and cultural evolution. These theories would and already do depart sufficiently from Jung's account that it's not clear why we should turn to Jung for anything more than inspiration. But the explanation for why we might be tempted to look to Jung may also be found in the way our brains seek information.

Our cultural brains (Muthukrishna, Doebeli, et al., 2018; Muthukrishna & Henrich, 2016) seek who to learn from; for example, those with expertise, success, or prestige. And we

seem to do this even for ancestors long gone. Evolutionary scientists often seek evidence in the words of Darwin, despite Darwin not being unique in his insights, even in his own time (consider Wallace's simultaneous discovery and the growing list of acknowledgments in each edition of *Origin of Species*), and despite the fact that we understand evolution far better than Darwin ever did. And yet, we point to originators of ideas as if they possessed special insight and then plumb their work for nuggets of hidden knowledge that perhaps the originator alone held. This Great Man view of science and history explicitly or implicitly attributes progress to the unique insights of stand-out geniuses rather than to gradual accumulation of knowledge, chance discovery, being at the right place at the right time, or recombination of existing ideas. These latter forces are more in line with what we know about how cultural evolution and innovation work from the theoretical and empirical literature, and we may even predict the factors that increase the rate and size of innovations (see Muthukrishna & Henrich, 2016). Motivations to draw upon Darwin for support or Jung for insights may be a product of our cultural-model seeking brains.

Even if Jung were somehow prescient or particularly insightful, we can acknowledge this insight but also recognize that it's not all that useful. As a comparable illustration from another discipline, physicist Leo Szilard first hypothesized nuclear chain reactions in 1933. H.G. Wells, however, had already introduced the idea with his mechanically specific portrayal of a "continuing explosive" and "atomic bombs" in his 1914 novel *The World Set Free*. This may have even inspired Szilard (Lanouette & Silard, 1992). But what it does not do is persuade nuclear physicists to draw on Well's corpus for further theoretical insight. Becker and Neuberg give no indication that Jung's ideas played any role in shaping any of the recent research that they cite as their rationale for returning to Jung. Thus Jung is arguably more like Wells than Darwin, but re-examining either of these figures is unlikely to offer more than historical curiosity.

None of this is to say that these recent developments in cognitive science, such as dynamical, embodied, sub-symbolic, and evolutionary psychological approaches do not coincide with some of the psychological principles espoused by Jung. And these recent advances are better justified than rigidly modular, symbol-manipulating, evolutionarily agnostic mental architectures. That Jungian theory is arguably consistent with these theoretical approaches while classical cognitivism is not does indeed help restore Jung's reputation, but it does not follow that he offers a guide to future research. The value of placing these recent approaches under the umbrella of Jungian archetypal theory remains unclear. If their goal was to restore Jung's reputation, Becker and Neuberg have succeeded to some extent. They may even motivate psychologists with psychoanalytic leanings to embrace contemporary evolutionary, cognitive, and developmental science. But if their goal was to use Jung as a basis for a theory of mental representations, there are better foundations.

References

Aoki, K., & Feldman, M. W. (2014). Evolution of learning strategies in temporally and spatially variable environments: A review of theory. *Theoretical Population Biology*, *91*, 3–19. https://doi.org/10.1016/j.tpb.2013.10.004

Atran, S., Medin, D., Lynch, E., Vapnarsky, V., Ucan Ek', E., & Sousa, P. (2001). Folkbiology doesn't Come from Folkpsychology: Evidence from Yukatek Maya in Cross-Cultural Perspective. *Journal of Cognition and Culture*, *1*(1), 3–42. https://doi.org/10.1163/156853701300063561

Boyd, R., & Richerson, P. J. (1985a). *Culture and the evolutionary process*. University of Chicago press.

Boyd, R., & Richerson, P. J. (1985b). *Culture and the evolutionary process*. University of Chicago Press. Retrieved from

https://books.google.co.uk/books?hl=en&lr=&id=MBg4oBsCKU8C&oi=fnd&pg=PP7&dq=culture+and+the+evolutionary+process&ots=58Q4yO8lm5&sig=-8bJvEFCLaLxyOqUlTBPq6VT8so#v=onepage&q=culture%20and%20the%20evolutionary%20process&f=false

Cavalli-Sforza, L. L., & Feldman, M. W. (1981). *Cultural transmission and evolution: a quantitative approach*. Princeton University Press.

Changizi, M. A., & Shimojo, S. (2005). Character complexity and redundancy in writing systems over human history. *Proceedings of the Royal Society B: Biological Sciences*, *272*(1560), 267–275. https://doi.org/10.1098/rspb.2004.2942

Changizi, M. A., Zhang, Q., Ye, H., & Shimojo, S. (2006). The Structures of Letters and Symbols throughout Human History Are Selected to Match Those Found in Objects in Natural Scenes. *The American Naturalist*, *167*(5), E117–E139. https://doi.org/10.1086/502806

Choi, I., Nisbett, R. E., & Norenzayan, A. (1999). Causal Attribution Across Cultures: Variation and Universality. *Psychological Bulletin*, *125*(1), 47–63.

Chomsky, N. (1980). Rules and representations. *Behavioral and Brain Sciences*, *3*(01), 1. https://doi.org/10.1017/S0140525X00001515

Chudek, M., & Henrich, J. (2011). Culture-gene coevolution, norm-psychology and the emergence of human prosociality. *Trends in Cognitive Sciences*, *15*(5), 218–226. https://doi.org/10.1016/j.tics.2011.03.003

Chudek, M., Muthukrishna, M., & Henrich, J. (2015). Cultural evolution. *The Handbook of Evolutionary Psychology*.

da Silva, S. G., & Tehrani, J. J. (2016). Comparative phylogenetic analyses uncover the ancient roots of Indo-European folktales. *Royal Society Open Science*, *3*(1), 150645. https://doi.org/10.1098/rsos.150645

Dehaene, S., Pegado, F., Braga, L. W., Ventura, P., Filho, G. N., Jobert, A., … Cohen, L. (2010). How Learning to Read Changes the Cortical Networks for Vision and Language. *Science*, *330*(6009), 1359–1364. https://doi.org/10.1126/science.1194140

Dehaene, Stanislas, & Cohen, L. (2007). Cultural Recycling of Cortical Maps. *Neuron*, *56*(2), 384–398. https://doi.org/10.1016/j.neuron.2007.10.004

Enquist, M., Strimling, P., Eriksson, K., Laland, K. N., & Sjostrand, J. (2010). One cultural parent makes no culture. *Animal Behaviour*, *79*(6), 1353–1362. https://doi.org/10.1016/j.anbehav.2010.03.009

Fodor, J. A. (1975). *The Language of Thought*. Cambridge, MA: Harvard University Press.

Fox, K. C. R., Muthukrishna, M., & Shultz, S. (2017). The social and cultural roots of whale and dolphin brains. *Nature Ecology & Evolution*, 1. https://doi.org/10.1038/s41559-017-0336-y

Freud, S. (1938). *Totem and taboo: Resemblances between the psychic lives of savages and neurotics*. Harmondsworth, Middlesex: Penguin Books.

Gibson, E., Futrell, R., Jara-Ettinger, J., Mahowald, K., Bergen, L., Ratnasingam, S., … Conway, B. R. (2017). Color naming across languages reflects color use. *Proceedings of the National Academy of Sciences*, *114*(40), 10785–10790. https://doi.org/10/cc8g

Gottschall, J. (2012). *The storytelling animal: How stories make us human*. New York: Houghton Mifflin Harcourt.

Henrich, J. (2004). Demography and cultural evolution: How adaptive cultural processes can produce maladaptive losses - the Tasmanian case. *American Antiquity*, *69*(2), 197–214. https://doi.org/10.2307/4128416

Henrich, J. (2016). The secret of our success: How learning from others drove human evolution, domesticated our species, and made us smart. Princeton University Press.

Henrich, J., Boyd, R., & Richerson, P. J. (2012). The puzzle of monogamous marriage. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, *367*(1589), 657–669. https://doi.org/10.1098/rstb.2011.0290

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world? *Behavioral and Brain Sciences*, *33*(2–3), 61–83. https://doi.org/10.1017/S0140525X0999152X

Heyes, C. M., & Frith, C. D. (2014). The cultural evolution of mind reading. *Science*, *344*(6190). https://doi.org/10.1126/science.1243091

Hoppitt, W., & Laland, K. N. (2013). *Social learning: an introduction to mechanisms, methods, and models*. Princeton University Press.

Hua, C., & Stainton, M. (2003). A society without fathers or husbands: the Na of China. *Anthropologica*, *45*(1).

Jablonski, N. G., & Chaplin, G. (2010). Human skin pigmentation as an adaptation to UV radiation. *Proceedings of the National Academy of Sciences*, *107*(Supplement_2), 8962–8968. https://doi.org/10.1073/pnas.0914628107

Jung, C. G. (2003). *Four Archetypes* (3rd ed.). London: Routledge. Retrieved from https://doi.org/10.4324/9781315722894

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*(7), 651–665. https://doi.org/10.1016/j.tics.2018.04.003

Kenrick, D. T., Neuberg, S. L., Griskevicius, V., Becker, D. V., & Schaller, M. (2010). Goal-Driven Cognition and Functional Behavior: The Fundamental-Motives Framework. *Current Directions in Psychological Science*, *19*(1), 63–67. https://doi.org/10.1177/0963721409359281

King, R. (2015). A regiment of monstrous women: Female horror archetypes and life history theory. *Evolutionary Behavioral Sciences*, *9*(3), 170–185. https://doi.org/10.1037/ebs0000037

Lanouette, W., & Silard, B. A. (1992). *Genius in the Shadows: A Biography of Leo Szilard, the Man Behind the Bomb*. New York: C. Scribner's Sons.

Lillard, A. (1998). Ethnopsychologies: Cultural Variations in Theories of Mind. *Psychological Bulletin*, *123*(1), 3–32.

Machiavelli, N. (2018). *The Art of War*. Charles River Editors. Retrieved from https://books.google.co.uk/books?id=4ptZDwAAQBAJ

Majid, A., Bowerman, M., Kita, S., Haun, D. B. M., & Levinson, S. C. (2004). Can language restructure cognition? The case for space. *Trends in Cognitive Sciences*, *8*(3), 108–114. https://doi.org/10.1016/j.tics.2004.01.003

Marcus Aurelius, E. of R., 121-180. (1942). *The meditations of Marcus Aurelius*. Mount Vernon [N.Y.] : Peter Pauper Press, [1942]. Retrieved from https://search.library.wisc.edu/catalog/999839588702121

Martrat, B., Grimalt, J. O., Shackleton, N. J., de Abreu, L., Hutterli, M. a, & Stocker, T. F. (2007). Four climate cycles of recurring deep and surface water destabilizations on the Iberian margin. *Science (New York, N.Y.)*, *317*(5837), 502–507. https://doi.org/10.1126/science.1139994

Masuda, T., & Nisbett, R. E. (2001). Attending Holistically Versus Analytically: Comparing the Context Sensitivity of Japanese and Americans. *Journal of Personality and Social Psychology*, *81*(5), 922–934.

Masuda, T., & Nisbett, R. E. (2006). Culture and Change Blindness. *Cognitive Science*, *30*(2), 381–399. https://doi.org/10.1207/s15516709cog0000_63

McCandliss, B. D., Cohen, L., & Dehaene, S. (2003). The visual word form area: expertise for reading in the fusiform gyrus. *Trends in Cognitive Sciences*, *7*(7), 293–299. https://doi.org/10.1016/S1364-6613(03)00134-7

McCauley, R. N., & Henrich, J. (2006). Susceptibility to the Müller-Lyer Illusion, Theory-Neutral Observation, and the Diachronic Penetrability of the Visual Input System. *Philosophical Psychology*, *19*(1), 79–101. https://doi.org/10.1080/09515080500462347

Medin, D. L., & Atran, S. (2004). The Native Mind: Biological Categorization and Reasoning in Development and Across Cultures. *Psychological Review*, *111*(4), 960–983. https://doi.org/10.1037/0033-295X.111.4.960

Muller, M. N., Marlowe, F. W., Bugumba, R., & Ellison, P. T. (2009). Testosterone and paternal care in East African foragers and pastoralists. *Proceedings of the Royal Society B: Biological Sciences*, *276*(1655), 347–354. https://doi.org/10.1098/rspb.2008.1028

Muthukrishna, M., Bell, A. V., Henrich, J., Curtin, C. M., Gedranovich, A., McInerney, J., & Thue, B. (2018). Beyond WEIRD psychology: measuring and mapping scales of cultural and psychological distance. *Available at SSRN 3259613*.

Muthukrishna, M., Doebeli, M., Chudek, M., & Henrich, J. (2018). The Cultural Brain Hypothesis: How culture drives brain expansion, sociality, and life history. *PLOS Computational Biology*, *14*(11), e1006504. https://doi.org/10.1371/journal.pcbi.1006504

Muthukrishna, M., & Henrich, J. (2016). Innovation in the collective brain. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*(1690), 20150192. https://doi.org/10.1098/rstb.2015.0192

Muthukrishna, M., & Henrich, J. (2019). A problem in theory. *Nature Human Behaviour*, 9.

Muthukrishna, M., Shulman, B. W., Vasilescu, V., & Henrich, J. (2013). Sociality influences cultural complexity. *Proceedings of the Royal Society B: Biological Sciences*, *281*(1774), 20132511–20132511. https://doi.org/10.1098/rspb.2013.2511

Nakahashi, W., Wakano, J. Y., & Henrich, J. (2012). Adaptive Social Learning Strategies in Temporally and Spatially Varying Environments : How Temporal vs. Spatial Variation, Number of Cultural Traits, and Costs of Learning Influence the Evolution of Conformist-Biased Transmission, Payoff-Biased Transmissi. *Human Nature (Hawthorne, N.Y.)*, *23*(4), 386–418. https://doi.org/10.1007/s12110-012-9151-y

Nunn, P. D., & Reid, N. J. (2016). Aboriginal Memories of Inundation of the Australian Coast Dating from More than 7000 Years Ago. *Australian Geographer*, *47*(1), 11–47. https://doi.org/10.1080/00049182.2015.1077539

Powell, A., Shennan, S., & Thomas, M. G. (2009). Late Pleistocene demography and the appearance of modern human behavior. *Science (New York, N.Y.)*, *324*(5932), 1298–1301. https://doi.org/10.1126/science.1170165

Ray, E., & Heyes, C. (2011). Imitation in infancy: the wealth of the stimulus: Imitation in infancy. *Developmental Science*, *14*(1), 92–105. https://doi.org/10.1111/j.1467-7687.2010.00961.x

Reali, F., & Christiansen, M. H. (2005). Uncovering the Richness of the Stimulus: Structure Dependence and Indirect Statistical Evidence. *Cognitive Science*, *29*(6), 1007–1028. https://doi.org/10.1207/s15516709cog0000_28

Regier, T., & Kay, P. (2009). Language, thought, and color: Whorf was half right. *Trends in Cognitive Sciences*, *13*(10), 439–446. https://doi.org/10.1016/j.tics.2009.07.001

Rendell, L., Fogarty, L., Hoppitt, W. J. E., Morgan, T. J. H., Webster, M. M., & Laland, K. N. (2011). Cognitive culture: theoretical and empirical insights into social learning

strategies. *Trends in Cognitive Sciences*, *15*(2), 68–76. https://doi.org/10.1016/j.tics.2010.12.002

Richerson, P. J., & Boyd, R. (2000a). Built for Speed: Pleistocene Climate Variation and the Origin of Human Culture. In F. Tonneau & N. S. Thompson (Eds.), *Perspectives in Ethology* (Vol. 13, pp. 1–45). Boston, MA: Springer US. https://doi.org/10.1007/978-1-4615-1221-9_1

Richerson, P. J., & Boyd, R. (2000b). Climate, culture and the evolution of cognition. *The Evolution of Cognition*, 329–345.

Russell, C. J. S., & Muthukrishna, M. (2018). Dual Inheritance Theory. In T. K. Shackelford & V. A. Weekes-Shackelford (Eds.), *Encyclopedia of Evolutionary Psychological Science* (pp. 1–7). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-16999-6_1381-1

Segall, M. H., Campbell, D. T., & Herskovits, M. J. (1966). *The influence of culture on visual perception*. Bobbs-Merrill.

Seneca, L. A., & Campbell, R. (1969). *Epistulae Morales Ad Lucilium:* Penguin Books Limited. Retrieved from https://books.google.co.uk/books?id=NGv8ndfpxqIC

Smith, J. M. (1977). Parental investment: A prospective analysis. *Animal Behaviour*, *25*, 1–9. https://doi.org/10/cz3mrj

Smith, L. B., Jayaraman, S., Clerkin, E., & Yu, C. (2018). The Developing Infant Creates a Curriculum for Statistical Learning. *Trends in Cognitive Sciences*, *22*(4), 325–336. https://doi.org/10.1016/j.tics.2018.02.004

Tehrani, J. J. (2013). The Phylogeny of Little Red Riding Hood. *PLoS ONE*, *8*(11), e78871. https://doi.org/10.1371/journal.pone.0078871

Tobias, R. (1993). *20 Master Plots and How to Build Them*. F+W Media. Retrieved from https://books.google.co.uk/books?id=RiTuAAAAMAAJ

Trivers, R. (1972). *Parental investment and sexual selection* (Vol. 136). Biological Laboratories, Harvard University Cambridge, MA.

Tzu, S., Giles, L., & Evans, M. (2017). *The Art of War*. Race Point Publishing. Retrieved from https://books.google.co.uk/books?id=rV3LDQAAQBAJ

Walker, R. S., Flinn, M. V., & Hill, K. R. (2010). Evolutionary history of partible paternity in lowland South America. *Proceedings of the National Academy of Sciences*, *107*(45), 19195–19200. https://doi.org/10/c6pnc5

Wiessner, P. W. (2014). Embers of society: Firelight talk among the Ju/'hoansi Bushmen. *Proceedings of the National Academy of Sciences*, *111*(39), 14027–14035. https://doi.org/10.1073/pnas.1404212111