

REVIEW ARTICLE

Four misunderstandings about cultural attraction

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Abstract

Cultural attraction theory (CAT) is a research agenda the purpose of which is to develop causal explanations of cultural phenomena. CAT is also an evolutionary approach to culture, in the sense that it treats culture as a population of items of different types, with the frequency of tokens of those types changing over time. Now more than 20 years old, CAT has made many positive contributions, theoretical and empirical, to the naturalization of the social sciences. In consequence of this growing impact, CAT has, in recent years, been the subject of critical discussion. Here, we review and respond to these critiques. In so doing, we also provide a clear and concise introduction to CAT. We give clear characterizations of CAT's key theoretical notions, and we outline how these notions are derived from consideration of the natural character of cultural phenomena (Box 1). This naturalistic quality distinguishes CAT from other evolutionary approaches to culture.

KEYWORDS

cognition, culture, cultural attraction, cultural evolution, evolution

1 | INTRODUCTION

Over the past 20 or so years, a research agenda known variously as “an epidemiology of representations,” “cultural epidemiology,” and “cultural attraction theory” (CAT)—the last label best representing the current content of the approach—has aimed to develop causal explanations of cultural phenomena; in other words, to identify the causal factors by which the microeffects of many individual moments of social and cognitive interaction scale up, over time and space, to create the macro phenomena of culture. This agenda is most closely associated with the work of Dan Sperber, but it is by now highly collective enterprise.^{1–4} CAT argues that a natural science of culture should draw inspiration from the science of medical epidemiology, in which macro phenomena, such as epidemics or proliferating addictions, are explained as the cumulative effect of the many microprocesses taking place inside and between individual members of a population and in their common environment; correspondingly, the disciplines of anthropology and psychology should have a similar, cognate relationship to one another as that which already exists in medical science, between epidemiology and pathology.^{4,5}

At the root of these claims is the observation that the cognitive mechanisms producing social transmission—most obviously those involved in communication, but others too—do not in general aim at high-fidelity copying as such. However, these mechanisms do create cultural chains of causally related events in which mental representations (beliefs, knowledge, intentions, etc) cause public productions (speech, artifacts, behavior, etc), which in turn cause further mental representations in other individuals, and so on. Because the item-to-item transformations that occur in these chains are biased (i.e., they are not wholly random), over time some items come to exhibit a degree of similarity to one another, and hence constitute relatively stable distributions of similar items in the population and its habitat. In short, they are tokens of the same cultural type. In this way, cultural stability emerges as the cumulative effect of many nonrandom (i.e., biased) transformations.^{6–9} Figures 1 and 2 provide a graphic illustration of this process.

These points have by now been developed and articulated at some length.^{2–4,10} There is also a growing body of anthropological work that has pursued CAT's research agenda empirically, that is, it

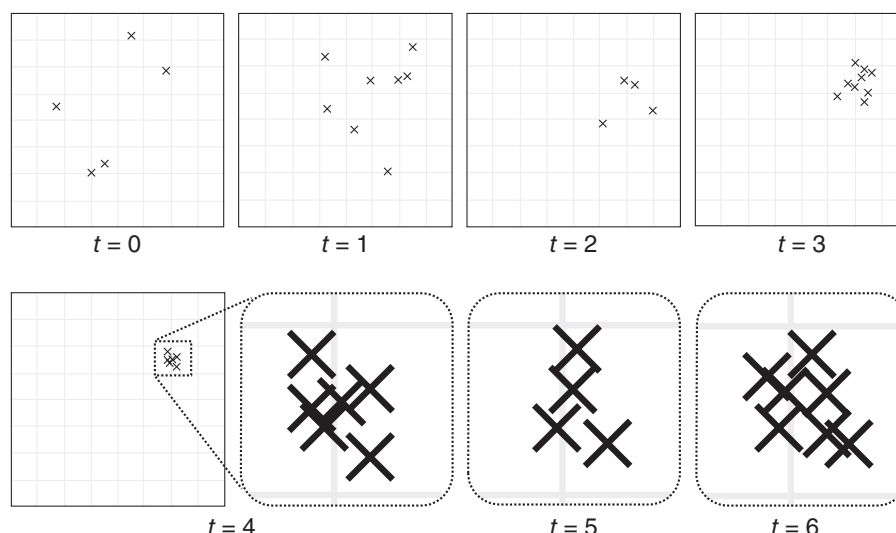


FIGURE 1 Cultural attraction. Crosses depict cultural items within a two-dimensional space of possible items, over seven different time steps. These items can be mental representations (beliefs, knowledge, intentions, etc) or public productions (speech, artifacts, behavior, etc). At each time step, the population of items can be observed to move in the direction of time steps (0–4) and then remain stable around time steps (4–6) a particular point in the space. Note that (a) the number of tokens can vary from one generation to the next and b) stabilization does not need to involve like-for-like copying: All that is required is that the tokens at one step produce, in the next time step, tokens that tend to cluster in the same portion of the overall space. (This space and the individual items could be given concrete identity for particular cases, if desired, but the main utility of this figure is to provide a general and abstract illustration for the purposes of exposition; just as is, say, the image of a fitness landscape in biological evolution, and the associated idea of hill climbing)

has aimed to document attraction so defined, and to find its causes in the microprocesses that form cultural chains. This literature covers a range of cultural domains that include both the global and

general and also the local and specific.^{11–21} In tandem with this growth, CAT has been the subject of critical discussion, especially so in recent years.^{22–31} This commentary has made a positive contribution to the literature by raising a number of important questions and challenges for CAT.

This article serves two purposes. First, we identify and respond to the main issues raised by existing critiques of CAT. We emphasize that the four particular points that contrary to some commentary are as follows: (a) attractors and attraction are statistical notions and not themselves anything concrete or causal; (b) CAT is not circular or tautological; (c) CAT's causal ontology is not limited to psychological factors alone; and (d) CAT is not the same as other approaches to cultural evolution, just dressed in different clothing. The next four sections address each of these misunderstandings in turn. In doing so, they collectively meet our second goal, which is to provide readers with a clear introduction to CAT as a means to facilitate future and further research—theoretical and empirical—that goes beyond existing critiques and misunderstandings. We use the final section to specify the key research challenges that lie ahead and to unify the various issues discussed. In particular, we conclude the article by describing, in outline, how the various theoretical notions employed by CAT (in particular attractor, attraction, and factors of attraction) are not created by fiat, but derived instead from consideration of the natural character of cultural phenomena (Box 1). In addition, this article clarifies a variety of existing confusions and misunderstandings related to a body of thought (CAT), the primary purpose of which is that it is an attempt to link together cognition and culture in a naturalistic, scientific framework.

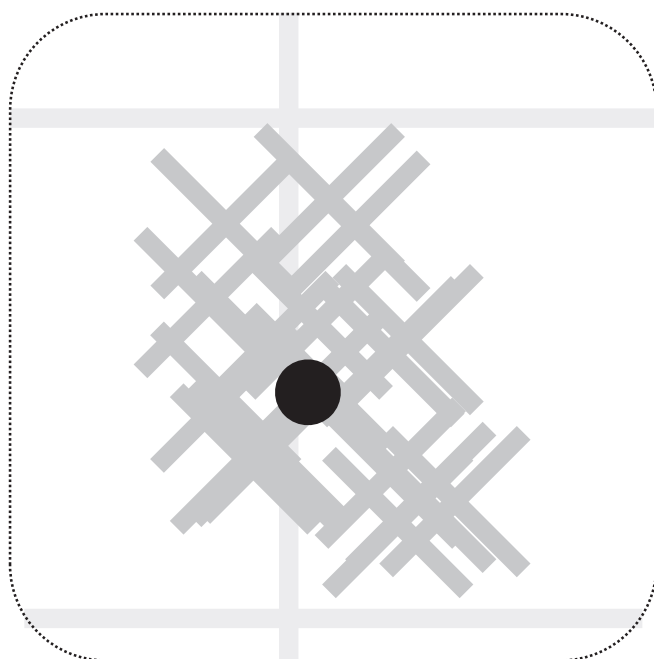


FIGURE 2 A cultural attractor. Grey crosses depict all the tokens observed at time steps 4, 5, and 6 in Figure 1, that is, after stabilization has been reached. An abstraction of what these tokens share in common—the attractor—is identified, in this two-dimensional characterization, as the mathematical centroid of the tokens, and depicted as a black circle

Box 1. Key theoretical notions for CAT

We here characterize CAT's key theoretical notions. (For further discussion see in particular Refs. 2,3,90,91.)

- *Cultural chains* (also known as cultural cognitive causal chains; see Ref. 90) are chains of causally related events in which (a) mental representations (beliefs, knowledge, intentions, etc) cause public productions (speech, artifacts, behavior, etc), which in turn cause further mental representations in other individuals, and so forth and (b) some items in the chain exhibit a degree of similarity and thus constitute relatively stable distributions of similar items in the population and its habitat, and across time and space. Cultural chains, so described, include not only the so-called "transmission chains" and "iterated learning," as described in other theoretical frameworks but also socio-cognitive events that stabilize items through rich inferential processes that cannot be reduced to copying or decoding (e.g., acquisition of word meaning, complex skills such as driving, etc.).
- *Cultural attraction*. In a web of crisscrossing cultural chains, cultural attraction is the probabilistic favoring of some types of items over others. This in turn affects the frequencies of items of different types, with some types acquiring high frequencies across time.
- *Cultural attractor*. A type of item whose frequency is relatively high and stable as an effect of cultural attraction. (See also Box 2)
- *Factors of attraction*. The factors that probabilistically bias how mental representations cause public productions (and vice versa), and which hence cause cultural attraction to occur. Factors of attraction can be in the mind (psychological) or outside it (ecological).
- *Culture*. A property, not a thing. Mental representations and public productions are cultural to the extent that their form is shaped in and by the cultural chains in which they occur.
- *Cultural token*. An individual occurrence of a type, which occurs in a cultural chain. It can be mental (such as, say, the religious beliefs of one individual at a given time) or public (such as, say, one occurrence of a ritual, or one material realization of a tool).

2 | MISUNDERSTANDING 1: ATTRACTORS ARE NOT PHYSICAL OBJECTS AND THEY DO NOT HAVE CAUSAL POWER; THEY ARE INSTEAD WHAT IS TO BE EXPLAINED

The notions of attractors and attraction have been glossed in some subtly different ways, both by cultural attractionists themselves and others too. This has led to some degree of ambiguity and misunderstanding about what exactly a cultural attractor is.²⁴ In this section, we address this issue directly, focusing in particular on the (mis)reading that attractors are physical objects, with causal effects.

Let us begin with an example. Each different rendering of the story of Little Red Riding Hood—and even more, each memory trace it leaves in the mind of all the people who have heard and remembered the tale—is, typically, slightly different from the next. However, if we abstract away from these individual instances, but keeping in focus their relative resemblance, general patterns and features can be described. In Box 2, we discuss the different degrees of granularity at which this recognition of similarity can take place.

Correspondingly, talk about "the" story of Little Red Riding Hood is, typically, talk about what all concrete instances of its telling can be seen to approximate, to some greater or lesser degree. When we speak of "Little Red Riding Hood," we refer not to an actual token of the tale, but refer to an abstracted type around which actual versions cluster. In other words, cultural items (both mental and public) are sometimes recognized as tokens of the same cultural type: different renderings, for instance, of the same tale. Specific tokens can and usually do differ from one another, but so long as the family resemblance remains, the population of cultural items can be identified as items of the same cultural type (a specific tale, dish, piece of music, word, ritual, social status, etc). When this is so, this type is an attractor. In

other words, attractors are not concrete objects, but abstractions (types) based on statistical distributions of individual items; the locus of a clustering of individual cultural items.

An attractor is similar in this respect to, say, life expectancy, which is also an abstraction based on a statistical distribution; or, to take another example, a center of gravity. A center of gravity is not itself causally active, but the identification of a center of gravity is hugely helpful to proper causal description of the dynamics of moving bodies. Similarly, an attractor is not itself causally active, but the identification of an attractor can be useful for the description of cultural dynamics and for their subsequent causal analysis. Centers of gravity, life expectancies, and cultural attractors do not by themselves provide causal explanation, but all provide explanatory purchase on their relevant domains of enquiry; claims about what is and is not a cultural attractor, about where a center of gravity is, or about a population's average life expectancy—these are all empirical claims that can be disputed by the provision of relevant data. One well-known example is the much discussed idea that supernatural entities tend to have the character of being minimally counterintuitive to human minds.^{13,32}

So no particular telling of Little Red Riding Hood—or indeed any cultural item—is an attractor and nor can it be; but an accurate statistical abstraction of the tale, derived from multiple actual tellings, is. Of course, a particular token can correspond very closely or even exactly to the abstracted version, but that still does not make the token an attractor. The attractor is the abstracted type, of which the particular token is but one manifestation. Identification of an attractor is, correspondingly, a matter of empirical discovery and description. Quite often attractors can be identified by members of the relevant cultural group themselves, as in the case of Little Red Riding Hood. At other times, deeper observation and analysis are required. Grammars, for instance, are often opaque even to those that hold them (native

Box 2. On the granularity of cultural description

Like any other object of scientific enquiry, culture can be described at many “different” levels of detail and granularity. For instance, two different tellings of Little Red Riding Hood might be described as “the same” as one another, or different, depending on what the observer is focused on. In some versions of the tale the antagonist is a fox, while in others the antagonist is a bear.³³ Two versions of the tale, one with a fox and one with a bear, might be described as “the same” if the observer is focused on the broad outline of the plot, but as “different” if the observer is focused on details such as the identity of the main characters. And of course, no two tellings are ever utterly identical: there will, at the very least, be physical differences in, say, the exact vocal pitch used. So what, then, is the appropriate level of description for causal description of cultural phenomena? CAT tends to highlight finer-grained descriptions than other, related approaches.²²

As we have said, CAT aims at natural, causal description of cultural phenomena. This requires identification of the various factors that shape and stabilize culture (Refs. 2,4,90,91; see also Misunderstanding 2). The signature of a given factor is the biased transformations that it induces, and so the scientist with a hypothesis that, say, the relative frequency of different animals in the local environment is a causal factor in the cultural evolution of folktales, requires, as a way to test this hypothesis, data about the relative frequency of different types of antagonists in Little Red Riding Hood. If, on the other hand, she has no such hypotheses or is focused on a different aspect of folktales, such information may be redundant. In short, description of cultural phenomena needs to be specific enough to differentiate between the signature effects of different possible causal factors, that is, the biased transformations that the hypothesized causal factors induce. Consequently, if all variants of Little Red Riding Hood—or indeed any cultural item— are subsumed under a single description, we potentially lose the ability to identify important causal factors.

Of course, the right level of granularity for any given case depends on the specific question at hand. Random variation of vocal pitch is unlikely to play any significant role in explaining the cultural success of a given folktale. In contrast, attraction toward portraits with direct—rather than averted-gaze;¹⁹ toward vertical and horizontal lines in the design of orthographic systems;⁹² toward the collocation of blood and action in medical treatments;¹⁸ toward procedural rather than realist interpretations of the infinitesimal in the evolution of calculus;⁹³ or toward misquotations with words more memorable than those in the original quote⁹⁴—with this short list we are highlighting just a small handful of the numerous empirical studies inspired by CAT—are all types of biased transformation that have effects at the cultural level, and whose effects can only be detected with relatively fine-grained description of the relevant data.

speakers of a language are rarely able to describe its grammatical rules in any detail). So too for many other cultural phenomena. Even if they do much use the terminology of cultural attraction themselves, it is one of the primary, self-set goals of both ethnography and linguistics to identify and describe cultural attractors in as much detail and richness as possible. Cultural attractors can, of course, appear, disappear, or change overtime; some cultural evolutionary research aims to identify and track historical changes in the attractors themselves (e.g., the example of Little Red Riding Hood³³).

Since attractors are statistical abstractions, their identification does not and cannot do any explanatory work in and of itself. Attractors do not have causal powers, and in particular they do not literally “attract” anything. The notion of an attractor is, to repeat, a descriptive notion, and as such what identification and description of an attractor does is provide a (hopefully) helpful description of what needs to be explained (“attractors and the process of attraction... do not provide explanations of cultural phenomena,”² [p. 7]). A proper causal explanation can come only from identification of the factors that produce attractors. In other words, CAT claims that to explain the frequency and stability of cultural items requires documenting the biased transformations that produce them (the cumulative effect of which is called attraction) and the causes of those transformations (called factors of attraction).

Cultural attraction, so defined, is not a deterministic notion, but a probabilistic one.^{2,6} In the study of dynamical systems, such as in

physics and applied mathematics, attraction is usually (not always, but usually) modeled in a deterministic way. If this approach were adopted to model cultural attraction, it would imply that no line of descent ever moves in any direction other than toward its attractor, and hence that attractors are metaphorical black holes: nothing ever escapes from them. This is clearly not the case in the cultural domain. Here attraction is *probabilistic*, and CAT is, correspondingly, a theory not about the evolution of a *system* toward one attractor but about the evolution of a *population* of cultural items that tends toward clustering, but which also involves some degree of stochasticity.³⁴ There are many types of things that have been called “attraction” in the world (gravitational, sexual, phonological, etc). “Cultural attraction” is a notion more specific and precise than the vague commonsense idea of attraction and less formal than that employed in dynamical systems theory. It is simply a descriptive term developed to help study culture from a naturalistic point of view.

3 | MISUNDERSTANDING 2: CULTURAL ATTRACTION THEORY IS NOT CIRCULAR

As we say, attractors are not themselves explanations. They are what is to be explained.

This fact has caused some readers to criticize CAT for being circular or tautological. Specifically, it has seemed, for some readers, that

for a cultural type to be an attractor its tokens must be frequent, stable, and long-lasting within a population, and that the frequency, stability, and longevity of cultural items are explained in terms of the fact their likeness to an attractor. We have often heard versions of this view expressed in person, and several versions of it exist in print. Here are two specific examples: "there is a certain tautology here,"³¹ [p. 102]); and, more elaborately and explicitly *to call a fashion or a custom a cultural attractor... simply repeats the fact that certain kinds of cultural representation are stably and frequently transmitted... The(se) models represent the consequences of transmission biases but they explain nothing about the sources of those biases.*²¹ (p. 848)

These worries are very reminiscent of a concern sometimes expressed about the theory of natural selection and the corresponding notion of "fitness." What is fit? Organisms that survive. Which organisms survive? Those which are fit. Karl Popper expressed this view:

The trouble about evolutionary theory is its tautological, or almost tautological, character: the difficulty is that Darwinism and natural selection, though extremely important, explain evolution by the "survival of the fittest" (...). Yet, there does not seem to be much difference, if any, between the assertion "those that survive are the fittest" and the tautology "those that survive are those that survive." For we have, I am afraid, no other criterion of fitness than actual survival, so that we conclude from the fact that some organisms have survived that they were the fittest, or those best adapted to the conditions of life.³⁵ (p. 242)

This is, of course, just a high-profile example of a historically common worry about evolutionary theory. The matter has by now been addressed often and with near unanimity. Here is one version of the rebuttal:

No reputable biologist accounts for an evolutionary development (just) by asserting the principle of natural selection – as if it were enough to say "It's the survival of the fittest again." Instead, each time the concept of fitness is employed in evolutionary explanations, biologists are compelled to advance some independent, empirically vulnerable, claim about the advantage conferred by a particular characteristic under particular circumstances... (E)volutionary biologists are not in the habit of declaiming *ad nauseam* that those who survive survive.³⁶ (p. 60)

Much the same applies here. Cultural attraction theorists are not in the habit of declaiming *ad nauseam* that those distributions of cultural items that change, change (or indeed, that those that are stable, are stable)—as if it were enough to say "It's cultural attraction again". Rather, each time the concepts of attractors and attraction are employed, what is also required is some independent, empirically vulnerable claim about why the adjustments and transformations that occur in the acquisition and expression of the cultural items are likely to be biased (in a probabilistic way) in particular directions and not

others. In short, attraction is explained by specifying what factors actually cause it.

Here is a (simple) example. GM food is often opposed on grounds of health risk, despite no scientific evidence of such risk, and despite its potential to contribute to sustainable forms of agriculture.³⁷ The exact details of how this opposition is cognitively represented will (we assume) vary between individuals, but there is nevertheless enough similarity between them to justify speaking of "opposition to GM food" as a type; or, in other words, as a statistical abstraction of what actual tokens share in common. In other words, the belief that GM food is a health threat is, currently, a cultural attractor (see Section 2 and again Box 2, about the appropriate level of granularity in cultural description). The question then is What factors of attraction might cause this attractor to emerge and be stable? Answers to this question should be empirically vulnerable. One recent proposal, developed by researchers making explicit use of the insights of CAT, is that the idea of genetic modification runs counter to humans' intuitive biology in several important ways, in particular, our natural dispositions toward essentialist and teleological ways of thinking.³⁸ If this is correct, then human intuitive biology is a factor of attraction that can help to explain the existence of the attractor in question.

The above example is post hoc: it makes claims about the causality of a phenomenon (in this case, opposition to GM food) after the phenomenon has been observed. An example of a predictive claim made using the tools and insights of CAT is about historical practices in portraiture.¹⁹ Portrait sitters look either toward the viewer (direct gaze) or away (averted gaze). At the same time, it is well established that direct eye contact is especially salient and attention grabbing to humans, in comparison to averted gaze. This preference is a possible source of biased transformation in cultural chains of portrait style, which could result in a long-term, tendential trend away from averted gaze, and toward direct gaze. This is an empirically vulnerable claim about the possible existence and direction of cultural attraction.

In some cultural environments, norms exist around which type of portrait can or should be painted/drawn; this can be the case if, for instance, direct eye contact is taboo. In other cultural environments, no such norms exist, and gaze direction is free to vary. The crucial test cases are those where norms did once exist and were later relaxed. What is the trend after the relaxing? Detailed empirical study of gaze in two different portrait traditions (the European Renaissance and the Joseon dynasty in Korea) shows that there is indeed a trend toward direct gaze—both in the choices that individual painters make and in what portraits become popular.¹⁹ The trend is not so strong as to be overwhelming—it is gradual, probabilistic, and contingent—and other factors will still be at play (for instance, a preference for at least some degree of variation in gaze direction); but the empirical data are, nevertheless, clear that direct gaze enjoys a slight advantage over averted gaze (*ibid*). In the terminology of CAT, there is *attraction* toward portraits with direct gaze, caused by a psychological *factor of attraction*, specifically the human preference for direct gaze. This type of portrait is, in turn, called an *attractor*. (Following Misunderstanding 1, this does *not* mean that the portraits themselves are attractors. They are tokens of a type, and it is *the type* that is the attractor.)

As we discussed in the Introduction section of this article, the empirical literature on CAT provides many further examples still, from

domains of human life as diverse as religion, language, medicine, social stratification, economic beliefs, and so forth. In each case, there is an empirical vulnerable claim—in the aforementioned cases, about the effects of human intuitive biology on beliefs about GM technology and about how the human visual system processes faces in a way that creates a preference for portraits with direct gaze—which, when coupled with CAT's observations about the biased nature of human cultural transmission, helps to explain a population level phenomenon. Now, the specific empirical claims in these cases, or any others, may or may not be true, but that is not the point. The point is rather that the proposed explanations are based upon empirical vulnerable claims, and this fact entirely alleviates any supposed circularity.

4 | MISUNDERSTANDING 3: FACTORS OF ATTRACTION ARE NOT JUST PSYCHOLOGICAL

In both the examples given above (direct-gaze portraits and continued opposition to GM technology), cultural persistence and stability were explained, in part, by reference to psychological factors: preferential attention in one case and intuitive biology in the other. And, indeed, the idea of attraction has usually been illustrated and explored with real-world examples of this sort, where the relevant factors of attraction are psychological in character.^{13,14,17–20,32,38,39} In consequence, factors of attraction are sometimes understood to be psychological as a matter of definition, and the thesis of cultural attraction is correspondingly read as a thesis about how psychological factors affect the distribution of cultural items. This reading is, in particular, implicit almost everywhere that most other cultural evolutionists discuss attraction.^{26,27,40–45} This is not correct, although there are some understandable reasons why this reading has been a common one (see below).

So to be clear, CAT has from its inception identified not only psychological but also ecological factors as causal components of any explanation of culture. Where the phrase “factors of attraction” was first coined, the relevant subsection is entitled “Ecological and psychological factors of attraction.”⁴ (p. 113) Subsequent publications have repeatedly made the same distinction and at times even clarified possible misunderstanding: “The epidemiological approach *insists* on the fact that the causal chains of cultural distribution are... cognitive *and* ecological processes that extend over time and across populations”¹⁰ (p. cxxiv, italics added);

Factors of attraction can be of different kinds. At the most general level, they may have to do with psychological dispositions or with environmental constraints and affordances... it has never been part of the theory that factors of attraction should be exclusively cognitive.⁶ (p. 92, italics added).

The distinction here is, roughly, between factors internal to the mind of the focal individual and those external to it. Psychological factors are cognitive competencies, preferences, and dispositions and also both currently and previously held beliefs, acquired skills, know-

how, memories, and other psychological phenomena held by a host (i.e., a biological individual) that affect whether and how a cultural item is processed by that host. In other words, all those aspects of cognition that contributes to the generation, expression, acquisition, and persistence of cultural items. Such factors are many and varied. Some, such as a preference for direct eye gaze, are evolved human dispositions, with very little developmental variance. Others psychological factors are caused, to varying extents, by previous processes of enculturation and scaffolding.⁴⁶ Literary preferences, for instance, are a psychological factor that can influence the cultural evolution of literary style, and this factor is itself caused by, among other things, the previous emergence of literacy. Knowledge of how existing canoes are built is a psychological factor that can influence the cultural evolution of future innovations in canoe technology, and it is itself caused by previous instances of training and pedagogy in existing techniques.

Ecological factors are, in contrast, those factors in the shared local environment that play a role in people's mental processes and in their interactions, and which are thus relevant to cultural dynamics. Like psychological factors, they too are many and varied. They include the biological and physical environment external to the organism (food and materials) and also behaviors and artifacts, including public representations such as speech, writings, and ritual performances, through which people interact with one another. Sperber and Claidière give several specific examples:

What may cause a stew recipe to evolve is the local availability of ingredients and possible substitutes. Higher population density with the increased availability of the expertise of others buttresses folk-knowledge, protects it from the risk of drift, and allows it to complexify. Hard-to-remember narratives nevertheless reach a cultural level of distribution when writing provides an external memory. Complex calculus is much more commonly performed and has a greater cultural impact when it can be handled by computers.⁴⁷ (p. 288).

Languages provide further examples still. Language form is naturally constrained by the trade-off between simplicity (easy to learn) and utility (expressively useful);^{48–50} but many ecological factors affect it too. These include social structure (e.g., languages spoken by more people and in more diverse social environments tend to have simpler morphology), the physical environment (e.g., climate and vegetation can have subtle but real differences in the perception and production, with knock-on effects on language form), and technological innovation (both the invention of writing and, more recently, of instant messaging have caused substantive changes in language form and language use). All of these are various causes are ecological factors in the cultural attraction of languages.^{16,51}

Both types of factor, psychological and ecological, include within them a graded distinction between global and local factors (Table 1; see also Ref. 3). Strong global factors are those that apply more-or-less universally, whereas local factors are specific to a small group of individuals for a limited time. The human preference for direct gaze is a global psychological factor; literacy is not global, but it is, in the

TABLE 1 Examples of different types of factor of attraction. Factors of attraction are many and varied. Two key taxonomic distinctions are: 1) but many ecological factors (i.e., factors internal to the mind, and factors external to it) and, 2) between global and local factors. The first of these distinctions is categorical (factors are one or the other), and the second is graded (factors can be more or less global and more or less local)

	Psychological factors	Ecological factors
Global	Human preference for direct rather than averted gaze	Time taken for the earth to rotate
Local	Football team's knowledge of its own strengths and weaknesses	Prevalence of particular plant species in local environment

modern world, widespread. In contrast, one football team's shared knowledge of its own strengths and weaknesses is a local factor that can, for instance, cause the emergence and stabilization of new tactical innovations—a cultural phenomenon. The rotation of the Earth is a global ecological factor, which has a clear causal influence on, among other things, the meaning of the word “day.” The prevalence of a particular plant species in the local environment is a local ecological factor (which can influence, for instance, local medicinal techniques). As suggested earlier, most of the present literature on cultural attraction has focused on global psychological factors, but, of course, all these different types of factor can contribute to the frequency and stability of cultural items and can interplay with each other in highly contingent ways.^{46,52,53} This can in turn give rise to massive cultural diversity.

It is worthwhile to dwell a little on two particular reasons why CAT has often been (mis)interpreted as a thesis only or primarily about psychological factors, because doing so helps to situate the matter in a broader context. First, it is true that the literature on cultural attraction has provided more specific examples of psychological factors of attraction than ecological ones; moreover, these examples have tended to be global ones: evolved, universal aspects of the mind, which, because of their developmental invariance, tend to channel culture in particular directions. The two examples given in the previous section (about GM food and about portrait style) are of this type. Ecological factors have certainly not been absent from the literature, especially in the key texts—see, for instance, chapter 3 of *Explaining Culture* (first published as Ref. 5), which discusses the impact of writing on the flow of cultural information—but it is true that the idea of attraction has been most often illustrated with psychological factors and this may have influenced how the idea has been understood.

A second reason why CAT has sometimes been understood as a thesis just about the role of cognition in cultural change is that there is, indeed, some degree of inconsistency in the existing literature. One important paper in this context is Nicolas Claidière and Dan Sperber's 2007 computational model,⁶ which adopted the more narrow usage for strategic reasons, that is, as a way to engage, in a constructive and positive manner, with the modeling work of Joseph Henrich and Robert Boyd,²⁶ which used the term attraction in the same way (Sperber, personal communication; note that Claidière and Sperber pursue this strategy—of adopting the terminologies of other cultural evolutionists as a means of engagement—in some other papers too,

in particular their comments⁴⁷ on Richerson and Boyd's book, *Not By Genes Alone*⁵⁴). Some cultural attractionists, and others partially sympathetic to CAT, have used the phrase cultural attraction, or propose to use it, in the more narrow, restricted sense, to describe only the effects that evolved, universal aspects of the mind have upon the form and distribution of cultural items.^{3,22} Such factors are, after all, the most likely candidates for leaving an observable trace on long-term cultural history.³ However, ecological factors are clearly also important, and well worth studying, and that is why factors of attraction have never been defined as just psychological in character. Given the overall objective to develop causal explanations of cultural phenomena, we see no particular reason to exclude ecological factors from any definition. In fact, it would be self-defeating.

5 | MISUNDERSTANDING 4: CAT IS NOT THE SAME AS, OR A VARIANT ON, OTHER APPROACHES TO CULTURAL EVOLUTION

As we have said, the defining objective of CAT is to provide a theoretical framework for the naturalistic integration of the cognitive and the social sciences.^{2,4,55} In pursuing this goal, it finds that culture has an evolutionary character. More specifically, CAT argues that it is both ontologically correct and methodologically useful to study culture as a population of items of different types, with the frequency of types changing over time (*ibid*). In response to these points, that CAT is a broad agenda concerned with both psychological and ecological influences on culture, some other cultural evolutionists have questioned the extent to which CAT is truly different from other approaches to cultural evolution. For example: “Cultural attraction seems little different to the notion of cultural evolution presented by Cavalli-Sforza and Feldman, Boyd and Richerson, and others.”²² (p. 488).

Nevertheless, CAT theorists have insisted that there are substantive differences here. In the section, we describe three of the key reasons for this. Specifically, the next three subsections describe (a) how these two research agendas have related but ultimately different end goals; (b) the similarities and differences in the ways that CAT and these other approaches conceive of biased transformation, and how they model it; and (c) a fundamental difference of view about the nature of cultural transmission and specifically its (non)independence from cultural change. We do not claim that these are the only differences; we have chosen them just as examples to illustrate the point that there are, indeed, genuine differences of scientific substance here.

Indeed, excessive focus on the contrast between these approaches would be counter-productive. There is a balance to be struck here, between addressing what is a genuine misunderstanding on the one hand, and, on the other, giving the appearance of myopic infighting among specialists—an outcome we certainly wish to avoid. We, therefore, do not aim at exhaustive comparison, and nor do we intend to review or recapitulate the details of the arguments made for and against the different approaches (relevant discussion can be found in Refs. 2,3,6,9,22,23,26,30,41,55–62). Our goal in this section is, rather, just to show with three specific examples that CAT

is indeed different to other approaches to cultural evolution in ways that matter; and not simply, as has been suggested, a (possibly relatively minor) addendum to what has been described and discovered by other approaches.

5.1 | CAT aims at partially different goals to much other work in cultural evolution

A first difference, noted in some recent book reviews, is that the main objectives of CAT are different to those of many other cultural evolutionists.^{30,61} Some of the most pioneering individuals in cultural evolution were originally trained in biology, and close reading of their work shows that the primary goals remain biological ones, namely to use an evolutionary approach to culture to help explain human adaptation. Many important findings and insights have followed from this perspective.^{63–65} In developing this, thesis cultural evolutionists have made important contributions to the anthropological goal of explaining culture itself, albeit with more of a focus on the question of how culture contributes to biological fitness. In contrast, the main objective of CAT is to explain why cultural items take the forms that they do, regardless of whether they foster biologically adaptive behavior or not. In this respect, then, CAT has more in common with some of the traditional goals of social and cultural anthropology, that is, to explain cultural phenomena.

These two projects—explaining human adaptation and explaining cultural phenomena—are of obvious relevance to one another and, indeed, are interdependent to some significant extent. Both groups of scientists have made important contributions to both goals. Nevertheless, it is still useful, when comparing these two schools of thought, to keep in mind that they approach, frame, and interpret the relevant issues and findings from subtly different perspectives and are engaged with them for subtly different reasons.^{30,61} By way of illustration, consider this comment from Peter Richerson, in his review of Morin's book: "adaptation to local environments in time and space is... what cultural evolution is all about".²⁸ Richerson writes this because he believes that Morin has missed the point—which he has if you believe, as Richerson and many of his collaborators do, that human adaptation is indeed what cultural evolution is all about. However, that is simply not what cultural evolution is all about for Morin and other CAT theorists (not to mention some other approaches to cultural evolution too, such as memetics⁶⁶).

As a good example, consider again Morin's study of gaze direction in portraiture. To students of culture, *qua* culture, the relative prevalence of direct gaze portraits is a cultural fact and as such it is something to be explained, one way or another. In contrast, to students of human adaptation, the prevalence of direct gaze portraits relative to averted gaze portraits is (presumably) not of any particular relevance. As we discussed in the Introduction section of this article, CAT considers itself an evolutionary approach not because it aims to explain human adaptation, but instead only and exactly because it finds a populational approach to be both appropriate and fruitful for advancing the naturalistic integration of the cognitive and the social sciences.³

5.2 | On biased transformation and guided variation

As we have stressed throughout, CAT emphasizes how cultural stability is commonly achieved not through cognitive mechanisms of high-fidelity copying, but instead because tokens at one step tend to produce, in the next time step, tokens that cluster in the same portion of the overall space (see again Figures 1 and 2). Other theoretical frameworks have included these biased transformations in some of their models of cultural evolution, often using the label "guided variation"—but they theorize and treat it quite differently. Specifically, these other approaches tend to treat biased transformations as deviations from faithful copying; as, in other words, an important source of change, but not usually, if at all, as a source of stability. Stability still results, on this view, from items being copied faithfully and sufficiently often.

Putting aside the point that CAT does not accept this ontological separation of stability and change (see below), we here we stress a point made in the Introduction section of this article, that CAT does not treat biased transformation as a deviation from any supposed process of faithful copying. Biased transformation is, rather, an ordinary feature of cultural transmission; and one that is, moreover, ubiquitous, revealing, and stabilizing.^{2–4,9,55,56,62,67} It is ordinary and ubiquitous because the relevant cognitive mechanisms are rarely wholly preservative in their function or intention. It is revealing, because it is a signature effect of causal processes (see Box 2). Biased transformation is stabilizing, because, as already mentioned, it causes some cultural types to be probabilistically favored over others, with the effect that for some types tokens at one time step will tend to produce, in the next time step, tokens that tend to cluster in the same portion of the overall space (see also Figures 1 and 2).

5.3 | CAT rejects causal separation of stability and change

Inspired as they are by the analogy with biological evolution, most approaches to cultural evolution stick relatively close to the biological model, where there is a generally clear distinction between, on the one hand, the mechanisms of gene proliferation, and on the other hand, the environmental factors that determine the relative success of different genes. The first of these has the effect of ensuring (a significant degree of) long-term evolutionary stability and the second has the effect of causing directed change in gene frequencies. Most approaches to cultural evolution adopt (implicitly or otherwise) a correspondingly similar taxonomy, that is, a distinction between factors responsible for stability and factors responsible for change.^{54,68,69}

The clearest illustration of this is in formal models:

We divide the evolving system into two parts. One is the "inertial" part—the processes that tend to keep the population the same from one time period to the next... cultural inertia comes from unbiased sampling and faithful copying of models. The other part consists of the forces—the processes that cause changes in the numbers of different types of cultural variants in the population. These processes overcome the inertia and generate evolutionary change.⁵⁴ (p. 68).

The distinction here is often made just as a useful simplification, born of analytical convenience and with recognized limitations,⁵⁴ (p. 264), but it feeds through into the empirical research agenda in a substantive way, such that a great deal of attention is paid to the discovery and description of psychological mechanisms capable of “copying” at levels of fidelity high enough to sustain cultural stability, just as DNA does in the biological case.^{70–72} Some researchers have even predicted the future discovery of a cultural equivalent of DNA, that is, of a means of inheritance the proper biological function of which is exactly to replicate: “The cultural ‘Watson and Crick’... are likely to be neuroscientists, looking at how information is stored in the brain.”⁷³ (p. 9).

This distinction, between aspects responsible for stability and aspects responsible for change, in turn, motivates a research agenda in which these phenomena are essentially de-coupled, and research into the cognitive aspects of cultural evolution can proceed “through functional considerations (alone) without any commitment to mechanism,”⁷⁴ (p. 200). “(W)e can black-box the problem of how culture is stored in brains by using plausible models based on observable features that we do understand, and forge ahead,”⁵⁴ (p. 81). This approach has been highly profitable in the biological case, where it goes by the name of the “phenotypic gambit.”⁷⁵ A large part of the justification for this investigative strategy derives from the fact that there is, indeed, in the biological case, a clear causal distinction between mechanisms of gene proliferation (which ensure stability) and the environmental factors that determine the relative success of different genes (which cause directed change).⁷⁶

CAT emphasizes that *this causal separation just does not hold in the cultural case*.^{2,4,9,55,62,77,78} The mechanistic causes of stability and of change are, *in the cultural case*, and unlike the biological case, fundamentally intertwined: “cultural contents are not replicated by one set of inheritance mechanisms and selected by another, disjoint set of environmental factors – not by a long shot... the causal forces involved cannot be neatly separated into reproductive mechanisms and environmental factors.”⁶² The point is not simply that causal explanation of culture is *incomplete* without engagement in the cognitive details, it is that causal explanation is *made impossible* (or at the very least is seriously handicapped), if we maintain an unrealistic separation between processes of stability and processes of change.

Moreover, the processes at work in cultural transmission are not the same for all types of cultural items. For instance, face recognition will have a role in the transmission of mask making practices but not in the transmission of agricultural technologies. Of course, some processes are of huge relevance and pervasive importance; this is why many cultural attractionists also actively study communication, argumentation, selective trust, and other aspects of cognition, which are commonly involved in social transmission.^{79–84} However, no particular process applies in general, and there is, in consequence, no general theory of cultural transmission—just as there is no general theory of medical epidemiology. There is, rather, a variety of explanations, which may be more or less specific to the type of cultural phenomena they explain.

In addition, proper causal explanation of the emergence and stability of cultural items can only be achieved if researchers specify the particular processes at work in a given case—yet the possibility of

specific explanations of specific cultural phenomena is precluded if researchers pursue an investigative strategy in which stability and change are treated as causally separate. These are some of the key reasons why CAT theorists—while recognizing the important progress achieved with the dominant investigative framework that is adopted by most cultural evolutionists—insist that a broader framework is now needed.

6 | OUTLOOK: DEFINING AND EXPLAINING CULTURE

Commentary on CAT has encouraged CAT theorists to refine and develop their ideas in ever more detail and continues to do so. In that vein, we focus in this final section on an important theoretical matter—the ontology of cultural things—that relates, in one way or another, to all the misunderstandings that we have discussed. What we aim to show is that the notions of an attractor, attraction, and factors of attraction are not given by fiat but, in fact, follow from how CAT conceives of culture itself. In other words, we will sketch how CAT is a unified set of ideas, in which definition and explanation are mutually reinforcing. In this way, we hope to advance future research beyond the issues discussed here.

Other evolutionary approaches to culture tend to describe and treat culture as an ensemble of ideas, skills, norms, practices, artifacts, and so forth, which are collectively characterized as “information.”^{54,85}

For example, “Culture is information capable of affecting individuals’ behavior that they acquire from other members of their species through teaching, imitation, and other forms of social transmission,”⁵⁴(p. 5), “Culture is... information transmitted between individuals or groups, where this information flows through and brings about the reproduction of, and a lasting change in, the behavioral trait,”⁸⁶ (p. 476). Many more traditional approaches in anthropology also tend toward such characterizations. Whether a given item is or is not cultural is, on a this view, a yes–no question. CAT departs from this view and, as we shall now explain, this departure leads, in turn, to the notion of an attractor, as described earlier (Section 1).

CAT theorists, and some others too, have argued that to treat culture as socially transmitted information produces both false positives and false negatives; in other words, that it identifies many phenomena that are, by general consensus, in fact not cultural; and also that it fails to identify some phenomena that are.^{3,47,57,85} To take just a trivial example, suppose that Alice tells Barry that it is raining. This knowledge, about the weather, fits most evolutionary and many other anthropological definitions of culture: it is information passed from one individual to another by means of social transmission. CAT theorists are skeptical to call this specific piece of knowledge culture and hence to use the same label for it as more quintessential examples (marriage rituals, say) seems to miss the point of what makes culture an empirical phenomenon worthy of study in the first place.

CAT theorists argue instead that the natural character of culture is not as a thing, or even a collection of things, but rather a *graded property* that things can have, to greater or lesser degrees. In other words, some mental states, behaviors, and artifacts are highly cultural and others less so.^{4,47} To be more specific, mental and public items

have the property of being cultural to the extent that they are *shaped* by the cultural chains in which they occur, that is, the extent that they acquire their properties from the cultural chains in which they occur.

As an example, consider chewing. Chewing is a natural behavior that all humans do, and exactly how they do it is indeed largely determined by the biological demands of having to convert food in the mouth into something that can be swallowed. Nevertheless, the action of chewing is also influenced, albeit to a small and limited degree, by seeing others chew, and, in some cases, beliefs about how to chew are influenced by explicitly communicated information, for example, cultural norms about chewing with the mouth closed or open. In other words, although the action of chewing is not socially transmitted, it is *shaped* by things that are social transmitted, albeit only to a partial and limited extent. In contrast, saying "Bon appétit!" before a meal is a practice much more shaped by social transmission. Indeed, in this case, the very existence of the action is a product of social transmission alone, and exactly how the action is performed is also much shaped by social transmission.

As such the difference between chewing and saying "Bon appétit!" is not a difference of kind, but one of degree. It is not that one of these is a cultural thing and the other is not; instead, one is just *more* cultural than the other. One is just (much) more shaped by processes of social transmission. CAT theorists believe that this approach carves the relevant phenomena in more fine-grained manner, closer to its natural character, than do other approaches, evolutionary or otherwise.^{47,52,87}

Note, incidentally, that some highly idiosyncratic beliefs and behaviors, which are not themselves socially transmitted, can nevertheless still be cultural. The content of a dream, for example, is much shaped by individual micromoments of social transmission. Dreams can hence be cultural to some degree or another, even though dreams are in general each different from one another and are not things that are socially transmitted themselves. In other cases (like, say, folktales), cultural items have much in common with one another and can hence come to be identified as tokens of a similar type. Such types are, as we said, attractors (and dreams are not).

A corollary of this characterization of culture is that causal explanation of culture requires identification and description of the various factors that cause items to acquire the property of being cultural (to the extent that they do). As we have stressed throughout this article, in particular Misunderstandings 2 and 3, such explanation can only come from identification of the specific causal factors that are at play in a given case. Attractors, attraction, and factors of attraction are scientific notions developed to serve exactly this goal.

We conclude with some remarks about future research directions. One key area for development is formal (mathematical) description of attraction and attractors. This will likely involve the mathematical description of a convergence of a time series representing the distributions of individual items at different time steps. This could be complemented by agent-based models that formally probe the verbal arguments presented here and elsewhere in the CAT literature, by investigating in detail the effects of biased transformations on population dynamics. Important progress along these lines has been made in the formal modeling of language evolution,^{88,89} but much more remains to be done. On the empirical side, the richest work will not

only identify, for a given case, *what* the relevant factors of attraction are, but also specify exactly *how* those factors shape and stabilize cultural items, that is, how they produce biased transformations in cultural chains. That is to say, it will identify the cultural chains through which factors of attraction have their causal effects.¹⁰ In the most sophisticated cases, this could, in turn, allow researchers to identify and describe particular features of attraction, such as its reach, its temporal dynamics and other statistical qualities. The clarification we have aimed for in this article will support these goals.

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REFERENCES

- [1] Boyer P. 1998. Cognitive tracks of cultural inheritance: How evolved intuitive ontology governs cultural transmission. *Am Anthropol* 100(4):876–889.
- [2] Claidière N, Scott-Phillips TC, Sperber D. 2014. How Darwinian is cultural evolution? *Philos. Trans. Royal Soc. B* 369(1642):20130368. <https://doi.org/10.1098/rstb.2013.0368>.
- [3] Morin O. 2016. *How traditions live and die*, Oxford, UK: Oxford University Press.
- [4] Sperber D. 1996. *Explaining culture. A naturalistic approach*, Oxford, UK: Blackwell.
- [5] Sperber D. 1985. Anthropology and psychology: towards an epidemiology of representations. *Man* 20(1):73–89. <https://doi.org/10.2307/2802222>.
- [6] Claidière N, Sperber D. 2007. The role of attraction in cultural evolution. *J Cogn Cult* 7(1):89–111. <https://doi.org/10.1163/156853707X171829>.
- [7] Kalish ML, Griffiths TL, Lewandowsky S. 2007. Iterated learning: Inter-generational knowledge transmission reveals inductive biases. *Psychon Bull Rev* 14(2):288–294. <https://doi.org/10.3758/bf03194066>.
- [8] Griffiths TL, Kalish ML, Lewandowsky S. 2008. Theoretical and empirical evidence for the impact of inductive biases on cultural evolution. *Philos. Trans. Royal Soc. B* 363(1509):3503–3514. <https://doi.org/10.1098/rstb.2008.0146>.
- [9] Claidière N, Amedon GK-K, André J-B, et al. 2018. Convergent transformation and selection in cultural evolution. *Evol Hum Behav* 39(2): 191–202.
- [10] Sperber D, Hirschfeld L. 1999. Culture, cognition, and evolution. In: Wilson RA, Keil FC, editors. *MIT Encyclopedia of the cognitive sciences* (pp. cxi-cxxxii), Cambridge, MA: MIT Press.
- [11] Atran S. 2002. *In gods we trust: the evolutionary landscape of religion*, New York, NY: Oxford University Press.
- [12] Bloch M, Sperber D. 2002. Kinship and evolved psychological dispositions: the Mother's brother controversy reconsidered. *Curr Anthropol* 43(4):723–748.

- [13] Boyer P. 1994. The naturalness of religious ideas: a cognitive theory of religion, Berkeley, CA: University of California Press.
- [14] Boyer P, Petersen MB. 2017. (accepted) Folk-economic beliefs: An evolutionary-cognitive model. *Behav Brain Sci.* 1–51.
- [15] De Cruz H. 2006. Why are some numerical concepts more successful than others? An evolutionary perspective on the history of number concepts. *Evol Hum Behav* 27(4):306–323. <https://doi.org/10.1016/j.evolhumbehav.2006.02.001>.
- [16] Enfield NJ. 2015. Natural causes of language: frames, biases, and cultural transmission, Berlin, Germany: Language Science Press.
- [17] Heintz, C. 2007. Scientific cognition and cultural evolution: theoretical tools for integrating social and cognitive studies of science. Ph.D. Thesis, EHESS, Paris.
- [18] Miton H, Claidière N, Mercier H. 2015. Universal cognitive mechanisms explain the cultural success of bloodletting. *Evol Hum Behav* 36(4):303–312. <https://doi.org/10.1016/j.evolhumbehav.2015.01.003>.
- [19] Morin O. 2013. How portraits turned their eyes upon us: visual preferences and demographic change in cultural evolution. *Evol Hum Behav* 34(3):222–229. <https://doi.org/10.1016/j.evolhumbehav.2013.01.004>.
- [20] Regnier D. 2015. Clean people, unclean people: the essentialisation of 'slaves' among the southern Betsileo of Madagascar. *Soc Anthropol* 23(2):152–168. <https://doi.org/10.1111/1469-8676.12107>.
- [21] Wengrow D. 2013. The origin of monsters: image and cognition in the first age of mechanical reproduction, Princeton, NJ: Princeton University Press.
- [22] Acerbi A, Mesoudi A. 2015. If we are all cultural Darwinians what's the fuss about? Clarifying recent disagreements in the field of cultural evolution. *Biol Philos* 30(4):481–503. <https://doi.org/10.1007/s10539-015-9490-2>.
- [23] Buskell A. 2016. Cultural longevity: Morin on cultural lineages. *Biol Philos* 31(3):435–446. <https://doi.org/10.1007/s10539-015-9506-y>.
- [24] Buskell A. 2017. What are cultural attractors. *Biol Philos* 32:1–18. <https://doi.org/10.1007/s10539-017-9570-6>.
- [25] Driscoll C. 2011. Fatal attraction? Why Sperber's attractors do not prevent cumulative cultural evolution. *Br J Philos Sci* 62(2):301–322. <https://doi.org/10.1093/bjps/axq032>.
- [26] Henrich J, Boyd R. 2002. On Modeling cognition and culture: why cultural evolution does not require replication of representations. *J Cogn Cult* 2(2):87–112. <https://doi.org/10.1163/156853702320281836>.
- [27] Henrich J, Boyd R, Richerson PJ. 2008. Five misunderstandings about cultural evolution. *Hum Nat* 19(2):119–137. <https://doi.org/10.1007/s12110-008-9037-1>.
- [28] Richerson PJ. 2017. Recent critiques of dual inheritance theory. *Evol Stud Imaginative Culture* 1:203–212.
- [29] Sterelny K. 2001. Review of *Explaining Culture: a Naturalistic Approach*. *Mind* 110(439):845–854.
- [30] Sterelny K. 2017. Cultural evolution in California and Paris. *Stud Hist Philos Biol Biomed Sci* 62:42–50. <https://doi.org/10.1016/j.shpsc.2016.12.005>.
- [31] Whitehouse H. 1996. Jungles and computers: Neuronal group selection and the epidemiology of representations. *J R Anthropol Inst* 2(1): 99–116. <https://doi.org/10.2307/3034635>.
- [32] Boyer P. 2001. Religion explained. The evolutionary origins of religious thought, New York, NY: Basic books.
- [33] Tehrani JJ. 2013. The phylogeny of little red riding hood. *PLoS One* 8(11):e78871. <https://doi.org/10.1371/journal.pone.0078871>.
- [34] Billard S, Alvergne A. 2018. Stochasticity in cultural evolution: a revolution yet to happen. *Hist Philos Life Sci* 40(9).
- [35] Popper KR. 1972. Objective knowledge: an evolutionary approach, Oxford, UK: Oxford University Press.
- [36] Kitcher P. 1982. Abusing science : the case against creationism, Cambridge, MA: MIT press.
- [37] Klumper W, Qaim M. 2014. A meta-analysis of the impacts of genetically modified crops. *PLoS One* 9(11):e111629. <https://doi.org/10.1371/journal.pone.0111629>.
- [38] Blancke S, Van Breusegem F, De Jaeger G, et al. 2015. Fatal attraction: The intuitive appeal of GMO opposition. *Trends Plant Sci* 20(7): 414–418. <https://doi.org/10.1016/j.tplants.2015.03.011>.
- [39] Boudry M, Blancke S, Pigliucci M. 2015. What makes weird beliefs thrive? The epidemiology of pseudoscience. *Philos Psychol* 28(8): 1177–1198. <https://doi.org/10.1080/09515089.2014.971946>.
- [40] Boyd R, Richerson PJ, Henrich J. 2013. The cultural evolution of technology: Facts and theories. In: Richerson PJ, Christiansen MH, editors. *Cultural evolution: Society, language, and religion*. vol 12, Cambridge, MA: MIT Press.
- [41] Henrich J, McElreath R. 2003. The evolution of cultural evolution. *Evol Anthropol. Issues, News Rev* 12(3):123–135. <https://doi.org/10.1002/evan.10110>.
- [42] Caldwell CA, Cornish H, Kandler A. 2016. Identifying innovation in laboratory studies of cultural evolution: Rates of retention and measures of adaptation. *Philos. Trans. Royal Soc. B* 371(1690):20150193. <https://doi.org/10.1098/rstb.2015.0193>.
- [43] Gil-White F. 2008. Let the meme be (a meme): Insisting too much on the genetic analogy will turn into a straightjacket. In: Botz-Bornstein T, editor. *Culture, nature, memes*, Newcastle Upon Tyne, England: Cambridge Scholars. p 158–190.
- [44] Laland KN, Brown GR. 2011. Sense and nonsense. *Evolutionary perspectives on human behaviour*, Second ed. Oxford, UK: Oxford University Press.
- [45] McElreath R, Henrich J. 2007. Modelling cultural evolution. In: Barrett L, Dunbar R, editors. *Oxford handbook of evolutionary psychology*, Oxford, UK: Oxford University Press. p 571–585.
- [46] Heintz C. 2013. Scaffolding on core cognition. In: Caporael L, Wimsatt WC, Griesemer J, editors. *Developing scaffolds in evolution, culture and cognition*, Boston, MA: MIT Press. p 209–228.
- [47] Sperber D, Claidière N. 2008. Defining and explaining culture (comments on Richerson and Boyd, not by genes alone). *Biol Philos* 23(2): 283–292. <https://doi.org/10.1007/s10539-005-9012-8>.
- [48] Christiansen M, Chater N. 2008. Language as shaped by the brain. *Behav Brain Sci* 31:489–509.
- [49] Regier T, Kemp C, Kay P. 2015. Word meanings across languages support efficient communication. In: MacWhinney B, O'Grady W, editors. *The handbook of language emergence*, Hoboken, NJ: Wiley. p 237–264.
- [50] Kirby S, Tamariz M, Cornish H, Smith K. 2015. Compression and communication in the cultural evolution of linguistic structure. *Cognition* 141:87–102.
- [51] Lupyan G, Dale R. 2016. Why are there different languages? The role of adaptation in linguistic diversity. *Trends Cogn Sci* 20(9):649–660.
- [52] Heintz C. 2009. Cognitive history and cultural epidemiology. In: Martin LH, Sorensen J, editors. *Past minds: Studies in cognitive historiography*. vol 2, London: Equinox Press.
- [53] Morin O. 2011. When does psychology drive culture? In: Slingerland E, Collard M, editors. *Creating consilience: Integrating science and the humanities*, Oxford, UK: Oxford University Press. p 179–193.
- [54] Richerson PJ, Boyd R. 2005. Not by genes alone. How culture transformed human evolution, Chicago, IL: University of Chicago Press.
- [55] Heintz C. (in press) Cultural epidemiology. In: Callan H, editor. *International encyclopedia of anthropology*, Oxford, UK: Wiley-Blackwell.
- [56] Claidière N, André J-B. 2012. The transmission of genes and culture: A questionable analogy. *Evol Biol* 39(1):12–24. <https://doi.org/10.1007/s11692-011-9141-8>.
- [57] Lewens T. 2015. *Cultural evolution. Conceptual challenges*, Oxford, UK: Oxford University Press.
- [58] Mesoudi A. 2017. Pursuing Darwin's curious parallel: prospects for a science of cultural evolution. *Proc Natl Acad Sci* 114(30):7853–7860.
- [59] Morin O. 2016b. Reasons to be fussy about cultural evolution. *Biol Philos* 31(3):447–458. <https://doi.org/10.1007/s10539-016-9516-4>.
- [60] Richerson PJ, Boyd R. 2008. Response to our critics. *Biol Philos* 23(2):301–315. <https://doi.org/10.1007/s10539-007-9084-8>.
- [61] Scott-Phillips TC. 2016. Can cultural evolution bridge scientific continents? *Stud Hist Philos Biol Biomed Sci* 57:170–173. <https://doi.org/10.1016/j.shpsc.2016.02.001>.
- [62] Sperber D, Claidière N. 2006. Why Modeling cultural evolution is still such a challenge. *Biological Theory* 1(1):20–22. <https://doi.org/10.1162/biot.2006.1.1.20>.

- [63] Henrich J. 2016. *The secret of our success: how culture is driving human evolution, domesticating our species, and making us smarter*, Princeton, NJ: Princeton University Press.
- [64] Boyd R. 2017. *A different kind of animal: how culture transformed our species*, Princeton, NJ: Princeton University Press.
- [65] Laland KN. 2017. *Darwin's unfinished symphony: how culture made the human mind*, Princeton, NJ: Princeton University Press.
- [66] Dennett D. 2017. *From bacteria to Bach and back: the evolution of minds*, New York, NY: WW Norton & Co.
- [67] Scott-Phillips TC. 2017. A (simple) experimental demonstration that cultural evolution is not replicative, but reconstructive — And an explanation of why this difference matters. *J Cogn Cult* 17(1–2): 1–11. <https://doi.org/10.1163/15685373-12342188>.
- [68] Charbonneau M. 2015. Mapping complex social transmission: technical constraints on the evolution of cultures. *Biol Philos* 30(4):527–546. <https://doi.org/10.1007/s10539-015-9487-x>.
- [69] Charbonneau M. 2015. All innovations are equal, but some more than others: (re)integrating modification processes to the origins of cumulative culture. *Biol Theor* 10(4):322–335.
- [70] Caldwell CA, Millen AE. 2009. Social learning mechanisms and cumulative cultural evolution. *Psychol Sci* 20(12):1478–1483. <https://doi.org/10.1111/j.1467-9280.2009.02469.x>.
- [71] Tomasello M. 1999. *The cultural origins of human cognition*, Cambridge, MA: Harvard University Press.
- [72] Tomasello M. 2016. The ontogeny of cultural learning. *Curr Opin Psychol* 8:1–4. <https://doi.org/10.1016/j.copsyc.2015.09.008>.
- [73] Mesoudi A, Whiten A, Laland KN. 2004. Is human cultural evolution Darwinian? Evidence received from the perspective of *The Origin of species*. *Evolution* 58(1):1–11. <https://doi.org/10.1554/03-212>.
- [74] Hoppitt W, Laland KN. 2013. *Social learning: an introduction to mechanisms, methods, and models*, Princeton, NJ: Princeton University Press.
- [75] Grafen A. 1984. Natural selection, kin selection and group selection. In: Krebs JR, Davies NB, editors. *Behavioural ecology: an evolutionary approach*, Oxford, UK: Blackwell Scientific Publications. p 62–84.
- [76] Davies NB, Krebs JR, West SA. 2012. *An introduction to behavioural ecology*, 4th ed. Oxford, UK: Wiley.
- [77] Sperber D. 2000. An objection to the memetic approach to culture. In: Aunger R, editor. *Darwinizing culture: the status of memetics as a science*, Oxford, UK: Oxford University Press. p 163–173.
- [78] Heyes C. 2016. Blackboxing: social learning strategies and cultural evolution. *Philos. Trans. Royal Soc. B* 371(1693):20150369. <https://doi.org/10.1098/rstb.2015.0369>.
- [79] Mercier H, Heintz C. 2014. Scientists' argumentative reasoning. *Topoi* 33(2):513–524.
- [80] Mercier H, Sperber D. 2017. *The enigma of reason*, Cambridge, MA: Harvard University Press.
- [81] Scott-Phillips TC. 2015. *Speaking our minds. Why human communication is different, and how language evolved to make it special*, London: Palgrave MacMillan.
- [82] Scott-Phillips TC, Sperber D. 2015. The mutual relevance of teaching and cultural attraction. (commentary on M. Kline, 'how to learn about teaching: an evolutionary framework for the study of teaching behavior in humans and other animals'). *Behav Brain Sci* 38:e31.
- [83] Sperber D, Wilson D. 1995. *Relevance: communication and cognition*, 2nd ed. Oxford, UK: Blackwell.
- [84] Sperber D, Clement F, Heintz C, et al. 2010. Epistemic vigilance. *Mind Lang* 25(4):359–393.
- [85] Driscoll C. 2017. The evolutionary culture concepts. *Philos Sci* 84(1): 33–55.
- [86] Ramsey G. 2013. Culture in humans and other animals. *Biol Philos* 28(3):457–479. <https://doi.org/10.1007/s10539-012-9347-x>.
- [87] Sperber D. 2011. A naturalistic ontology for mechanistic explanations in the social sciences. In: Demeulenaere P, editor. *Analytical sociology and social mechanisms*, Cambridge, MA: Cambridge University Press. p 64–77.
- [88] Kirby S, Dowman M, Griffiths TL. 2007. Innateness and culture in the evolution of language. *Proc Natl Acad Sci* 104(12):5241–5245.
- [89] Griffiths TL, Kalish ML. 2007. Language evolution by iterated learning with Bayesian agents. *Cogn Sci* 31(3):441–480.
- [90] Sperber D. 2001. Conceptual tools for a natural science of society and culture (Radcliffe-Brown lecture in social Anthropology 1999). *Proc Brit Acad* 111:297–317.
- [91] Sperber D, Hirschfeld L. 2007. Culture and modularity. In: Carruthers P, Laurence S, Stich SP, editors. *The innate mind: Culture and cognition*, Oxford, UK: Oxford University Press. p 149–164.
- [92] Morin O. 2018. Spontaneous emergence of legibility in writing systems: the case of orientation anisotropy. *Cogn Sci* 42(2):664–677.
- [93] Heintz, C. 2017. The epidemiology of a mathematical representation: The 'infinitesimal' at the end of the 17th century in France. Working paper. Available at: <http://christophe.heintz.free.fr/papers/EpidemioInfinite130821.pdf>
- [94] Lérique S, Roth C. 2018. The semantic drift of quotations in blog-space: a case study in short-term cultural evolution. *Cogn Sci* 42(1): 188–219.

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