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Understanding Cultural Fidelity

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ABSTRACT

A leading idea of cultural evolutionary theory is that for human cultures to undergo evolutionary change, cultural transmission must generally serve as a high-fidelity copying process. In analogy to genetic inheritance, the high fidelity of human cultural transmission would act as a safeguard against the transformation and loss of cultural information, thus ensuring both the stability and longevity of cultural traditions. Cultural fidelity would also serve as the key difference-maker between human cumulative cultures and non-human non-cumulative traditions, explaining why only us humans, with our uniquely high-fidelity transmission capabilities, are capable of evolving and sustaining complex traditions. But what does it mean for cultural transmission to be more or less faithful? This article has two objectives. The first is to clarify the meaning and uses of the concept of cultural fidelity and to evaluate their explanatory import. I argue that cultural evolutionists use several fidelity concepts (episodic, propensity, and generalized fidelity), concepts that I will define and clarify. The second objective is to challenge the explanatory significance of a general notion of fidelity (generalized fidelity) as being both explanatorily meaningful and operationalizable. I conclude that if fidelity is to serve as an explanation of the key differences between human cumulative cultures and non-human non-cumulative traditions, then the concept will have to be redesigned and rely on different assumptions.

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1 Introduction

Cultural fidelity is at the core of two central explanatory projects of cultural evolutionary theory. Fidelity is used to explain why cultural traditions—lineages of cultural traits such as social norms, rituals, tales, artefacts, and so on—can last for long periods of time while remaining relatively stable in the face of disruptive factors. As individuals learn from one another, there is a constant risk that the transmitted knowledge gets altered, either by being miscopied to some degree or through a loss of the information necessary to sustain the tradition. The high fidelity of human cultural transmission would act as a safeguard against the transformation and the loss of cultural information, thus ensuring both the stability and longevity of cultural traditions (Tomasello [1999]; Richerson and Boyd [2005]; Mesoudi [2011]; Laland [2017]).

Fidelity also serves to explain the human-specific capacity for an open-ended, cumulative cultural evolutionary process, that is, our capacity to cumulate innovations leading to evermore complex and sophisticated cultural and technological traditions. Fidelity would thus serve as the key difference-maker between human cumulative cultures and non-human non-cumulative traditions, explaining why only us humans, with our uniquely high-fidelity transmission capabilities, are able of evolving and sustaining complex traditions (for example, Galef [1992]; Heyes [1993]; Tomasello [1999]; Boyd and Richerson [2005]; Tennie *et al.* [2009]; Mesoudi [2011]; Lewis and Laland [2012]; Henrich [2016]; Laland [2017]).

Based on its explanatory importance alone, one would expect cultural fidelity to be a clearly defined, unified concept. However, the literature shows no consensual understanding of what cultural fidelity amounts to, yet alone any principled way to operationalize the concept such that it can serve its two main explanatory roles. Instead, cultural evolutionists have used two different strategies to characterize fidelity, both largely uninformative and epistemologically problematic.

The first strategy is to characterize cultural fidelity in terms of an analogy with the fidelity of genetic replication (Dawkins [1976]). Although cultural evolutionists are nowadays generally sceptical of a literal understanding of gene–culture analogies (Claidière and André [2012]), it is still not uncommon to find cultural fidelity explained in terms of its purported analogies with genetic transmission:

> Cultural variants can be passed faithfully from one individual to another, just as genes are passed from parent to offspring in biological evolution. Moreover, this cultural inheritance is of sufficiently high fidelity that it can successfully support the gradual accumulation of modifications, just

> as Darwin observed for lineages of biological organisms. (Mesoudi [2011], p. 34)

Whereas the analogy does suggest that cultural fidelity serves as a unified concept that can be applied uniformly to the transmission of the vast diversity of cultural traditions, it is unclear just what else can be derived from it. On the one hand, cultural evolutionists generally agree that cultural transmission is not as faithful as genetic transmission (for example, Henrich *et al.* [2008]). On the other, it is also agreed upon that the fidelity of cultural transmission can't be assessed through the same means as the fidelity of genetic transmission is: cultural information is not made of discrete units as DNA is made of discrete nucleotides (for example, Richerson and Boyd [2005]). With both the degree of fidelity and the means of its assessment differing between genetic and cultural transmission, exactly what the analogy is supposed to amount to remains unclear and open to interpretation.

The second strategy consists in defining the fidelity concept independently from an analogy with genetic replication. Unfortunately, the available definitions are generally spelt out in terms of near synonyms, thus making these definitions circular. Laland ([2017], p. 151) defines 'the fidelity of cultural transmission [as] the accuracy with which learned information passes between individuals'. However, we are not explained what 'accuracy' means nor how it differs in meaning from 'fidelity'. For instance, it seems that faithfully recalling a story consists in the exact same thing as accurately recalling it. Other definitions are rarely more informative. Muthukrishna and Henrich ([2016], p. 6) write, 'Transmission fidelity refers to the fidelity with which individuals can copy different ideas, beliefs, values, techniques, mental models and practices'. Yet again, it is unclear how defining fidelity in terms of 'fidelity' or 'copying' is supposed to clarify just what the faithful transmission of a cultural trait is supposed to amount to. Similar to the analogy strategy, attempts at defining cultural fidelity overall suggests fidelity is some unified property of human cultural transmission. However, both the analogical and definitional approaches end up depending more on one's idiosyncratic interpretation and intuitions than they do on the theoretical and operational concerns of the field. As central as transmission fidelity may be to cultural evolutionary theory, there does not seem to be any clear understanding of the concept.

The main objective of this article is to stimulate a much-needed discussion about the meaning and explanatory significance of the notion of cultural fidelity. I do so through two lines of argumentation. First, I argue that cultural evolutionists in fact use several fidelity concepts, concepts that I will define and clarify. I argue that cultural fidelity is typically construed as a property ascribed either (i) to episodes of cultural transmission (episodic fidelity)—where a cultural trait is acquired more or less faithfully, (ii) to the mechanisms

involved in the cultural transmission of specific cultural traits (propensity fidelity)—where some transmission mechanism is more or less faithful than another in perpetuating some tradition, or (iii) to the ensemble of social learning mechanisms possessed by a species (generalized fidelity). For each notion, I offer a definition and illustrate their use by cultural evolutionists.

Second, I will clarify how each of these concepts serve their different explanatory roles. I argue that episodic fidelity and propensity fidelity are adequate concepts when used to explain cultural stability. However, I offer a more critical argument concerning the explanatory import of a general notion of cultural fidelity (generalized fidelity) by arguing that the concept, in its current form, rely on problematic assumptions. I first identify three conditions underlying the generalized fidelity concept as it is currently used in the literature: (i) a mechanism of cultural transmission possesses one and only one degree of fidelity, (ii) the degree of fidelity of all transmission mechanisms should be quantifiable using a common metric, and (iii) fidelity is an intrinsic property of a transmission mechanism. I then argue that each condition suffers from problems that makes the concept of generalized fidelity inoperative and deprives it of explanatory power. I conclude that if generalized fidelity is to serve as an explanation of the key differences between human cumulative cultures and non-human non-cumulative traditions, then the concept will have to be redesigned and rely on different assumptions.

2 Generalized Fidelity

2.1 The need for an explanatory concept of fidelity

Cultural fidelity figures predominantly in explanations of the apparently human-specific capacity for cumulative cultural evolution. Psychologist Tomasello ([1999], pp. 4–5) writes:

> The evidence that human beings do indeed have species-unique modes of cultural transmission is overwhelming. Most importantly, the cultural traditions and artifacts of human beings accumulate modifications over time in a way that those of other animal species do not—so-called cumulative cultural evolution [...] The process of cumulative cultural evolution requires not only creative invention but also, and just as importantly, faithful social transmission that can work as a ratchet to prevent slippage backward [...] Perhaps surprisingly, for many animal species it is not the creative component, but rather the stabilizing ratchet component, that is the difficult feat.

Other authors agree:

> [Our] findings strongly supported Tomasello's argument that the apparent absence of cumulative culture in other species resulted from their reliance on low-fidelity copying mechanisms, such as local

> enhancement, rather than the high-fidelity processes observed in humans [such as teaching, language, imitation, and so on]. (Laland [2017], p. 156)

These quotes concur on two empirical claims. First, human cultural transmission mechanisms are generally assumed to be of higher fidelity than those of non-human animal species. For instance, humans would be endowed with high-fidelity transmission mechanisms such as imitation, teaching, and language, which non-human species either lack or use to a lesser degree. Second, as the capacity for cumulative culture demands high-fidelity transmission, the higher fidelity of human transmission mechanisms would serve as the key difference-maker between human cumulative culture and non-human non-cumulative traditions (Tomasello [1999]; Tennie *et al.* [2009]; Lewis and Laland [2012]; Dean *et al.* [2014]; Laland [2017]). I will not critically discuss the inference that cumulative cultural evolution depends on high-fidelity transmission mechanisms, as the validity of the inference depends on the meaning ascribed to the notion of fidelity. For the sake of exposition, it suffices to point to the general rationale that a low-fidelity transmission mechanism would tend to lose improvements over traditions such that modifications will fail to accumulate, whereas a high-fidelity mechanism would retain the innovations and allow the later accumulation of further innovations, incrementally. For more detailed discussions of the reasoning, see (Tomasello [1999]; Tennie *et al.* [2009]); but see also (Charbonneau [2015a]) for a criticism of the rationale.

What is of central concern here is the first claim: the hypothesis that the fidelity of transmission mechanisms—or of sets of mechanisms when dealing with inter-specific contrasts—can be compared, where some mechanism—or set of mechanisms—can be said to be of higher or lower fidelity than another. However, just how one is to effectively identify and quantify the overall fidelity of a set of transmission mechanisms, yet alone of a single transmission mechanism, is left unexplained. In fact, there does not even seem to be any attempt to effectively measure and compare such quantities, nor even to devise procedures to obtain them.

An illustrative example of this absence can be found in a figure used by Laland ([2017], p. 152), where humans are situated on the higher end of a fidelity scale, in comparison to other non-human species, set lower down on the same scale. Nowhere are we explained how the species are associated with a specific value or range of values of overall transmission fidelity, nor are explanations offered such that the ordering could be justified. In fact, no such quantities are given. Still, Laland ([2017], p. 174) insists: 'Humans alone possess cumulative culture because humans alone possess sufficiently high-fidelity information transmission mechanisms'. It thus seems that Laland's ordering is more an affair of intuitions than of empirically acquired, quantitative results.

At this point, a sceptical reader may ask why leaving the notion of cultural fidelity undefined and open to a subjective appreciation should be undesirable. The problem with intuitions is that they vary from one investigator to the next. Different investigators may understand the notion of fidelity or assess the fidelity of a transmission mechanism differently yet fail to realize that they do so. Equivocation also opens the door to those disagreeing about the explanatory importance of fidelity to talk pass one another. Additionally, newcomers to the field of cultural evolution may find the concept ambiguous, understand it through unchecked idiosyncratic interpretations, and thus perpetuate its equivocation. Considering the central role of the fidelity concept, it seems legitimate to avoid leaving its explanatory purport open to idiosyncratic interpretations and instead set the concept on a more solid conceptual and operational ground.

2.2 Three conditions for a general notion of cultural fidelity

I now turn to spell out in more details how the notion of cultural fidelity is currently used to make sense of the claims that some transmission mechanism is, overall, of higher fidelity than another, or that the set of transmission mechanisms of a species is generally of higher fidelity than the one of another species.[1] I propose that such a notion of fidelity, as it is currently used by cultural evolutionists, relies on three conditions.

The first condition is that a mechanism of cultural transmission possesses one and only one degree of fidelity. This is a straightforward stipulation: a transmission mechanism cannot have two degrees of fidelity such that it is both of high and low fidelity. Should it have multiple degrees of fidelity, then it would be contentious to claim that a mechanism is of a higher degree of fidelity than another as the resulting comparison may be due more to the choice of which degrees of fidelity one choses to compare rather than on any impartial comparison.

The second condition is that the degree of fidelity of all transmission mechanisms can be quantified using a common metric. This condition demands that fidelity serves as a quantifiable property of a transmission mechanism and that we can determine, using a common metric, what that quantity is for all transmission mechanisms. It would be meaningless to claim that a mechanism—or set of mechanisms—is of higher fidelity than another if we had no common scale to assess their differences in fidelity. Indeed, without using a common

[1] By 'transmission mechanisms', I refer to the different forms of social learning typically dealt with by cultural evolutionists, such as stimulus enhancement, emulation, imitation, teaching, and so on. I use the term 'mechanism' simply to reflect the common usage of the expression among cultural evolutionists. Whether these different forms of social learning are adequately characterized as 'mechanisms' is an issue that goes beyond the scope of this article. See (Hoppitt and Laland [2013], Chapter 4) for a more exhaustive list and description of these mechanisms.

metric, the two measures could not be acquired and then compared as there would be no common denominator on which to ground the comparison. The figure by Laland ([2017], p. 152) discussed above illustrates well this condition: the overall fidelity of the transmission mechanisms of different species are ranked on a single, continuous dimension.

Finally, the third condition is that the degree of fidelity of a transmission mechanism be an intrinsic property of that mechanism. This last condition is subtler. It relies on the idea that the degree of fidelity of a transmission mechanism is a property constitutive of the mechanism. By constitutive or intrinsic, I mean that the degree of fidelity of a transmission mechanism does not vary with the context of transmission. For instance, the degree of fidelity of a transmission mechanism should not vary with the specific traditions that it serves to transmit. It is clear from the quoted passages—and from the literature more generally—that the hypothesis is supposed to be context-independent: the claim that cumulative culture is a human-specific phenomenon is never qualified as depending on the context of transmission. Instead, it seems fair to read the generalizing claim as consisting in saying that humans' transmission mechanisms are, *ceteris paribus*, of higher fidelity than those of non-humans.

When these three conditions hold, transmission mechanisms (or sets of transmission mechanisms) can be quantitatively compared and ranked based on their different degrees of fidelity. Let us refer to a notion of fidelity that satisfies all three conditions as 'generalized fidelity'.

I have given reasons for each of the three conditions by showing that, should they turn out to be false, the claim of human uniqueness would fail to be justified by an inter-specific difference in transmission fidelity. However, rejecting these conditions, as I do below, does not entail that it is impossible to devise an operational notion of generalized fidelity. Rather, I take these conditions to be implicit assumptions currently made by cultural evolutionists underlying the use of a general notion of cultural fidelity. Disagreeing with these conditions means rejecting the notion of generalized fidelity as it is currently used by cultural evolutionists. Should one want to ground a generalized notion of cultural fidelity capable of explaining the human-specific capacity for cumulative culture, then the notion of generalized fidelity would have to be redesigned along different lines. I point to some possible avenues of reform in the conclusion of this article. However, considering that there are no existing critical discussions of the meaning of the fidelity concept, the notion of generalized fidelity provided here will have to serve as a starting point. As my objective is to offer a clearer understanding of fidelity and its explanatory import, hopefully the argument developed here, even if critical, will stimulate further developments and refinements for an improved understanding of cultural fidelity.

Let us now turn to how a procedure for assessing the degree of generalized fidelity of a transmission mechanism—or of a set of mechanisms—could be devised.

3 Episodic Fidelity

Any episode of cultural transmission consists of at least two steps (Boyd and Richerson [1985]; Sperber and Hirschfeld [2007]). First, a source produces some public display of a cultural trait—be it an utterance, a behaviour, and/or an artefact, and so on. Guiding the production of the display is the source's mental representation of what the cultural trait should consist of. Although the source's knowledge may not be directly accessible to other individuals—knowledge is a private mental state (see below)—by producing a public display of this knowledge, the source makes the relevant private information available to the learner. The second step of cultural transmission consists in the learner acquiring from the public display her very own private mental representation—or information—of the cultural trait. In future instances, through this newly acquired mental representation, the learner will be able to reproduce public displays of the cultural trait, which in turn will make the relevant private information available for another individual to learn, thus sustaining a cultural tradition.

Fidelity is often used to characterize episodes of cultural transmission based on the similarity of the cultural trait of the source and that of the learner. When the cultural traits of a source and of a learner are highly similar to one another, the episode of cultural transmission for that trait is understood to be one of high fidelity (or, equivalently, that the trait was faithfully transmitted). The lower the degree of similarity between the two traits, the less faithful the episode of cultural transmission. Understood this way, fidelity denotes the degree of similarity between the source's and the learner's traits. Let us refer to this second notion of cultural fidelity as 'episodic fidelity'.

3.1 Measuring episodic fidelity

In order to assess the degree of fidelity of an episode of cultural transmission, we need to measure the similarities and dissimilarities between the cultural traits of a source and that of a learner. Identifying a general criterion to assess cultural fidelity would give the cultural evolutionist a very powerful measuring tool, one that would ensure the possibility of generalizing claims about the fidelity of cultural transmission. Indeed, a general metric for episodic fidelity would allow to measure and compare the fidelity of transmission of any two cultural traits, even though these traits may have very few if any properties in common. For instance, this means that a linguist, interested in the

transmission of word morphology, could use the same metric as the archaeologist interested in the transmission of artefact form. Moreover, a common metric could be used to compare the fidelity of transmission episodes across species.

One way to measure the fidelity of an episode of cultural transmission using a common metric would be to measure and compare the information—or mental representation—used by a source during an episode of cultural transmission with the information—or mental representation—acquired by the learner during that same transmission episode (Mesoudi [2011]). Episodic fidelity would then be assessed by measuring and comparing the similarity of the two mental representations. Any deviation in the correspondence between the two will reduce the degree of episodic fidelity.

While this view of fidelity may be alluring theoretically, behind it lie important operational problems. Mental representations are private mental events. They are not directly observable. This is true for the learner trying to capture some information from a source, and it is also true for the investigator measuring the fidelity of cultural transmission (O'Brien *et al.* [2010]). In contrast to genetic transmission, there is no such thing as a material substrate directly transmitted by cultural transmission, yet alone some structured information that is divisible 'into tiny, independent genelike bits that are faithfully replicated' (Richerson and Boyd [2005], p. 60). Mesoudi ([2011], pp. 214–16) suggests that we need to wait for a 'cultural Watson and Crick' to solve this apparent disanalogy, that is, for the development of neuroscientific methods capable of directly assessing the content of mental representations. While this is an optimistic piece of speculation, we do not have such methods yet, and it is unclear that we should expect finding any at all. In fact, even if we one day develop such methods, it remains unclear whether there could be any general, common metric for measuring the similarity of mental representations (Acerbi and Mesoudi [2015]).

Lacking a direct access to the structure of the culturally transmitted information, cultural evolutionists are forced to measure the similarity not of the mental representations involved in the transmission episodes but, instead, of the public displays produced by the sources and their associated learners. In other words, the investigator has no choice but to use public displays—such as utterances, behaviours, artefacts, and so on—as proxies for the private information that is transacted during episodes of cultural transmission. So how does the cultural evolutionist know—in the absence of a direct means to access private cultural information—how to measure the public displays in order to properly assess the degree of fidelity of any given episode of cultural transmission?

3.2 The relevance problem

Measuring the similarity between any two items, whether they are cultural or not, is a tricky issue. It is a problem that philosophers and cognitive scientists have been working with for a long time, one that has spawned a specialized literature of its own (see Goldstone and Son [2012] for a general overview). A consensus emerging from this 'similarity literature' is that there is no such thing as a relation of similarity *tout court*: any two things are always both similar and dissimilar in an indefinite number of ways (Goodman [1970]). Instead, the consensus is that assessing the similarity between any two things is always an affair of contextual relevance (for example, Goodman [1970]; Tversky [1977]; Gärdenfors [2004], *inter alia*). In other words, in order to have a meaningful measure of similarity, one always need to specify some criterion that distinguishes between the properties from which to make the similarity assessment, highlighting properties understood as relevant and downplaying those deemed contextually irrelevant.

This general scientific problem finds its analogue in the assessment of episodic fidelity. For instance, consider that a cultural trait transmitted from a source to a learner, such as a nut-cracking behaviour, can be similar and dissimilar in an indefinite number of ways. Both individuals, one male, the other female, may use a rock as a hammer and have done so while both facing north. One individual may have hammered the nut while sitting, whereas the other by standing up. The two individuals may have used two different rocks, which may differ in shape, colour, weight, chemical composition, and so on, but the rocks used may also have been equally dry. In one case, the behaviour may have been enacted by mid-June, the other in late October. We can list more similarities and dissimilarities, indefinitely.

Intuitively, some similarities and dissimilarities seem more relevant than others in assessing the degree of fidelity of a transmission episode. We want to say that using a rock to hammer a nut (instead of one's fists, for instance) seems more relevant a similarity than the geographical direction faced by the two individuals while cracking their respective nuts. The same goes for dissimilarities. Differences in the stance of the individuals (sitting or standing up, and so on) may have some relevance, but the differences in the sex of the individual or the time of year certainly less so, if at all. And then, some similarities and dissimilarities may or may not seem relevant, yet it is unclear how we should assess their importance (for instance, is the dryness and chemical composition of the rock relevant when assessing if the technique was replicated or poorly copied?).

As mentioned above, the problem with intuitions is that they vary from one investigator to the next. We could perhaps settle the question by comparing the specific information used during the enactment of both behaviours, but as

pointed out above, we do not have a direct access to this private information. So, unless we can specify in a principled way what counts as (ir)relevant similarities and (ir)relevant dissimilarities between two public displays, the episodic fidelity concept can only remain arbitrary and ineffectual. Required is a relevance criterion that is both capable of downplaying irrelevant similarities and dissimilarities between two public displays, while at the same time pinpointing which similarities and dissimilarities are relevant for an assessment of episodic fidelity, all this in the absence of a direct access to the information effectively used when producing the public displays. If the reader finds these concerns far-fetched and too philosophical, I invite her to consider the following practical question: when two cultural evolutionists disagree on how to measure the degree of fidelity of a same episode of cultural transmission, how shall we resolve the issue in a non-arbitrary way? In the absence of a direct access to the mental representations of the source and the learner, it is unclear how we ought to solve the relevance problem in a systematic way, that is, which properties of the public displays to elect as the proper proxies for tracking the information effectively transmitted during any episode of cultural transmission.

3.3 Explanatory pluralism

In order to deal with the relevance problem, I suggest that we understand the assessment of episodic fidelity as being driven by the specific explanatory interests of the investigator. Adopting this relevance criterion, a same episode of cultural transmission may be one of perfect replication from one explanatory perspective, yet it may be poorly faithful from another, without these two apparently contradictory conclusions conflicting with one another. As there is a plurality of explanatory projects populating the research programme of cultural evolutionary theory, so long as two explanatory projects address different problems, their different assessments of the fidelity of a same episode of cultural transmission need not be inconsistent.

Consider an archaeologist interested in the evolution of pottery as a means for transporting liquids. Given her explanatory interests, she will focus on the properties of the pottery that are relevant for the transportation of liquids, such as the materials the pots are made of and the shape of the vessels, and so on, but not with those traits relating to the decorative styles of the potteries. From her explanatory perspective, two pots will be similar to the degree that they share the functional properties that are relevant for the transportation of liquids. In contrast, and for the very same two pots, another archaeologist interested in the evolution of the decorative styles of the pottery will focus on the ornamentation of the pots, such as the painted patterns and the colours used to decorate the vessels, and so on, yet will downplay their functional

properties. For this latter explanatory project, the two pots will be similar to the degree that they share a relevant set of stylistic properties. Consequently, the two archaeologists may understand a very same episode of cultural transmission as being of high fidelity in one case (the functional properties of the two pots may be very similar), and of low fidelity in the other (the ornamentation styles may be very dissimilar). As each investigator is interested in explaining the stability of different properties of the pots, they will disagree in their assessment of episodic fidelity yet without there being any conflict in their different conclusions. Consequently, a same episode of cultural transmission can be both of high and low fidelity, depending on the explanatory interests of the investigator.

Assessments of episodic fidelity also depend on the way the investigators carve the public displays into analytical units best suited to serve their explanatory purposes. In the previous example, the two archaeologists agreed to set their analysis at the level of the pots, although being interested in different characteristics of the pots. However, for a same set of public displays, two investigators may well carve their analytical units in very different ways, potentially leading to differences in their assessment of episodic fidelity.

The study of tale transmission offers a good example of the many ways that the same public displays can be carved at different levels of analysis. Studying the transmission of stories, one can decompose the trait in terms of its plot structure. For instance, de Lima *et al.* ([2016]) analyse the different plot structures of variants of the Little Red Riding Hood tale, coding for the specific sequences of events occurring in the tale (such as go(Little Red Cap, the woods), meet(Little Red Cap, Wolf), go(Wolf, house (Grandmother))). Alternatively, one might be interested in identifying variation at the level of plot elements. Tehrani ([2013]) decomposes the Little Red Riding Hood tale into seventy-two discrete plot variables, either presence/absence variables (the victim wears a red cap/hood or not) or multi-state characters (the species of the villain is fox, ogre, wolf, and so on). Finally, one might be interested in variations in the written text of the stories. Accordingly, Spencer and Howe ([2001]) developed a framework to systematically compare written texts in terms of their word differences. The differences in the choices of a level of analysis for a same public display can have considerable impacts on the assessment of its degree of transmission fidelity (Acerbi and Mesoudi [2015]). For instance, two texts using very different words may nevertheless relate the exact same story structure while mildly differing in their plots elements.

An important consequence of the plurality of explanation-based criteria in measuring episodic fidelity is that the degree of fidelity of an episode of cultural transmission is relative to the specific explanatory interests of the investigator. This does not mean that the investigator arbitrarily decides what the degree of episodic fidelity is, but rather that the specific questions asked by the

investigator will drive which units of analysis are the most relevant, which in turn will influence the resulting measurement of transmission fidelity. Endorsing a pluralistic account of the explanatory interests of cultural evolutionists, Acerbi and Mesoudi ([2015], p. 493) rightly conclude: 'there doesn't seem to be a "correct" answer to whether people or traits [or trait characters] are the units of analysis, but which decision we take determines whether the process is transformative [low fidelity] or preservative [high fidelity]'. This relativity in analytical framework reflects the common practices of cultural evolutionists, and these are entirely coherent with the existing plurality of explanatory projects that populate the field (Lyman and O'Brien [2003]; O'Brien *et al.* [2010]; Mesoudi [2011]; Acerbi and Mesoudi [2015]). However, as we will see below, the explanatory relativity of episodic fidelity assessments has important implications for the prospect of a meaningful generalized fidelity concept.

3.4 The incommensurability of fidelity metrics

Assessing the fidelity of an episode of cultural transmission depends not only on the investigator's particular choices of the relevant units of analysis but also on the metrics best suited to measure the relevant properties of the units. Accordingly, the investigator choses and/or designs metrics best suited for their specific explanatory project. As the explanatory relevance of specific similarities and differences will vary from one investigative project to the other, different metrics will be employed. For instance, in order to assess the transmission fidelity of word forms, Kirby *et al.* ([2008]) use Levenshtein edit distances, the minimal number of changes, such as insertions, replacements, and deletions, necessary to transform one specific string of characters into another. In contrast, archaeologists use a variety of spatial metrics in order to assess the morphological similarities and differences between the model artefact of a source and the copied artefact of the learner (for example, Shennan [1997]). In some laboratory settings, the measurements of episodic fidelity are based on similarity scale coding, such as on some coder's intuitive assessment of similarity between two displays (for example, Caldwell and Millen [2008]) asked coders to use a scale going from one (low similarity) to seven (high similarity) to measure the similarity of spaghetti towers). Yet other metrics deal with the presence and absence of some specific set of characters, with the overall similarity of the displays assessed by the number of characters they share (for example, O'Brien *et al.* [2001]).

A consequence of the plurality of metrics used to quantify episodic fidelity is that although each metric is tailored to assess the relevant (dis)similarities of two cultural traits, the metrics themselves are often incommensurable with one another. In other words, the metrics are often not convertible into one

another. Because different metrics typically measure very different kinds of public displays, and the range of properties measurable by each metrics usually do not overlap, there is often no common denominator available to convert the results of one metric into those of another. For instance, Levenshtein distance measures similarity of word morphology in terms of specific operations on a string of symbols. In contrast, the morphometrics used by archaeologists typically evaluate the similarity of artefact form in terms of shape differences, measured in centimetres or angle degrees. As there is no common denominator between operations on a string of symbol and morphological differences measured in centimetres or angle degrees (for instance, how many typos is a six-degree difference in the notches of an arrowhead worth?), the two metrics cannot be converted into one another. In other words, they are incommensurable.

What makes one metric incommensurable with another is not that the specific cultural traits they are comparing do not belong to the same empirical domain, such that linguistic traits are always incommensurable with, say, behavioural ones. For instance, Derex *et al.* ([2013]) use Levenshtein metrics to measure similarity in sequential behaviours, comparing how many actions in a sequence differ from one another, analogously to how Kirby *et al.* ([2008]) do with string of characters. Nor is it that two metrical systems measure similarity using different base units (for instance, centimetres instead of inches). What makes a metric incommensurable to another is that the two metrics deal with different dimensions. For instance, whereas Levenshtein metrics measure differences in two sequences or strings of items in terms of insertion, deletion, or substitutions of items, morphometrics as those used by archaeologists deal with very different dimensions, such as spatial dimensions. This is formally known as the violation of the mathematical principle of dimensional homogeneity: because the dimensions being measured are different, the two scaling systems are incommensurable, that is, their measurements cannot be converted from one another (Barenblatt [2003]; Lemons [2017]).

As most explanatory projects only demand a limited set of metrics capable of dealing with the transmission episodes of some specific cultural traditions, the general incommensurability of the metrics used by cultural evolutionists across their different explanatory projects is usually not a practical problem. The investigator interested in the fidelity of word transmission need not worry that the similarity metric she uses cannot be converted into an equivalent similarity metrics scaled in terms of centimetres, as used by the archaeologist. However, the incommensurability of episodic fidelity metrics is problematic if one is interested in developing a single, common fidelity metric that would apply to any and all cultural traits, as the generalized fidelity concept would have it (Section 2, Condition 2). Indeed, a common cultural fidelity metric can only be obtained if all the metrics used to assess episodic fidelity were

convertible into one another, such that there would exist a common denominator to compare the similarities of any and all cultural traits. Perhaps such a common denominator could be found if we were able to directly compare the information contained in the mental representations used during episodes of cultural transmission. But, again, we have no such means, and even having such means, that there would be such a common denominator remains hypothetical.

In Section 5, we will return to the consequences that the relativity involved in the carving of units of cultural transmission and the incommensurability of fidelity metrics have on the notion of generalized fidelity. Before doing so, however, let us now turn to the idea that mechanisms of cultural transmission each have one and only one context-free degree of fidelity.

4 Propensity Fidelity

In addition to ascribing degrees of fidelity to episodes of cultural transmission, cultural evolutionists also often speak of fidelity as the tendency of transmission mechanisms to lead to high-fidelity episodes of cultural transmission, with some mechanisms being more or less capable to do so than others (for example, Heyes [1993]; Tomasello [1999]; Tennie *et al.* [2009]; Laland [2017]). For instance, it is commonly held that imitative learning (or imitation)—copying both the actions and end results of some behaviour—would be more faithful a learning mechanism than emulative learning (or emulation)—a learning mechanism that only copies the end results of some behaviour (Hoppitt and Laland [2013]). Put differently, imitation is, *ceteris paribus*, of higher fidelity than emulation. This is because imitation would ensure that the behaviour acquired by the learner will generally be similar in both the actions and end-results to that of the source, whereas emulation can only ensure the copying of the end results, leaving open to variation which specific actions the learner will enact to reach the same, copied end result (for example, Tomasello [1999]; Tennie *et al.* [2009]; Hoppitt and Laland [2013]). We can make sense of this second use of cultural fidelity by understanding the degree of fidelity of a transmission mechanism as its propensity to bring about episodes of high-fidelity transmission. Let us refer to this third and last notion of cultural fidelity as 'propensity fidelity'.

Propensity fidelity is defined here in terms of episodic fidelity, as the degree of fidelity of a transmission mechanism is cashed in terms of its propensity to lead to high-fidelity episodes of cultural transmission. A mechanism is one of high propensity fidelity if it generally leads learners to acquire cultural traits highly similar to the traits of the sources they learn from. In contrast, a mechanism is of lower propensity fidelity than another if it leads to the transmission

of cultural traits that are generally less similar than those transmitted by an alternative, higher-fidelity mechanism.

Propensity fidelity figures in many formal models of cultural evolution. When considering discrete traits, propensity fidelity is often parametrized as the probability that a copying-error—sometimes referred to as a 'cultural mutation'—occurs (for example, Boyd and Richerson [1985]; Henrich and Boyd [2002]). Models dealing with quantitative traits typically parametrize propensity fidelity as the distribution probability that a learner's trait take some value and is thus more or less similar to that of the source (for example, Henrich [2004]; Acerbi *et al.* [2012]). Also, several empirical studies have investigated the degrees of transmission fidelity of different learning mechanisms. For instance, Eerkens ([2000]) has examined how visual perception, motor skills, and memory affect variation in artefact shape, identifying as a general rule that copying-errors in some morphometric properties (such as length, width, and so on) that are under 5% of the original value go unnoticed and thus are left uncorrected. Similarly, Schillinger *et al.* ([2015]) have investigated the different degrees of copying-errors introduced by imitation and emulation when learning to shape blocks made of foam.

Adopting a criterion of explanatory relevance to assess episodic fidelity (Section 3) has important consequences on the explanatory role the propensity fidelity concept can play for cultural evolutionary theory. As propensity fidelity is defined in terms of episodic fidelity, the sensitivity of episodic fidelity to the explanatory interests of the investigator implies that propensity fidelity also serves as an explanation-relative notion. A transmission mechanism will thus be more or less faithful depending on its propensity to lead to the kind of episodic fidelity that the investigator is interested in explaining. In other words, a same mechanism of cultural transmission can be both of high and low fidelity, depending on the specific dimensions of a cultural tradition one is taking as the basis for assessing the mechanism's propensity fidelity.

Many investigators are only interested in the presence and absence of certain discrete functional behaviours. For instance, Horner *et al.* ([2006]) built a puzzle-box that could be opened either by lifting a door or by sliding it. In situations like this one, emulation and imitation can end up being as faithful as one another as the cultural trait is entirely defined in terms of its end result (for instance, whether the door was lifted or whether it was slid). In other words, there are no actions, different from the end result, that emulation can fail to copy. Alternatively, the investigator's explanatory project may require her to refine her grain of analysis such that the contrast between the actions and the end results of some functional trait becomes explanatorily relevant. For instance, Wasielewski ([2014]) found that when experimental participants are asked to produce some cognitively opaque end result—an end result is cognitively opaque when the specific actions required to reproduce it are

not obvious to the learners—imitation would surpass emulation in reproducing the cultural trait. In such scenarios, imitation will prove to be more faithful than emulation, as only imitation copies the specific actions necessary to faithfully reproduce the end result. Yet again, the investigator's explanatory project may require an even subtler grain of analysis, such that a contrast between the specific actions and the sub-goals they serve become explanatorily relevant (for example, Byrne and Russon [1998]; Charbonneau [2015b]; Stout [2011]). Palaeoarchaeologists are specifically interested in the transmission of knapping techniques, the faithful transmission of which hardly depends on copying the exact actions of a source. Indeed, when producing some sophisticated stone tool, knappers need to adapt each of their actions to the specific materials and local circumstances they are dealing with, often requiring online, *ad hoc* corrective measures (Whittaker [1994]). Learning by imitation would lead the learner to fail to produce a functional artefact as action copying would not allow the knapper to adjust her actions to the idiosyncrasies of her materials. In contrast, learning by emulation is likely to yield more similar artefacts as it will allow the knapper to learn the specific sub-goals of the recipe, the satisfaction of which will vary accordingly to the idiosyncrasies of the material context. In this latter case, emulation may serve as a higher propensity fidelity mechanism than imitation would.

The relativity of the degree of propensity fidelity of a transmission mechanism to the explanatory interests of the investigator is perfectly in line with the practices of most cultural evolutionists. As archaeologists, anthropologists, cognitive scientists, historians, and so on are typically interested in the evolution of specific traditions, which can be decomposed in many different ways, and ask different questions about these specific case studies, most cultural evolutionists will see very little issue in adopting local, explanatorily relevant criteria of propensity fidelity. It makes perfect sense that, for a same tradition, one transmission mechanism has a higher propensity fidelity than another, whereas for another tradition, it ends up being the less faithful one. Moreover, when dealing with a same cultural trait, it is perfectly feasible to compare the propensity of two (or more) mechanisms to lead to faithful episodes of cultural transmission by using a same metric. However, for claims relying on the assumption that the degree of fidelity of transmission mechanisms can be assessed in general—independently of the transmission of any specific cultural tradition—the sensitivity of both episodic and propensity fidelity to the local explanatory interests of the investigator is deeply problematic: a same transmission mechanism can have multiple degrees of fidelity, depending on the specific tradition it is transmitting, with the metrics used to assess the fidelity by which the tradition was transmitted varying accordingly.

5 Fidelity as an Explanatory Concept

5.1 Explaining cultural stability

The distinction between episodic fidelity and propensity fidelity structures the explanatory role of cultural fidelity when dealing with the stability of specific cultural traditions. Consider first that episodic fidelity merely assesses the similarity between two affiliated cultural traits. As it denotes an abstract relation of resemblance, episodic fidelity has no causal power of its own; it is merely a descriptive concept. For instance, we can understand a stable cultural tradition to consist in a lineage of highly similar cultural traits throughout multiple episodes of cultural transmission such that two cultural traits separated by multiple transmission episodes remain highly similar to one another. But in order to explain what made the tradition stable in the first place—why it is constituted of a chain of high-fidelity transmission episodes—we need to understand how some causal mechanism(s) led to such a successive series of highly similar cultural traits, during a prolonged period of time (Sperber [2000]).

Whereas episodic fidelity merely describes what a stable tradition consists of, propensity fidelity can explain the stability of a cultural tradition: the more propensity faithful a learning mechanism, the more often it will lead to the transmission of similar traits from sources to learners, thus promoting the integrity of the traditions it serves to transmit. Consequently, higher propensity fidelity learning mechanisms will tend to lead to more stable, longer-lasting cultural traditions than lower propensity fidelity mechanisms, as the first will more robustly produce chains of high-fidelity episodes of cultural transmission than the latter (Enquist *et al.* [2010]).

Many if not most cultural evolutionists have embraced a pluralistic approach to the explanation of cultural stability and so attempt to identify additional factors complementing the fidelity of transmission mechanisms in stabilizing cultural traditions. Indeed, the consensus is that transmission mechanisms are generally not faithful enough to explain—on their own—why cultural traditions remain as stable and long-lived as we observe them to be (Henrich and Boyd [2002]; Henrich *et al.* [2008]; Claidière and Sperber [2010]). For instance, the number of sources one learns from, the number of episodes of social learning involved in acquiring a same cultural trait, and the size and connectedness of human populations can all participate in stabilizing a cultural tradition (for example, Powell *et al.* [2009]; Strimling *et al.* [2009]; Enquist *et al.* [2010]; Morin [2016]). Strategies in selecting from whom, when, and what to learn from others, perhaps even combining (blending) different sources, can also reduce, at the level of the population, the variation introduced by imperfect transmission mechanisms (for example, Boyd and

Richerson [1985]; Henrich [2004]; Laland [2004]). The motivation, prosociality, and conservativeness of individuals may also affect the stability of a cultural tradition (for a general overview and relevant references, see Dean *et al.* [2014]).

It is important to note that these complementary factors—they are complementary in that they all can increase the stability of a cultural tradition—do not add to the degree of propensity fidelity of cultural transmission mechanisms *per se*. Transmission biases and population structure, for instance, can jointly winnow—at the level of the population—the variation generated by transmission inaccuracies, thus increasing the stability of cultural traditions at the level of the population (for example, Henrich and Boyd [2002]). However, these additional factors do not directly affect the expected degree of fidelity of the specific transmission mechanisms involved in the transmission of traditions. Rather, they increase the degree of stability of cultural traditions by constraining, at the level of the population, the spread of cultural variation introduced by imperfectly faithful transmission mechanisms.

5.2 Explaining human distinctiveness

The explanatory prospect of cultural fidelity is much less promising for claims concerning inter-specific differences in cumulative cultural capabilities.

Recall that in Section 2 the notion of generalized fidelity was defined as one that satisfies three conditions: (i) a mechanism of cultural transmission needs to possess one and only one degree of fidelity, that it cannot have multiple degrees of fidelity, (ii) the degree of fidelity of any transmission mechanism should be quantifiable using a common metric, and (iii) the degree of fidelity of a transmission mechanism must be an intrinsic property of that mechanism, that it is not a contextual, tradition-relative property of the mechanism. As discussed throughout Sections 3 and 4, none of the three conditions are nor can be satisfied.

When analysing the notion of episodic fidelity, we found that assessing the fidelity of any episode of cultural transmission always depends on the specific explanatory interests of the investigator. Resulting from this explanatory pluralism, measures of episodic fidelity were found to always be relative to the specific way the investigator carved out her unit of analysis. As the propensity fidelity of a transmission mechanism depends on which sorts of episodic fidelity the investigator is interested in, the assessment of a mechanism's fidelity is also always relative to the specific way the cultural units are carved up. Consequently, the assessment of a transmission mechanism's degree of fidelity is relative both to the specific explanatory interests of the investigator and to the different kinds of cultural units the mechanism transmits. This context-dependence violates the third condition, that is, that the degree of fidelity of a

transmission mechanism is an intrinsic, context-independent property of that mechanism.

We have also seen that comparing the degree of fidelity of two transmission mechanisms, even when using a same metric of similarity, does not always show that one mechanism is, *ceteris paribus*, of higher fidelity than the other (for instance, that imitation is consistently a higher-fidelity mechanism than emulation). In Section 4, we saw that differences in the fidelity of two transmission mechanisms can favour one mechanism when comparing their accuracy in transmitting some tradition, but for other traditions, the advantage may shift to the other mechanism. This is because transmission mechanisms have different degrees of fidelity, degrees of fidelity that vary depending on the type of cultural traditions they serve to transmit. This violates the first condition, that is, that a transmission mechanism possesses one and only one degree of fidelity.

Finally, I have argued that there is no common metric that can be used to compare the degree of fidelity of any and all cultural transmission mechanisms. Lacking a direct access to the mental representations (or information) transacted during cultural transmission, cultural evolutionists are forced to measure similarities of the public displays of cultural traits. Because the specific metrics used by cultural evolutionists vary from one case study to the other and are designed to measure similarities between different, non-overlapping dimensions of the public displays, most metrics used by cultural evolutionists are incommensurable. In other words, they cannot be converted into one another. This violates the second condition, which demands that we can determine, using a common metric, the degree of fidelity of transmission mechanisms such that we can effectively compare them all on a common scale.

Contrary to what is commonly assumed, the notion of generalized fidelity is currently not capable of determining whether some transmission mechanism is, in general, of higher-fidelity than another. Consequently, the conceptual analysis developed here challenges the claim that human transmission mechanisms are of higher fidelity than that of non-human species by showing that the notion of generalized fidelity currently used by cultural evolutionists when making these comparisons has no operational grounds.

6 Conclusion

In this article, I have argued that cultural evolutionists in fact use several concepts of cultural fidelity. I have shown that episodic fidelity—the degree to which a cultural trait of a learner is similar to that of its source—and propensity fidelity—the propensity of a mechanism to lead to high-fidelity episodes of cultural transmission—are both conceptually and operationally functional notions of cultural fidelity and that their use by cultural

evolutionists causes no problem. In fact, I have argued that these two notions are useful concepts when one seeks to explain why some cultural traditions are stable. In contrast, I argued that the notion of generalized fidelity, as it is currently used by cultural evolutionists, is problematic and explanatorily inoperative. Unless an alternative concept of generalized fidelity is designed, the claim that only we humans possess the capacity for cumulative cultural evolution because of our higher-fidelity transmission mechanisms will remain unfounded.

On a more positive note, I would like to point at two potential avenues in devising an operational and explanatory concept of generalized fidelity. A first possibility is that we may, one day, be capable of directly accessing the mental representations transacted by cultural transmission, develop a systematic method to carve cultural units at their natural joints, and establish a common metric capable of measuring their degree of fidelity. Should this happen, not only would a notion of generalized fidelity become operational, but both episodic and propensity fidelity will have to be remoulded in terms of information transmission instead of (dis)similarities between public displays. However, whether this will one day be feasible remains open to speculations.

An alternative, more promising avenue would be to redefine generalized fidelity not as an intrinsic property of transmission mechanisms but instead as a comparative relation between different mechanisms in different contexts.[2] For instance, we may observe that, in most contexts of transmission, one mechanism generally exhibits higher propensity fidelity than another. Consequently, we could generalize that, over most traditions, one mechanism typically exhibits higher propensity fidelity than another. This solution takes seriously the context-dependence of fidelity assessments and avoids the incommensurability problem by comparing cultural traits sharing the same dimensions with one another. Instead of being measured on a continuous quantitative scale (see Section 2), generalized fidelity would be measured on an ordinal scale, with a mechanism being of higher or lower fidelity than another, but not being intrinsically a high- or low-fidelity mechanism. This solution demands, however, that cultural evolutionists systematically compare how different transmission mechanisms fare in transmitting the same tradition and whether these results are robust across different traditions and across different domains (see Tamariz *et al.* [2016]) and, more importantly, whether these results are robust across different species. An explanatorily potent concept of generalized cultural fidelity is thus still an open possibility, but it remains to be properly designed.

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