**Replicate After Reading. On the extraction and evocation of cultural information.**

**Abstract**

Is replication in the cultural domain ubiquitous, rare, or non-existent? And how does this compare to that paradigmatic case of replication, the copying of DNA in living cells? Theorists of cultural evolution are divided on these issues. The most important objection to the replication model has been leveled by Dan Sperber and his colleagues. Cultural transmission, they argue, is almost always reconstructive and transformative, while strict ‘replication’ can be seen as a rare limiting case at most. By means of some thought experiments and intuition pumps, I clear up some confusion about what qualifies as ‘replication’. I propose a distinction between *evocation* and *extraction* of cultural information, and apply these concepts at different levels of resolution. I argue that we should stick to a purely informational definition of replication, and resist a more material conception. Even after taking Sperber’s valuable and important points on board, the notion of cultural replication still remains valid and useful. This is fortunate, because we need it for certain explanatory projects (i.e. understanding cumulative cultural adaptations).

Keywords: cultural evolution; replication; information; granularity; extraction and evocation; memes

**Introduction**

Many discussions in the burgeoning field of cultural evolution still revolve – in one way or another – around the scope and limitations of the analogy with biological evolution (Lewens 2015; Mesoudi 2011; Buskes 2013; Claidière, Scott-Phillips et al. 2014; Mesoudi, Whiten et al. 2006). How Darwinian is cultural evolution exactly? Is it cumulative, as in in the biological realm? Is it blind or guided? Does the phenotype/genotype distinction hold in the cultural domain? What, if anything, is the cultural equivalent of a ‘mutation’? Perhaps one of the most contentious points of comparison is the following: does cultural evolution happen through a process of replication (or copying/imitation)? Most famously, the notion of replication is associated with ‘memes’, the cultural counterpart of genes, coined by Richard Dawkins in *The Selfish Gene* (1976). According to Dawkins and others, memes play the role of the replicator in the cultural realm, analogous to genes in the biological realm (Blackmore 2000; Dennett 1995, 2017).

Many authors have disputed the usefulness of ‘replicators’ and replication in the cultural domain. Jablonka and Lamb (2014) have argued that the concept of cultural replicators ignores the role of learning and developmental construction. Others reject the idea that culture can be broken down into discrete, gene-like units (Bloch 2000; Mesoudi 2011), or they object that there is no cultural analogue for genetic codes and DNA replication machinery (Lewens 2015; Acerbi and Mesoudi 2015). Henrich and his colleagues, for their part, have argued that the whole issue of ‘replication’ is a distraction, as cumulative cultural evolution works perfectly well without discrete, gene-like replicators (Henrich, Boyd et al. 2008). One of the most forceful objections against the replication model of culture has come from Dan Sperber. For many years, Sperber and his colleagues have argued that culture does not evolve by straightforward replication, despite what the superficial analogy between genes and memes suggests (Atran 2001; Boyer 1994; Scott-Phillips 2015; Claidière, Scott-Phillips et al. 2014; Sperber 1996; Sperber 2000; Heintz and Claidière 2015). In the cultural realm, replication is a limiting case at best, applicable to only a few isolated phenomena. In all other cases, cultural transmission involves heavy doses of transformation and reconstruction on the basis of prior knowledge. This poses a serious problem to memes. According to Lewens (2015, p. 27) and many others, the memetic approach to culture is committed to “a strict process of replication”, and is therefore immediately ruled out a serious contender for studying culture. And Sperber’s objections to memes have wider consequences. Some other approaches in cultural evolution may well disavow meme-talk, but still rely on a conception of culture as consisting of discrete units that undergo a process of reproduction and selection (e.g. Hull 1990; O’Brien 2010). Thus, they may also fall prey to the Sperber’s objection (for a discussion of memetic versus selectionist approaches, see Lewens 2015, section 4.1).

In this paper, I provide a conceptual analysis of the term “replication” in both the cultural and the biological realm, defending a purely abstract and information-theoretical approach. In order to understand in what sense genes can be treated as ‘replicators’, we have to think of them in terms of abstract mathematical information, not in terms of physical substrates. Once we adopt *this* definition and extrapolate it to culture, some important objections against cultural “replication” evaporate. By means of some thought experiments, I make a distinction between *evocation* and *extraction* of cultural information, and apply these concepts at different levels of abstraction.

**Amusing mathematicians**

A group of mathematicians likes to tell jokes during their conference dinners. Because they have known each other for a long time and are such avid humorists, they have designed a more efficient system for their amusement. They have assigned numbers to each joke in their repertoire, so now they can save time and just call out that number. So one night at a conference dinner, the first mathematician shouts out: "56!" Boisterous laughter from around the table. The second mathematician has a go: "532!" Everyone cracks up again. A third mathematician shouts "345!" Just a few chuckles and groans, with the exception of one young mathematician, who is rolling over the floor laughing. The third joke-teller turns over to the rookie and asks him: "So you really liked my last joke, didn't you?" The young one responds: “It's just that I had never heard that one before!"[[1]](#footnote-1)

I am not sure where this joke originated, but for all I know, it could have been dreamt up by Dan Sperber or one of his collaborators, because it nicely illustrates an important insight of theirs about cultural evolution. Many models of cultural evolution assume more or less by default that, whenever we see chains of identical or similar representations in a cultural environment, some sort of replication must be going on. But the joke about the mathematicians illustrates how this assumption is wrongheaded. Their system of amusement is not based on straightforward transmission. The joke teller does not transmit the joke, but just selects one from the repertoire and calls out its number, thus bringing about a similar representation in the minds of the receivers. This may well look like replication, because there is a causal arrow going from sender to receiver, supported by the usual counterfactuals. For example, if you mishear the number being called out, you will end up with a different the representation. But the numbers themselves are not funny. They provoke laughter only because they elicit some previously stored, fully formed semantic content. For the system to work, every participant already needs all the jokes stored in memory, along with the corresponding numbers.[[2]](#footnote-2) This, of course, is the point of the punch line: if you start laughing, you *must* have heard the joke before.

Sperber himself illustrates the point with a different thought experiment. Imagine you see a sequence of tape recorders: the first recorder plays a song, then stops. A few seconds later the second recorder in line starts playing the same song. When it has finished, the third sets in, etc. If you witness these events, you may reasonably infer that the devices are recording and then replaying a song. In other words, there seems to be replication going on. But then it is revealed that the sound-recorders already have a repertoire of songs stored in memory, and they are “activated by the sound of the last five bars of any melody in their repertoire” (Sperber 2000, p. 169). After the first recorder stops playing, the second recorder identifies the song and retrieves it from its internal memory. No replication is taking place, even though a naive observer might be forgiven for thinking so. Returning to human beings, we could imagine – ruining our punchline – that people are born with an innate repertoire of jokes, each of which can be triggered by a certain stimulus (hearing a call-out number). In this way, we can imagine a Chinese whisper chain of people amusing each other with jokes, even though no transmission is going on (or hardly any).

It goes without saying that Sperber and his colleagues are not suggesting that humans are born with innate knowledge of jokes, or with any other semantically complex representations. But still, this is a useful limiting case to think about cultural transmission. In general terms, Sperber proposes three “minimal conditions for true replication”. For B to be a copy of A,

(1) B must be caused by A (together with background conditions)  
(2) B must be similar in relevant respects to A  
(3) The process that generates B must obtain the information that makes B similar to A from A. (Sperber 2000, p. 169)

The third condition is the crucial one, and is generally not fulfilled in the cultural domain, and certainly not in our scenario about the mathematicians. In a typical act of communication or social learning, people do not copy representations directly, but “reconstruct” them on the basis of knowledge they already possess, whether that knowledge is innate, has been acquired earlier, or is embodied in the environment: “information provided by the stimulus is complemented with information already available in the system” (Sperber 2000, p. 171). Although Sperber does not define his notion of “information”, I think his discussion of triggering makes most sense in the context of the mathematical definition of ‘information’ (Shannon 1948/2001), and I will rely on this definition to cash out my own distinction between *evocation* and *extraction* (see further). [[3]](#footnote-3) In this mathematical sense, information, roughly speaking, can be seen as a measure of surprise. For instance, in the case of Sperber’s triggered tape recorders, the ‘receiver’ already has the full song stored in memory, so the message is not ‘surprising’, and contains no information. Similarly, if you listen to a joke that you have heard before, the message carries no new information (for you). But a novel joke has the ability to surprise you, because it contains new information (for you).

In any event, without the availability of some prior knowledge, cultural transmission could not succeed in the first place. Public expressions or displays of culture almost always underdetermine the representation being transmitted. In the extreme case of the mathematicians, an observer can immediately see this, even without knowing the details of their communication system. A three-digit number cannot store all the semantic content that goes into a joke. If the mathematicians end up laughing in concert (presumably entertained by the same joke), that must have been because the semantic content in question was *already* available to them prior to the calling-out.

Even when a joke is spelled out in the usual way, however, successful transmission depends on substantial prior knowledge on the part of the listeners: mastery of the language in which the joke is related (vocabulary, pronunciation, grammar, etc.), but also folk psychological knowledge, familiarity with the conventions of joke-telling, and perhaps also background knowledge about politics, social life, sex, etc. In a successful recounting of a joke, the utterances of the joke-teller should provide enough clues (but not too many) for the audience to reconstruct the intended meaning and ‘get’ the punchline.

If we are trying to explain the existence of stable cultural traditions through time, we therefore have to take into account the contributions made by transmission as well as evocation. Some representations achieve wide dissemination in part because humans beings have universal cognitive predispositions and biases, and because they live in similar environments. Certain representations are more salient, memorable and inferentially rich to the human mind than others. In Sperber’s framework, “cultural attractors” are locations in the space of possible representations that are maximally relevant, from a cognitive perspective. In a cultural population, shared representations will gravitate towards those attractors: “to some extent all humans, and to a greater extent all members of the same population at any one time, are attracted in the same direction” (Sperber 1996, p. 118). In his book on cultural traditions, Morin (2015) has proposed a spectrum between “evoked” and “transmitted” culture. If the mathematicians in our joke were to play a game of Chinese whisper, making use of their coding system, the stability of the transmission chain would be mostly a function of *evocation*, not transmission. We would find ourselves at the ‘evoked’ end of Morin’s spectrum, just like the sequence of sound recorders in Sperber’s though experiment. Other cultural traditions may be closer to the transmission end of the spectrum, but probably no cultural traditions can persist without at least *some* element of evocation.

**Reconstructing and Decoding**

Sperber and his colleagues are completely right to call our attention to the role of evocation and reconstruction in cultural traditions. If we see a chain of similar representations that is causally connected, we should not assume by default that some process of straightforward replication is going on. In Sperber’s words, cultural theorists should not “take for granted that the co-occurrence of causation and of similarity between cause and effect is sufficient evidence of inheritance” (Sperber 2000, p. 169)**.** Apart from this conceptual point, I also grant that Sperber is probably right about the empirical facts. In human culture, virtually *every* form of cultural transmission involves at least some element of evocation. The respective contributions of transmission/evocation may differ, but the stability of cultural traditions is never exhaustively explained by transmission alone.

But now let us proceed to the areas of disagreement. Imagine that our mathematicians have devised a slightly different way of telling jokes. Suppose they are particularly fond of dirty jokes, but they don’t want to be overheard by colleagues with more delicate sensibilities. Rather than assigning numbers to a fixed inventory of jokes, they have devised to numerical code. Each number that is called out corresponds to a specific joke, as before, but this time the code is generative. Novel as well as old jokes can be encrypted. Now suppose that we have a transmission chain of mathematicians, like in the Chinese whisper game. Each mathematician communicates a certain number to his neighbor, who then deciphers the semantic content, and proceeds to ‘tell’ the same joke to the next one in line.

In many respects, the new scenario resembles the original. A joke-teller utters a number, the receiver ‘gets’ the joke and cracks up. In both cases, a listener cannot appreciate the jokes without prior possession of substantial knowledge. If you don’t know the code for deciphering jokes, or if you don’t know the inventory, you will not end up with the original representation in your mind, and communication will fail. Despite appearances, no straightforward copying is taking place, but rather a complicated process of reconstruction on the basis of prior knowledge.

In some crucial respects, however, our new situation is clearly different from the first. Even though the jokes are being *reconstructed* on the basis prior knowledge, it is perfectly possible that some mathematician listening to the encrypted joke had indeed ‘never heard it before’. I propose that we can treat the second system of communication, unlike the first, as a form of *replication*, despite the fact that it relies on heavy doses of reconstruction, and does not involve a straightforward copying mechanism. The main motivation behind this proposal is pragmatic. If we are studying the dissemination of a certain joke in a population of mathematicians, it does not really matter how exactly ‘replication’ is achieved. Whether the jokers are spelling out the jokes in the usual way, or using some sort of elaborate code, we will observe the same processes of dissemination, mutation, cultural attraction, branching of lineages, etc. As long as the encryption system is faithful and reliable, we can stand back and abstract away from the precise mechanism. Notice that we can *not* do that with the Sperber’s sound recorders, or with the first scenario of the mathematicians. If we black-box the machines and treat them as replication devices, then we are bound to go astray in our explanatory projects. For instance, a theorist blackboxing the sound recorders might be led to predict that mutations and noise in the “transmission” chain will accumulate over time, and lineages will start to evolve. But this would be factually wrong: the sound-recorders will keep playing the same song over and over again. There might be noise or glitches in each playing, but those will not accumulate.

As a real-life example of the second scenario, consider the famous Enigma code employed by Nazi Germany during the Second World War. Enigma encryption was carried out by an electro-mechanical cipher machine, and was based on a substitution scheme for each letter in a given message. It was also coordinated by an elaborate system of constantly changing routines. In order to extract the intended message on the receiving end, substantial ‘knowledge’ is already presupposed. First of all, the receiver needs to have another Enigma machine to decipher to message, but she also needs to know the exact instructions for setting it up, which was based on the daily changing routine. Because the British intelligence agencies intercepting the German messages lacked such prior knowledge, they could not decipher the messages.

Does the Enigma system for communication qualify as a form of *replication*? In many respects, Enigma communication is behaviorally indistinguishable from replication, as indeed it was designed to be by German cryptographers. For the sake of military success, the message coming out at the receiving end (e.g. plans for military maneuvers) had better be an exact copy of the original. For a military historian interested in cultural transmission chains, it would have made no difference if the Germans had used a difference system of communication, or indeed if they had relayed un-coded messages (though of course it would have been strategic folly).

If all these examples can be regarded as “replication”, as I propose, then it seems that replication is perfectly compatible with heavy reconstruction on the basis of prior knowledge. Even though the information of the stimulus is “complemented with information already available in the system”, in Sperber’s words, and even though the transmission chain would break down completely without such prior information, both scenarios still fulfill Sperber’s third minimal condition of replication: “The process that generates B must obtain the information that makes B similar to A from A.” (Sperber 2000, p. 169). Lewens (2015, p. 28) also criticized Sperber for being too demanding about what constitutes proper replication. For Lewens, replication in the cultural domain just means that “a given idea [is] causally responsible for the structure of a resembling daughter idea”.[[4]](#footnote-4) Because Sperber’s concept of “reconstruction” is ambiguous in this regard, I propose instead to distinguish between *evocation* and *extraction*. In a case of *evocation*, the final representation is already available to the receiver and is merely being triggered by some simple stimulus. [[5]](#footnote-5) No transmission is taking place (except for the trigger), and thus no replication is happening. In the case of *extraction*, by contrast, prior knowledge on the part of the receiver merely serves to recreatethe transmitted representation, not to evoke some previously stored representation. In the case of extraction, the message itself is novel and surprising to the receiver, even though the transmission process is elaborate and indirect (below I’ll apply these concepts to different levels of abstraction).

**Information and Redundancy Demons**

My proposal relies on an abstract and information-theoretical conception of cultural representations. In the second scenario of the mathematicians, but not the first, there is a significant transfer of information, in line with Shannon’s (1948/2001) conception of information as a reduction of uncertainty. The extracted semantic content is ‘surprising’ to the receiver, assuming he has not heard the joke before. In the first scenario, by contrast, there is hardly any reduction of uncertainty, except for the few bits of information involved in the current choice from the repertoire. This, of course, will be reflected by the length of the call-out numbers. In the original situation, the listener only needs a few bits to “reconstruct” the semantic content of the joke. In the second scenario, however, the numbers need to be significantly longer, as each individual word in the joke needs to be conveyed.

Some cultural theorists resist this purely abstract approach to cultural representations in terms of information. Rather than identifying cultural representation with information, they are looking for some sort of physical entity or structure that is being copied, such as brain states, behaviors, tools, sound waves, etc. (Aunger 2002). Many of them see DNA replication as a paradigm case of ‘proper’ replication, because it involves an identifiable and straightforward causal mechanism. Consequently, when they are talking about ‘replication’, they are thinking of some sort of straightforward physical mechanism for duplicating a physical object, structure or pattern. Other theorists endorse the conception of culture as information, but fail to maintain this informational perspective throughout, and sometimes (covertly) fall back on a more material conception. In his insightful book on cultural transmission, for example, Morin writes: “*Can traditions be identified with the information that is passed on when they are transmitted?* No, not always. Just because cultural transmission involves an exchange of ideas does not mean that traditions themselves are the ideas that their proliferation relies on.” (Morin 2015, p. 49, italics in original). But it seems that Morin is sliding from "information" to "conceptual idea" here, as is also visible a few pages earlier when he rejects the default conception that “culture is a set of socially transmitted representations (or bits of information)” (2015, p. 47). Morin is right that culture does not just involve ideas (mental representations), but also physical artefacts, behaviours and perceptual patterns (e.g. sound waves). But this does not compromise the informational conception of culture. External artefacts instantiate *information* no less than neural representations of ideas. Defenders of the informational view argue that, in all these cases, we should equate culture with the information instantiated by the material carrier, not with the material carrier itself.[[6]](#footnote-6)

Take the paradigm case of replication, DNA copying. As George Williams and others have argued, genes should not be identified with physical molecules, but rather with the *information* residing in those molecules (Williams 1992; Durham 1991; Haig 2007). It is tempting to think that the entity being copied is the physical DNA molecule itself. DNA, after all, is a discrete and visible physical structure. But on the informational approach, the only thing that matters is that some abstract information (a digital sequence) is recreated in a different physical environment. Even though the mechanism responsible for replication of genes is relatively straightforward and simple, this is not a necessary requirement to justify talk about ‘replication’.

A thought experiment will help to see this. Imagine that the replication of genetic information in our bodies is carried out by a cohort of tiny agents. Let’s call them Redundancy Demons. During cell division, the demons unwind a DNA strand, communicate the sequence to each other, and then re-assemble a complement DNA string base by base (think of plastic toy models of DNA used for educational purposes). The Redundancy Demons are extremely diligent and achieve almost perfect fidelity, just as in the actual world we live in. Does this qualify as replication? *Ex hypothesi*, the demons’ labor would be indistinguishable from “true” replication. It is logically possible that such demons are at work as we speak, just as some liberal theologians have suggested that God is secretly fiddling with our DNA, all the while making sure that He stays below the threshold of statistical detectability (Haught 2000; Miller 2000). We could easily make our thought experiment more fanciful, without changing the basic point. Even if it were discovered that Redundancy Demons use a range of different molecules for encrypting the genetic information, rather than the four known nucleobases (ACGT), that would not make any difference in practice, as long as information can still be somehow transcribed to the right amino acid sequences. And what if they used tiny Enigma machines for secrecy, decoding the information in each transmission event? None of this would make a difference for the informational view, and none of it would compromise the evolutionary algorithm of variation and selection: to all intents and purposes, what is going on is still “replication”.

**Level of resolution**

What are the Redundancy Demons copying? Information of course, just like natural DNA copying mechanisms in the real world. But information is not a given in the world. It needs to identified, and this can happen at different levels of resolution. Even in this paradigm case of replication, we need to settle on the right level of analysis to identify information. If we say that two chromosome in two different cells are “replicas” of one another, when the process of regular (mitotic) cell division has been completed, we don’t mean to say that they are *exactly* alike. In fact, there will be plenty of differences between them: they are wound up and folded in a different way, they have a different spatial orientation, and their molecules are arranged in countless different ways. Two chromosomes are only “replicas” of each other to the extent that both can be seen as embodying a certain amount of abstract information in the way their base pairs are arranged along their doubled helix, abstracting away from everything else. There is much more “information” in a chromosome than that which resides in the one-dimensional arrangement of their base pairs, but that information is not preserved during cell division, so we ignore it. It is a difference that doesn’t make a difference (Dennett 2017).

Now let’s apply these same points to the cultural realm. If you identify cultural representations with some sort of physical substrate, you will look in vain for simple replication machinery that makes copies of those material entities, in the way that DNA strands unwind and assemble a replica. But on an informational approach, this is not necessary. What matters is that some piece of information is somehow transmitted from one physical carrier to the next, no matter how roundabout and circuitous the mechanism, and no matter how different the physical carriers.

Here as elsewhere, information can be found at different levels of resolution (Acerbi and Mesoudi 2015). For instance, when we say, upon being told a joke, that we have heard “it” before, we have implicitly adopted a certain level of resolution in our analysis. We are not talking about the specific wording, or acoustic qualities, or even the language the joke was spoken in. We recognize two representations as instantiating the *same* joke in virtue of some higher-level semantic similarities. If we want to amuse a friend with a joke we heard before, we are not interested in 'replicating' the exact wording, but we tell the story in our own words. At the highest level of abstraction, we may even identify a joke as the *same* one if it has a different storyline, but a similar set-up and comic effect. In Peter De Vries’s version of our mathematicians joke, the number system has been devised by prison inmates. At the end of the joke, after a similar build-up of shouting out different numbers, a newbie calls out a number from his cell, but he is met with dead silence. “The newcomer asked his cell partner, a seasoned inmate who had just got through explaining the system to him, ‘What’s the matter? Isn’t that a good story?’ ‘Oh, sure,’ the cellmate answered, ‘but he don’t tell it right.’” (De Vries 1958, , loc. 551) When I read this joke, I immediately recognized it as basically the “same” joke as the one I heard before about the mathematicians. But that relation of identity is only situated at the highest possible level of abstraction.

This is the context of our everyday understanding of jokes, but we can imagine other contexts. Several physical copies of *The Mackerel Plaza* contain an exact word-for-word copy of the joke about the inmates and their numbered jokes (as does my Kindle e-book). The book itself abstracts away from the verbal delivery of the joke (even though that, coincidentally, provides the very punchline). If *The Mackerel Plaza* is ever made into a stage play, then the actor playing the Reverend Mackerel may want to give an exact word-for-word verbal delivery of the joke. If professional comedians learn jokes from each other, they may pay attention to nuances of intonation, phrasing and delivery, but abstract away from exact wording. An even higher level of resolution is the *Aristocrats* joke, a notorious off-color joke which is more of an abstract template for telling a joke, but which is instantly recognizable and has been performed by countless comedians.[[7]](#footnote-7) Moving to lower levels of resolution, mnemonists like the famous Solomon Shereshevsky are capable of repeating several pages of texts verbatim, after having heard them once, though they have difficulties extracting the gist of story and relating it in their own words. If someone like Shereshevsky recounts a joke he heard from someone else, he will be able to ‘replicate’ at the level of individual words and phrases, but he will be unable to replicate it at the level of resolution that most of us focus on. And of course we can make a sound recording of a specific delivery of a joke, which replicates the jokes at an ever finer-grained level.

**Replicate after reading**

If we now (1) adopt an abstract definition of information and (2) distinguish between different levels of abstraction, we can resolve the issue of evocation vs. extraction in the cultural realm. In several publications, Sperber has argued that replication in the cultural domain is not impossible, but should be seen as a *limiting case* of the more general mechanism of cultural attraction: “there are cases of actual memes, though much fewer than is often thought. Chain-letters, for instance, fit the definition.” (Sperber 2000, p. 163).

We agree that chain letters can be treated as ‘memes’ that replicate in a cultural environment. But in virtue of what do we treat one chain letter as a replica of another, as an instantiation of the same ‘meme’? Two token letters of the same type can be different in numerous ways. In everyday talk about chain letters, we abstract away from type of ink, font, letter spacing, quality of paper, etc. In some contexts, we can move up to a higher level of abstraction: if I translate a chain letter into a different language, or rephrase it in my own wording, we would still arguably call it the ‘same’ chain letter (for instance, because it threatens the reader with the same evil curse). Popular understanding of chain letters also abstracts away from the exact physical copying mechanism. Many chain letters contain explicit instructions to ‘copy’ the letter and send it to a certain number of people, but often do not specify the copying mechanism, nor the physical substrate to be used. Chain letter memes do not “care” about such trifles, as long as they make it to the next generation. They leave the choice of physical implementation to their willing executioners.

In earlier days, people used pen and paper to copy chain letters.[[8]](#footnote-8) Later on, some mechanical procedures were developed to speed up the process, such as carbon paper and photocopy machines, or the forward button on an e-mail service. Note that, strictly speaking, none of these mechanisms involve simple and straightforward copying, not even photocopying machines. For one thing, all of those methods rely on a complex intermediate step which involves heavy doses of Sperberian reconstruction: reading. In particular, the chain letter meme needs to wrestle its way into a human brain, so as to trigger the right dispositions in the reader and enlist him to the memetic cause, for example by exploiting his superstitious fears. Photocopy machines are not superstitious, and do not copy anything out of their own accord.

Now, how about the difference between evocation and extraction? Think about a medieval scribe copying a handwritten Latin manuscript of the Bible, before the invention of the printing press. In order to copy the manuscript, the scribe needs to possess plenty of prior knowledge, about the orthography of the roman alphabet, about Latin vocabulary, systems of punctuation and grammar, etc. He wants to copy the manuscript, not the physical arrangement of ink on the parchment sheet, down to the minutest splotch. Every time the scribe glances at the source manuscript, such prior knowledge is retrieved from his memory, and relied on to normalize errors and noise: misshaped letters, typos, crossed-out words etc. A scribe who has no knowledge of the Arabic script is not capable of producing a decent copy of an Arabic manuscript, because he does not have the requisite knowledge to correct to the orthographical norm.[[9]](#footnote-9) At the lower (orthographical) level of manuscript copying, we see merely evocation. If we can talk about replication at all, it is at a higher level of abstraction. Each individual character and word is evoked from memory rather than transmitted, but the specific sequence of letters that I observe on the page constitutes novel information, and is *extracted* from the message. It was not already present wholesale in my mind.

**Digitization and copying fidelity**

But once we admit all of this for the case of chain letters, we will see that there is much more replication in the cultural realm than Sperber admits. More generally, any transcription of a written text can be analyzed in the same way, because it is similarly based on prior knowledge of alphabet and vocabulary: evocation at a lower level, extraction (and thus replication) at a higher level. Most fundamentally, such faithful replication at a higher level of abstraction is possible because of the partial digitization of language, in the form of a written alphabet. By sharing a fixed repertoire of building blocks out of which more complex representations are constructed, human communicators can achieve a higher level of copying fidelity.[[10]](#footnote-10) Because they normalize on the level of the building blocks, and also because use redundancy and repetition (Morin 2015), they prevent rapid decay and distortion of information. But language does not provide the only such example of digitization. In his latest book, Dennett (2017) also discusses digitization schemes for dance, musical notation, weaving, and computer programming. An especially interesting case is origami folding, in which a student witnesses a folding demonstration by a teacher, and then carries out the steps herself. Dawkins (1999) originally presented the example of origami folding as a solution to the problem of low copying fidelity in a cultural environment. In his account, the instructions in origami are “self-normalizing” (Dawkins 1999, p. xii), which prevents degeneration and distortion of the meme. Imperfect demonstration and small errors will be corrected by the pupil, and will not be preserved in the next generation. Sperber, for his part, has used the same example of origami folding to turn the table on Dawkins, and to show that cultural transmission generally does *not* involve replication. The student, Sperber argues, is not trying to imitate each and every gesture of the teacher. Instead, she is reconstructing a set of instructions, by drawing inferences about plausible intentions on the part of the instructor. In order to identify the steps in the sequence, the student is normalizing the behavior displayed by the teacher, parsing it into discrete steps (e.g. “fold the four corners into the middle of the page”).

Thus the normalisation of the instructions results precisely from the fact that something other than copying is taking place. It results from the fact that the information provided by the stimulus is complemented with information already available in the system. (Sperber 2000, p. 171)

This is true, but it is not very different from the example of chain letters, which Sperber already admitted as an instance of memetic replication. In reality, both chain letters and origami folding involve significant amounts of evocation of previously stored information, as well as extraction from the source. But they occur at different levels of resolution. At a lower level, what we see is mostly evocation. The student already possesses substantial knowledge about geometric figures, about the general philosophy of origami, and the typical steps out of which origami instructions are composed (fold / upper half / diagonal / turn over / opposite corners). Those are the building blocks of origami folding, partially digitalized in the same way as the letters of the roman alphabet. Aided by inferences about goals and intentions, the pupil identifies the building blocks she is already familiar with, and ignores the noise and errors in the demonstration. For example, when the student observes something approximating a rectangle, she infers that the teacher intends to make a rectangle, and then retrieves this representation from memory, rather than copying the slightly skewed figure displayed by the instructor. In that sense, lower-level knowledge about geometric figures is merely evoked, not transmitted.

Nevertheless, when we move up to a higher level of abstraction, we see that discrete pieces of information are being transmitted from the teacher to the pupil. If the teaching moment is to be successful, the specific sequence of steps must be reproduced by the pupil, in the right order. Now *this* sequence of steps, unlike underlying knowledge about triangles and folding lines, is not merely being evoked. It contains information that is novel and surprising to the pupil, and cannot be retrieved from memory. To be sure, as Sperber points out, there is no straightforward copying mechanism. But neither is there in the case of chain letters. In both cases, the information is being *extracted* from the stimuluson the basis of certain perceptual clues, in conjunction with background knowledge about lower-level building blocks, and possibly also higher-order contextual knowledge. In the case of the original joke about the mathematicians, by contrast, the information is being evoked *wholesale*, at the highest possible level of abstraction. There are no building blocks out of which the target representation is composed. Or in fact, there is only one building block, which is the complete joke itself. Naturally, Sperber is not suggesting that this is typical of real-life situations, and he admits that “in the cultural world, triggering and copying can and do combine in various degrees” (Ibid., p. 171). But this way of putting it remains vague, and suggests a situation of communicating vessels: the more triggering, the less copying, and vice versa. I propose to resolve the issue by distinguishing different levels of abstraction. In many cases of cultural transmission, evocation (at a lower level) *enables* extraction and replication (at a higher level).

**Evocation and extraction**

This analysis in terms of extraction vs. evocation, on different levels of analysis, can be applied to a range of different cultural phenomena. Claidière et al. (2014, p. 5) discuss the example of a student correcting writing errors made by the lecturer, while taking notes. This is not replication, according to these authors, because the student complements the information written on the blackboard with knowledge about the spelling of words that she already possesses. But even though the student already knows how to spell, she did not know the content of what the teacher is writing on the blackboard. In his own analysis of spelling errors, Dennett (2006) has argued that normalization in cultural evolution can take place at different levels of semantic depth: on the level of orthography (from “sePERaTE" to “separate”), spelling (from “sePERaTE" to “separate”) and at higher semantic levels (from “separate butt equal” to “separate but equal”). But the fact that humans correct “thinkos” on top of typos, as Dennett puts it, does not invalidate the replicative framework: it just makes it slightly more complicating (Dennett 2006; Dennett 2017, pp. 224-233).

As a final example, take a complex cultural representation in an oral tradition: a fairy tale. Acerbi and Mesoudi (2015) have analyzed the story of Cinderella on different levels of granularity. In an informal telling and retelling of the story, information is only preserved at a highest level of abstraction, namely the basic outline of the plot: “a story involving a young lady, first oppressed by her stepmother and stepsisters, and then succeeding in marrying a prince” (Acerbi and Mesoudi 2015, p. 493). In order to extract this information from the stimuli provided by the teller, people already need to have knowledge of the building blocks of the story, both at a lower level of granularity (words and expressions), but also at an intermediate level of abstraction (the concepts of stepmother, prince, sibling rivalry, romantic love). Cognitive psychologists have suggested that a proper appreciation of fairy tales depends on certain innate expectations about ontological categories (person, animal, inanimate object), which are triggered (evoked) in the minds of the listeners (Boyer 1994; Spelke 1994). In any event, whether the origin of evoked knowledge is innate or cultural, it is not transmitted by the storyteller, but is already presupposed. In virtue of this prior knowledge, the listener will be able to fill in some gaps and reconstruct the story, gravitating in the directions of certain cultural attractors (Sperber 1996; Scott-Phillips 2015; Sperber 2012). But the narrative itself is not evoked, because the listener had never heard the story before. At that level of granularity, the information is *extracted* from the stimuli. And we can model this as replication.

It is instructive to have another look at DNA. It is often argued that we can talk about proper “replication” in the biological domain because, unlike in the cultural domain, biological inheritance is caused by a single, robust and specifiable mechanism, and genes have discrete boundaries (Claidière, Scott-Phillips et al. 2014). But as Wilkins and Hull write about such critiques, “time and again an overly idealized view of Mendelian genetics is contrasted to a much more realistic view of [social-cultural-conceptual] change (Wilkins and Hull 2001). In particular, many critics underestimate the complexity and messiness of DNA replication. During cell division, the double DNA strands are unzipped, and each strand serves as a template for the assembly of its complement. But the reality is more complex. Not only does the replication machinery “normalize” at the level of the AGTC alphabet, but living cells also use a variety of complex DNA repair mechanisms, which are constantly at work to correct occasional errors. Such correcting enzymes, as Dennett writes, normalize to semantic norms just like intelligent human beings, albeit “local or proximal semantic norms” (Dennett 2006, p. 140). And the analogy extends further: there are mechanism for “proofreading” during DNA replication, analogous to how a student corrects errors on the blackboard. If there is a mutation in a single DNA strand, usually the repair mechanism excises the damaged parts, and recompletes the strand by using the other strand as a template (genes use redundancy to minimize errors, just like human beings in cultural transmission). In other types of repair, no template is needed, as the damage is “known” to occur only in one of the four bases. In the case of double strand breaks, there are different mechanisms for ligating the broken ends, with some mechanisms used as a preferred “first response”, while others only as a “last resort” in case of severe damage. Loss of the genes for proofreading results in hypermutation, and prevents high-fidelity transmission chains.

None is this is to deny that cultural replication, by and large, is a lot more messy and complicated than biology. But there is no qualitative difference. If we adopt an informational approach, we can abstract away from the nitty-gritty of both biological and cultural evolution. Heintz and Claidière, after presenting the Sperberian argument about the constructive nature of cultural evolution, argue that it is “not possible” to do an analysis of cultural phenomena “without peering into […] constructive cognitive processes.” (Heintz and Claidière 2015, p. 800) I think the current analysis shows that, for certain theoretical purposes, we may indeed safely black-box the underlying constructive processes, as long as we have assured ourselves that we are dealing with reconstruction rather than with wholesale evocation. Reconstructive processes do not rule out replication, or as Dennett writes: “You can finesse your ignorance of the gory mechanical details of how the information got from A to B, at least temporarily, and just concentrate on the implications of the fact that some information did get there—and some other information didn’t.” (Dennett 1995, p. 359) If we adopt a purely abstract conception of cultural representations, we can see under which conditions the gory details of cultural transmission can be safely ignored, and when they cannot be. My claim in this paper is that a process of information *extraction* can be safely blackboxed and treated as conceptually equivalent to ‘replication’, provided of course that the information in the target representation instantiates the same information as the source. By contrast, a process of *evocation* cannot be blackboxed, because the appearance of information being transmitted is merely an illusion.

**Conclusion**

In this paper, I have defended an informational approach to biological and cultural evolution, on the basis of some thought experiments and intuition pumps. Genes should not be identified with the DNA molecule itself, but with the abstract *information* of which the DNA molecule is the carrier. The fact that gene replication is achieved by a single identifiable molecule, with an alphabet of no more than four letters, is a coincidental fact about the efficiency of biological evolution, not a necessary condition for replication to take place.

The informational approach is open-ended and flexible, as it does not require any specific physical substrate or specific mechanism for replication. To be sure, culture is much more messy than biology, but this need not pose a serious problem to the replication framework. Any physical object can act as a carrier of information, and ‘information’ can be identified at numerous levels of abstraction. However, we have to be careful about where the information is *coming from*. As Sperber and his colleagues have argued, just because we observe chains of re-occurring representations does not mean that some sort of replication is going on. On our informational approach, this makes sense: in a process of mere evocation, there is no reduction of uncertainty on the part of the receiver, because the information in question was already in place.

Pace Sperber and his colleagues, however, I have argued that heavy-handed reconstruction is not incompatible with a replication framework *per se*. But we have to distinguish between different levels of abstraction. Even though the building blocks of cultural representations are often merely evoked, their specific arrangement is typically not. The latter is a form of *extraction*, not evocation. I agree with Sperber that almost every form of cultural transmission involves an element of reconstruction on the basis of prior knowledge, but I part ways with him when it comes to the usefulness of the replication model. By distinguishing between different levels of abstraction and sticking to an informational approach to culture, I hope to have defused some resistance to talk of replication and memes.

This analysis in terms of evocation and extraction sheds some light on the mechanisms of cultural transmission, and hopefully provides more clarity about what exactly we are tracking when we are studying cultural or biological evolution. But my discussion also serves more distant explanatory goals. In particular, if we want to understand the evolution of complex cultural adaptations (Henrich 2015; Mesoudi, Whiten et al. 2006), we need to be able to track cultural items as they accumulate, combine, branch out, and form different cultural traditions. In order to do so, we need to grant cultural items a relative measure of autonomy (Dennett 2017; Norenzayan 2013; Boudry, Blancke et al. 2015; Boudry in press). If cultural transmission is too close to the ‘evoked’ end of the spectrum, however, all of this becomes hard to make sense of. On the one hand, the facts of human history show that cultural information is preserved, transmitted, and eventually accumulated across generations. On the other hand, Sperber and his colleagues may well be right that that humans do not have a special talent for simple imitation, and that cultural transmission is always a highly reconstructive affair (but see Herrmann, Call et al. 2007; Tennie, Call et al. 2009; Whiten, McGuigan et al. 2009). I hope to have shown that these two perspectives can be reconciled. Reconstruction does not rule out replication.

**Acknowledgements**: XXX

**References**

Acerbi A and Mesoudi A (2015) If we are all cultural Darwinians what’s the fuss about? Clarifying recent disagreements in the field of cultural evolution. Biology & philosophy 30(4):481-503

Atran S (2001) The trouble with memes. Human Nature 12(4):351-381

Aunger R (2002) The electric meme: A new theory of how we think, Cambridge Univ Press

Blackmore S (2000) The meme machine (Vol. 25), Oxford Paperbacks

Boudry M, Blancke S, et al. (2015) What Makes Weird Beliefs Thrive? The Epidemiology of Pseudoscience. Phil Psych 28(8):1177-1198

Boudry, M. (in press) Parasites of the Mind. Why Cultural Theorists Need the Meme’s Eye View. Cognitive Systems Research

Boyer P (1994) The naturalness of religious ideas : A cognitive theory of religion. Berkeley (Calif.), University of California Press

Buskes C (2013) Darwinism extended: a survey of how the idea of cultural evolution evolved. Philosophia 41(3):661-691

Claidière N, Scott-Phillips TC, et al. (2014) How Darwinian is cultural evolution? Phil Trans R Soc B 369(1642):20130368

Dawkins R (1976) The selfish gene. Oxford, Oxford University Press

Dawkins R (1999) Foreword to The Meme Machine by Susan Blackmore: New York: Oxford University Press

De Vries P (1958) The Mackerel Plaza: A Novel, Open Road: Amazon e-book edition

Dennett DC (1995) Darwin's dangerous idea: evolution and the meanings of life. New York, Simon & Schuster

Dennett DC (2006) Breaking the spell: Religion as a natural phenomenon. New York, N.Y., Viking (Penguin)

Dennett DC (2006) From typo to thinko: When evolution graduated to semantic norms. Evolution and culture:133-145

Dennett DC (2017) From bacteria to Bach and back: The evolution of minds, WW Norton & Company

Dennett DC (2011) Homunculi rule: Reflections on Darwinian populations and natural selection by Peter Godfrey Smith. Biology & Philosophy 26(4):475-488

Dennett DC (2017) From Bacteria to Bach and Back: The Evolution of Minds, Penguin Books, Limited

Durham WH (1991) Coevolution: Genes, culture, and human diversity, Stanford University Press

Haig D (2007) The gene meme. In M. Ridley (Ed.), Richard Dawkins: How a Scientist Changed the Way We Think (pp 50-65)

Haig D (2017) Making sense: information interpreted as meaning, Preprint on PhilSci http://philsci-archive.pitt.edu/13259/

Haught JF (2000) God after Darwin : a theology of evolution. Boulder (Colo.), Westview press

Henrich J, Boyd R, et al. (2008) Five misunderstandings about cultural evolution. Human Nature 19(2):119-137

Heintz C and Claidière N (2015) Current Darwinism in social science Handbook of Evolutionary Thinking in the Sciences (pp 781-807), Springer

Henrich J (2015) The secret of our success: How culture is driving human evolution, domesticating our species, and making us smarter, Princeton University Press

Herrmann E, Call J, et al. (2007) Humans have evolved specialized skills of social cognition: The cultural intelligence hypothesis. Science 317(5843):1360-1366

Howe CJ, Barbrook AC, et al. (2001) Manuscript evolution. *Trends in genetics, 17*(3):147-152.

Hull, David L (1990) Science as a Process: An Evolutionary Account of the Social and Conceptual Development of Science. Chicago, University of Chicago Press

Jablonka E and Lamb MJ (2014) Evolution in four dimensions, revised edition: Genetic, epigenetic, behavioral, and symbolic variation in the history of life, MIT press

Legman G (2097) Rationale of the Dirty Joke: An Analysis of Sexual Humor: Simon & Schuster

Lewens T (2015) Cultural Evolution: Conceptual Challenges, OUP Oxford

Mesoudi A (2011) Cultural evolution. How Darwinian theory can explain human culture and synthesize the social sciences. Chicago, Chicago University Press

Mesoudi A, Whiten A, et al. (2006) Towards a unified science of cultural evolution. Behav Brain Sci 29(4):329-347

Miller KR (2000) Finding Darwin's God : a scientist's search for common ground between God and evolution. New York (N.Y.), HarperCollins

Morin O (2015) How traditions live and die, Oxford University Press

Norenzayan A (2013) Big gods: How religion transformed cooperation and conflict, Princeton University Press

O'Brien MJ, Lyman RL, et al. (2010) Cultural traits as units of analysis. Philosophical Transactions of the Royal Society B: Biological Sciences 365(1559):3797-3806

Scott-Phillips T (2015) A simple (experimental) demonstration that cultural evolution is not replicative, but reconstructive-and an explanation of why this difference matters. Journal of cognition and culture

Shannon CE (1948/2001) A mathematical theory of communication. ACM SIGMOBILE Mobile Computing and Communications Review 5(1):3-55

Shipman SL, Nivala J, et al. (2017) CRISPR–Cas encoding of a digital movie into the genomes of a population of living bacteria. Nature 547(7663):345

Spelke ES (1994) Initial knowledge: six suggestions. Cognition 50:431-445

Sperber D (1996) Explaining culture: A naturalistic approach. Cambridge, Mass., Blackwell

Sperber D (2000) An objection to the memetic approach to culture. In R. Aunger (Ed.), Darwinizing culture: The status of memetics as a science (pp 163-173). Oxford, Oxford University Press

Sperber D (2012) Cultural attractors. This will make you smarter:180-183

Tennie C, Call J, et al. (2009) Ratcheting up the ratchet: on the evolution of cumulative culture. Philosophical Transactions of the Royal Society B: Biological Sciences 364(1528):2405-2415

Tooby J and Cosmides L (1994) The biological foundations of culture. In J. Barkow, J. Tooby and L. Cosmides (Eds.), The adapted mind Evolutionary psychology and the generation of culture (pp 19-136). New York, New York, USA, Oxford University Press

Whiten A, McGuigan N, et al. (2009) Emulation, imitation, over-imitation and the scope of culture for child and chimpanzee. Philosophical Transactions of the Royal Society B: Biological Sciences 364(1528):2417-2428

Williams GC (1992) Natural selection, Oxford University Press

Wilkins JS and Hull D (2001) Replication and reproduction. The Stanford Encyclopedia of Philosophy https://plato.stanford.edu/entries/replication/

1. But the joke is much older than that. Peter de Vries’ satirical novel *The Mackerel Plaza* (1958) contains a version of the joke with prison inmates instead of mathematicians. [↑](#footnote-ref-1)
2. It doesn’t have to be memorized: we could imagine that all the mathematicians have been given a sheet of paper, with numbered jokes, and they are just looking up the jokes in the list. [↑](#footnote-ref-2)
3. The mathematical theory of information expressly leaves out all semantics, as Shannon thought this was “irrelevant to the engineering problem”. Shannon’s definition is a way to measure the *amount* of information, but it tells us nothing about what this information is *about*.It is unclear exactly how the mathematical definition relates to our everyday understanding of (semantic) information (Wilkins and Hull 2001; Dennett 2017, chapter 6), and this remains an outstanding problem in the philosophy of information. For a recent ambitious attempt to bridge the gap from mathematics to semantics, see Haig (2017). [↑](#footnote-ref-3)
4. I think this is actually closer to Sperber’s third criterion than Lewens suggests, but more importantly, if Lewens has such a relaxed notion of “replication”, it is hard to see why he still dismisses memes, which clearly fulfill his definition. A meme gets ‘replicated’ when it is causally responsible for the occurrence of another cultural representation that is sufficiently similar to be treated as an instantiation of the same ‘meme’. [↑](#footnote-ref-4)
5. Defined thusly, “evocation” should be distinguished from Tooby & Cosmides’ concept of “evoked culture” (Tooby and Cosmides 1994), which more narrowly refers to the role of innate cognitive mechanisms in bringing about cultural representations. My concept of “evocation” is broader. As the example of the mathematicians shows, information that is “evoked” need not be innate. It is possible that it was simply acquired or transmitted at an earlier point. [↑](#footnote-ref-5)
6. Consistent with his more material approach, Morin has also rejected the “reduction of genes to information” (personal communication, 2017). If genes are mere information, asks Morin, can we send them through the internet? Yes. According to a strictly information conception, “genes” can indeed be saved on a flash disk or e-mailed (see Dennett 2011). For Morin, this is a *reductio ad absurdum* of a strictly informational point of view, but I welcome the conclusion. The informational view also works both ways: researchers have recently succeeded in encoded a digital video into the DNA of a bacterium (Shipman 2017). [↑](#footnote-ref-6)
7. See [www.aristocratsjokes.com](http://www.aristocratsjokes.com) for a list of renditions and versions. The Wikipedia entry about “The Aristocrats” provides the abstract template of the joke (the “meme”), which consists only of three basic elements (Legman 2007). Thanks to an anonymous reviewer for this reference. [↑](#footnote-ref-7)
8. It has been argued that chain letters did not become truly epidemic until the invention of carbon paper. Memes ride piggyback on available technologies. [↑](#footnote-ref-8)
9. The analogy between manuscript copying and DNA replication is so close that programs for analysing phylogenetic inference can be used to uncover the relationships between medieval manuscripts (Howe 2001). [↑](#footnote-ref-9)
10. More fundamentally, humans are capable of copying action sequences (*imitation*), rather than just end products (*emulation*) (Whiten, McGuigan et al. 2009; Mesoudi 2011, p. 198-199). [↑](#footnote-ref-10)