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Corpses, maggots, poodles and rats: Emotional selection operating in three phases of cultural transmission of urban legends

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Abstract

In one conception of cultural evolution, the evolutionary success of cultural units that are transmitted from individual to individual is determined by forces of cultural selection. Here we argue that it is helpful to distinguish between several distinct phases of the transmission process in which cultural selection can operate, such as a choose-to-receive phase, an encode-and-retrieve phase, and a choose-to-transmit phase. Here we focus on emotional selection in cultural transmission of urban legends, which has previously been shown to operate in the choose-to-transmit phase. In a series of experiments we studied serial transmission of stories based on urban legends manipulated to be either high or low on disgusting content. Results supported emotional selection operating in all three phases of cultural transmission. Thus, the prevalence of disgusting urban legends in North America may be explained by emotional selection through a multitude of pathways.

Keywords: emotional selection; cultural transmission; disgust; emotion and memory; serial reproduction

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Several authors have argued for a Darwinian approach to explaining prevalent culture, in which one focuses on which cultural items are more likely to survive (Dawkins, 1976; Dennett, 1995; Sperber, 1996; Boyer, 2001).[1] Forces of cultural selection may include ecological factors but also details of the human psychology such as content biases (Sperber, 1996; Kelly, Machery, Mallon, Mason and Stich, 2006). As reviewed by Mesoudi and Whiten (2008), a provisional list of content biases includes a bias for stereotype-consistent information (Bangerter, 2000; Kashima 2000), a bias for counter-intuitive concepts (Barrett and Nyhof, 2001), a bias for hierarchically organized information (Mesoudi and Whiten, 2004), and a bias for social information (Mesoudi, Whiten and Dunbar, 2006). In addition, there is the idea of *emotional selection* proposed by Heath, Bell and Sternberg (2001), which will be the focus of the present paper.

Heath et al. (2001) proposed that the success in cultural evolution of stories such as urban legends, which are transmitted from individual to individual on a large scale, is to a considerable extent determined by the stories' ability to evoke widely shared emotions. These emotions may be both negative and positive. As a case study, Heath et al. focused on urban legends' ability to elicit disgust. Two main findings emerged. First, a study of web sites that document urban legends showed that legends with disgusting motifs were more likely to be spread across many web sites. Second, in an experiment where urban legends were manipulated with respect to their capacity to evoke the emotion of disgust, participants expressed greater willingness in passing along those stories that were more disgusting (controlling for how other emotional and information factors were altered by the manipulation). The two findings together support the theory of emotional selection: A certain outcome of cultural evolution was demonstrated (viz., stories that evoke the

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[1] The cultural items on which selection operates are often referred to as *memes* (Dawkins, 1976), but as a general concept it is not without its problems so we avoid that term in this paper. Our focus is specifically on transmission of stories.

emotion of disgust are prevalent among popular urban legends) which corresponded to an identified

mechanism for emotional selection (viz., stories that evoke widely shared emotions are more likely to be

passed along).

Whereas the emotional selection studied by Heath et al. (2001) operated through people's choices of

which stories to pass along at all, the dominant focus in studies of content biases has been what story content

is most likely to survive when stories are recalled (Mesoudi and Whiten, 2008). In order to make this

distinction explicit, the first aim of the present paper is to introduce the concept of different *phases of*

cultural transmission. The second aim is to extend the scope of emotional selection to include all of these

phases.

Different phases of the cultural transmission process

The idea that there exist several phases in which cultural selection can operate seems not to have been

explicitly discussed before.[2] In their provisional list of content biases, Mesoudi and Whiten (2008) cite only

studies that use the ambitious methodology known as "serial reproduction" (or "Chinese whispers"). In this

method, originally developed by Bartlett (1932), a story is transmitted along a chain of people such that each

individual receives a certain story and is requested to retell the same story for the next individual along the

chain. Thus, there is no element of choice in which story to receive, nor in which story to transmit. Biases

enter only with respect to how stories interact with memory. We shall refer to this phase of the cultural

transmission process as the *encode-and-retrieve phase*.[3]

In contrast, the study of Heath et al. (2001) deals with the question of which stories people prefer to

pass along. They study the situation where an individual knows several stories and chooses among them

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[2] A distinction between different phases is sometimes made implicitly, e.g., by Norenzayan, Atran, Faulkner and Schaller

(2006).

[3] This phase clearly consists of several steps. Although we do not pursue it in this paper, cultural selection may operate

through mechanisms specific to each step, i.e., selective encoding of certain content (cf. Zadny and Gerard, 1974; Kardes, 1994),

selective retention in memory of certain content (Bartlett 1932), and selective retrieval of certain content (Lyons and Kashima,

2003).

which stories to transmit (in the sense of pass along to others). This is another important phase of the cultural transmission process, which we will refer to as the *choose-to-transmit phase*.

Finally, individuals obviously have a choice not only on what material to transmit but also on what material to receive. People certainly have preferences over different cultural items; e.g., Martindale (1990) proposed a bias for novelty. People typically choose what stories they want to read. Even in oral storytelling, the listener will have an influence on what story is told (indeed, children are notorious for being very particular about what bedtime story they want). We shall refer to this phase of cultural transmission as the *choose-to-receive phase*.

It is possible that people's general preferences for what stories they want to hear are not identical to their preferences for what stories they like to tell. (For instance, parents and teachers may find that the things they want to tell children are not at the top of the list of things that the children want to hear.) In other words, it is not necessarily so that the cultural selection pressure goes in the same direction in choices to receive and transmit. Nor is either set of preferences necessarily linked to what is easily remembered. Thus, in order to understand how culture is shaped in the process of repeated cultural transmission within a population, the forces of cultural selection must be studied in each of the phases of the process. In this paper we make a first attempt at such a study, focusing on emotional selection based on disgust.

Emotional selection is likely to operate in all phases of cultural transmission

Heath et al. (2001) argued for emotional selection as a general phenomenon, such that stories that evoke any kind of widely shared emotion were hypothesized to have an advantage in the cultural evolution process. Two potential pathways were suggested whereby such an advantage might arise. First, people may pass along stories that evoke emotions because people may enjoy the consumption of emotions, both positive and negative (Andrade and Cohen, 2007; Tamir, 2009). Second, both positive and negative emotions may enhance social interactions by encouraging social sharing (reviewed by Rimé, 2009). In part, this may be related to effects of arousal (Berger, 2011).

Although the argument of Heath et al. (2001) was focused on what we have termed the choose-to-transmit phase, each of these factors seem to apply also to the choose-to-receive phase. To illustrate, suppose

that individual T knows an emotion-evoking story and has the option to retell it to individual R. With a focus on the transmitter (T), Heath et al.'s argument translates into the following two scenarios for the choice to transmit: mechanisms: T may want to retell the story because retelling it gives him or her an attractive opportunity to taste the emotion again, but also because the emotion has created a need in T to share it. With a focus on the receiver (R) instead, we obtain two scenarios for the choice to receive: R may want to listen to the story because it is an attractive opportunity to consume the emotion T has to offer, but also because of the social bond created by R sharing T's emotion. These are all plausible mechanisms that have echoes in the emotional intelligence literature where the expression, understanding and management of both one's own and another's emotions are discussed (Salovey, Detweiler-Bedell, Detweiller-Bedell and Mayer, 2008).

So far, we have argued that the original theoretical basis for emotional selection applies to two of the three phases of cultural transmission we defined above. To motivate emotional selection in the encode-and-retrieve phase, we must instead turn to the literature on emotions and memory. There exists a large body of evidence for enhanced recall of emotionally charged events; such emotional modulation of memory is associated with both positive and negative emotions, and emotions play a role both in encoding and retrieval (McGough, 2002; Baumeister, Vohs, DeWall and Zhang, 2007; Kensinger and Schacter, 2008). There is also an emerging neurobiological understanding of emotional modulation of memory, where independent memory systems linked to the amygdala and hippocampal complex act in concert when emotion meets memory (Phelps, 2004). Arousal may play a part too (Mather and Sutherland, 2011). All this evidence seems to support the notion of emotional selection operating also in the encode-and-retrieve phase of cultural transmission of stories. However, research on verbal recall tends to study recall of single words rather than entire stories, which might be an important difference from the point of view of cultural evolution (Norenzayan et al., 2006). In recall of stories, one story element may bias the recall of other parts of the story (Schacter, 1999). Thus, it is not self-evident that emotionally charged story elements have a positive net effect on recall of the entire story.

Emotional selection based on disgust

In their original study of emotional selection, Heath et al. (2001) specifically studied the emotion of disgust. Their motivation for this choice is that disgust is a distinct emotion, the elicitors of which have been precisely described. Indeed, the powerful emotion of disgust has received recent attention from theorists of both biological and cultural evolution. The disgust system may have evolved to help individuals in their decisions about what to eat in a world where infection and bacteria are spread through physical contact (Curtis, 2007; Schnall, Haidt, Clore and Jordan, 2008). Psychological research shows that food and its potential contaminants, such as body products and animals, are the main elicitors of disgust (Davey and Matchett, 1991; Rozin, Haidt and McCauley, 2008a; Oaten, Stevenson and Case, 2009).

According to the pathway expansion model of disgust and disgust elicitors, the "core" emotion of disgust originated in the mammalian bitter taste rejection system and evolved to protect the body from disease and infection and is elicited through food, eating, body products and animals; through biological and cultural evolution the system has then expanded to encompass disgust related to interpersonal and moral concerns (Rozin, Lowry, Imada and Haidt, 1999; Rozin, Haidt and Fincher, 2009). Indeed, the activation of disgust has been shown to influence both economic decisions and moral judgements (Sanfey, Rilling, Aronson, Nystrom and Cohen, 2003; Eskine, Kacinik and Prinz, 2011). Kelly et al. (2006) argued for the specific importance of disgust as a force of cultural evolution. In support of this notion they cited not only Heath et al. (2001) but also a study of the cultural evolution of etiquette norms by Nichols (2002). By comparing the norms from a 16th century etiquette manual with contemporary manners, Nichols found that old norms prohibiting actions that elicit disgust were much more likely than other old norms to be part of contemporary manners. Nichols connected this outcome of cultural evolution with a plausible mechanism, namely that cultural items that elicit negative affect, such as disgust, in general tend to have more memorable mental representations and hence an advantage in cultural evolution. Thus, in the terms we use in the present paper, he proposed disgust-based emotional selection operating in the encode-and-retrieve phase of cultural transmission as an explanation for the relatively high survival of etiquette norms related to disgust.

In summary, experimental evidence for disgust-based emotional selection of stories is limited. Heath et al. (2001) found emotional selection to operate in the choose-to-transmit phase in an experiment where the disgust level of stories was manipulated, but participants were only asked to rate the likelihood that they would pass on a given story. Thus, no actual decisions to pass along stories to someone else were made, which is a limitation of the study. For the encode-and-retrieve phase, despite a wealth of experimental evidence on emotional modulation of recall, there has been no experimental study of emotional selection in serial reproduction of stories, which has become the standard method of demonstrating effective content biases in this phase of cultural transmission (Mesoudi and Whiten, 2008). Finally, with respect to the choose-to-receive phase there is certainly lots of evidence that many people seek out opportunities to experience negative emotions under certain circumstances in which cognitions indicate there is no real threat, such as roller coasters and horror movies (Rozin, Haidt and McCauley, 2008b). The appeal of fear and disgust within the horror genre has long been the subject of theorizing grounded in psychoanalysis (Schneider, 2004; Fahy 2010), but there is also a recent experimental literature investigating when and why people consume negative emotions such as disgust (Andrade and Cohen, 2007; Tamir, 2009). Nonetheless, no prior research explicitly tests whether preferences to seek out disgusting stories are sufficiently general to act as a force of cultural selection of stories. In our studies, we aim to address all three issues mentioned above.

Materials used

As disgust can occur in many types of stories, we decided to narrow our focus to the domain of food and travel. This seems a reasonable approach as food and its contaminants are the main elicitors of core disgust. There is no shortage of stories about food and disgust among urban legends. We adapted four documented urban legends into components of a story about a traveller named Jasmine. One story component was about a poodle and a restaurant, one was about baking a cake for charity, one was a moral dilemma over what to eat in an extreme situation, and finally one was about the unexpected contents of a pizza; see Appendix A. From each of these basic story components, which were all high on disgust, we created a low-disgust version by changing the disgusting element into something benevolent (such as

changing "rat meat" to "olive stone"). In all of these stories Jasmine is acting alone. We also created versions where we added company for Jasmine (such as changing "Jasmine travelled alone" to "Jasmine travelled with some friends"). This manipulation, between asocial and social versions of the same story, turned out to have no significant effects and for the purposes of this paper we pool data from asocial and social versions.

Outline of studies

We present four studies. Experiment 1 was a classical serial reproduction experiment, conducted to test whether stories are better retained along a transmission chain if they contain a disgusting element. In other words, we investigated emotional selection in the encode-and-retrieve phase of cultural transmission. In addition, we asked participants to rate each story component on the likelihood that they would pass along such a story, in order to replicate the finding of Heath et al. (2001).

A concern with the argument that the effect of disgust manipulations can be attributed to elicitation of negative emotions was that disgusting elements are also known to be capable of evoking amusement (Rozin, Haidt and McCauley, 2008b; McGraw and Warren, 2010). In Experiment 2 we therefore used a survey to collect ratings of the same stories on how humorous they were, and also on all qualities previously found to be important predictors of pass along ratings (Heath et al., 2001).

In Experiment 3 we studied a novel type of transmission chain that incorporates the choose-to-receive and choose-to-transmit phases but avoids the encode-and-retrieve phase. Respondents were presented with story headlines (describing the key element of the story) which they could click to read the entire story, in which case they would then decide whether the story was worthy to be passed along to the next participant in the chain.

In the fourth and final study we investigated individual differences in the willingness to pass along stories involving various emotions, both positive and negative. For all studies except the first one we employed the Amazon Mechanical Turk, an online labour market where "workers" are recruited by "requesters" for the execution of online tasks. Tasks are rewarded by small amounts of money, typically less than one US dollar. The large supply of workers from different countries, age groups and educational backgrounds make the Turk an attractive source of participants in social science studies (Eriksson and

Simpson 2010; Mason and Watts 2009). Studies indicate that data obtained through the Turk are at least as reliable as those obtained via traditional methods (Buhrmester et al. 2011; Paolacci et al. 2010).

EXPERIMENT 1

In this experiment we used disgust-manipulated stories and the serial reproduction paradigm to examine emotional selection in the encode-and-retrieve phase of cultural transmission. We also collected data on the preference to pass along stories, to replicate previous findings of emotional selection in the choose-to-transmit phase (Heath et al. 2001).

Materials and methods

Materials and design

This study used transmission chains of four generations as in much previous serial reproduction research (Bangerter, 2000; Lyons and Kashima, 2003; Mesoudi et al., 2006). There were 40 transmission chains, which is the basic unit of analysis. The original story to be transmitted along the chain consisted of four components (paragraphs), each of which consisted of seven sentences crafted with the aim that each sentence would constitute a natural unit of the story in terms of recall (see Appendix A). The dependent variables were, for each story component and each generation, the number of sentences for which the gist was accurately recalled. As described earlier, each story component existed in four versions, which types we here label HA, HS, LA and LS (with H and L standing for high and low disgust, A and S standing for asocial or social setting). As described in detail in the "Coding" section below, the aim was to conduct a within-chain comparison of recall between different types of components. In order to achieve counter-balancing of story components, four different versions of the full story were constructed where the types of the story components varied according to a Latin square design. For instance, one version of the story had the *Dog* component of type HA, *Cake* of type HS, *Nepal* of type LA, and *Pizza* of type LS; a second version had *Dog* of type HS, *Cake* of type LA, *Nepal* of type LS, and *Pizza* of type HA, etc. Every transmission chain was given only one version of the story, so that each version was used in ten chains.

Between reading and recalling the story, participants were given a distracter task that took approximately ten minutes.

Participants

There were 160 participants in the main study (108 female and 52 male). The age range was 18 to 39 and the average age was 20.66 years (SD = 2.07). The students were attending an international summer school at the University of Sussex. The majority were third and fourth year undergraduates from American universities and in the main study 115 participants were science majors, 41 were art majors and 4 were unknown. All students understood the purpose of the study and each of them gave written consent in advance. All participants had normal reading and writing ability and were willing to take part in the study in exchange for chocolate bars and entry into a £50 prize draw.

Procedure

Students were approached and asked to take part in a story-telling experiment with the above-mentioned incentives. Each participant was presented with a set of six sheets. The first was the consent form on which bio data was also recorded, the second was the story that the participants were instructed to read and be prepared to recall. When participants had finished reading the story, they were asked to turn the page and complete the distractor task. The time in which they completed this task varied between 5 and 10 minutes. Participants were then asked to turn the page and, without looking back, "write as much of the story as they could remember" on a blank sheet of lined paper.[4] After completing their recall of the story, participants filled in a short questionnaire where they rated each story component on a few parameters, including the extent to which they found them disgusting and whether they would be willing to pass the story on to someone else (Heath et al., 2001). When responding to this questionnaire, they were at liberty to turn back to look at the story. Responses were on a Likert scale coded 5 = strongly agree, 4 = agree, 3 = don't

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[4] Five recalls in the first generation were discarded (and another five collected) as the participants had written bullet points rather than full sentences. Care was taken after this to emphasise to the participants that the story needed to be written in sentences.

know, 2 = disagree and 1 = strongly disagree. A final page was included where each student wrote their name and email address as entry for the prize draw at the end of the summer school.

Participants in the first generation were given one of the four versions of the full story about Jasmine. The written recall was then typed up and any spelling or grammatical errors were corrected; the recalled version of the story from the previous participant was then presented to the next participant and this was continued until a chain of four participants had recalled the story.

Coding

Each story component consisted of seven sentences, which served as the units of recall in the coding stage. Two coders (one author and one person who was unaware of the purpose of the study) went through the 160 reproductions of the stories and marked the items that were recalled accurately. As in Lyons and Kashima (2003) a sentence was judged to be reproduced if the basic content was present; the recall did not need to be verbatim. The coding across all four generations in this study produced a very high correlation between raters' scores ($r = 0.94$). Coders then discussed the few discrepancies in their coding to reach a consensus. For each participant, this yielded a recall measure between 0 and 7 for each of the four story components. Denote these recall measures by ρ_{HS}, ρ_{HA}, ρ_{LS} and ρ_{LA} where the indices indicate the type of the manipulation of the corresponding story component. Pairwise sums of these measures were used as measures of high disgust stories ($\rho_{H} = \rho_{HA} + \rho_{HS}$), low disgust stories ($\rho_{L} = \rho_{LA} + \rho_{LS}$), asocial stories ($\rho_{A} = \rho_{HA} + \rho_{LA}$), and social stories ($\rho_{S} = \rho_{HS} + \rho_{LS}$). Aggregated measures for chains were obtained by averaging over the four participants in a chain.

Results

First the disgust manipulation was checked. A total of 11 participants had not completed disgust ratings and were excluded from this analysis. Across all story versions and all generations, participants rated the high disgust story components as more disgusting than the low disgust components (paired differences, $M=1.46$, $SD=1.60$, t(148)=11.1, $p<.001$). Average recall, aggregated for chains, did not differ significantly between social and asocial story components (paired differences, $M=0.54$, $SD=1.60$, $t(39)=1.14$, $p=.26$). Nor did average ratings of the likelihood of passing along stories differ significantly between social and asocial

story components (paired differences, *M*=0.07, *SD*=0.53, *t*(39)=0.81, *p*=.42). Social and asocial story

components were therefore pooled in subsequent analyses.

Pass along ratings

Average ratings of the likelihood of passing along stories was higher for high disgust than low disgust

story components (paired differences, *M*=0.50, *SD*=0.69, *t*(39)=4.56, *p*<.001).

Recall

Average recall was higher for high disgust than low disgust story components (paired differences,

M=1.64, *SD*=2.48, *t*(39)=4.18, *p*<.001). Figure 1 illustrates how recall declined over generations. In each

generation along the chain, story components high on disgust showed better recall than low disgust versions

(all *p*s<.005).

Figure 1 about here

Figure 2 shows the chain average recall for high and low disgust versions of each story component

separately. For the dog component, there was no significant difference in recall. For each of the other three

story components, the high disgust version was recalled at a significantly higher level than the low disgust

version (Cake, *p*=.045; Nepal, *p*= .003; Pizza, *p*=.006).

Figure 2 about here

Discussion

In this experiment we measured the decline in recall of an original story over four generations of serial

reproduction. As discussed in the introduction, the serial reproduction method involves only the encode-and-

retrieve phase of cultural transmission Results supported emotional selection operating in this phase: stories

were better recalled down the chain when a key element was manipulated to be high rather than low in

disgust. However, a potential concern is that the disgust manipulation might also have affected the humorous

qualities of the stories (Oppliger and Zillman, 1997; Rozin, Haidt and McCauley, 2008b; McGraw and

Warren, 2010). Also humorous material tends to be recalled at higher rates (Carlson, 2011). We therefore

decided to investigate whether the manipulation had affected the humorous qualities, and whether this could explain the anomalous results for the dog story (Experiment 2 below).

Experiment 1 also replicated the finding of Heath et al. (2001) that people prefer to pass along stories with more disgusting content, i.e., emotional selection operating in the choose-to-transmit phase. However, Heath et al. also controlled for other important factors, such as ratings of interest, surprise and plausibility. Also these factors were added to the next study.

EXPERIMENT 2

This study was designed to answer the questions raised in the discussion of the Experiment 1. Firstly, how did the disgust manipulations affect how humorous the stories were perceived to be? Secondly, is the finding of a general preference for the more disgusting stories in the choose-to-transmit phase robust if one controls for ratings of interest, surprise and plausibility?

Method

Participants

80 participants (47 women, 32 men, one unknown; mean age 34 years) were recruited from the pool of US workers on the Amazon Mechanical Turk. The sample had a mix of educational backgrounds: 30% had no education after high school, 16% were currently in college, and the remaining 54% had a college education.

Design and Procedure

Participants were recruited to answer a web survey on "what people think of short stories" for a compensation of 50 US cents. The instructions read: "We will now present you with four brief stories about Jasmine and ask you to rate each of them on a few criteria: how they make you feel (in terms of interested, disgusted, surprised and amused); whether they are plausible (i.e., could occur); and whether you would be likely to pass along the story to others." All ratings were made on a Likert scale between 1 (= not at all) and 7 (= a lot).

Each participant rated, in turn, the pizza story, the Nepal story, the dog story and the cake story. Following the same Latin square design as in Experiment 1, there were four versions of the survey that varied in which story was presented in which type of version (high or low disgust, social or asocial).

Results

Table 1 about here

Table 1 reports how the amusement ratings of stories depended on the disgust manipulation. The mean amusement rating of the two high disgust stories was *lower* than the corresponding rating of the low disgust stories (paired differences, $M=0.53$, $SD=1.63$, $t(79)=2.88$, $p=.005$). As is apparent from Table 1, this effect was driven by the dog story.

Table 2 about here

Each participant made ratings of four stories. To study effects of various predictors on pass along ratings, we therefore analyzed a multi-level regression model that included an individual-specific error term. The results are shown in Table 2. Replicating the finding of Heath et al. (2001), pass along ratings were predicted by how surprising, plausible and interesting the stories were perceived to be; further, even when controlling for these other predictors the disgust manipulation had an effect on pass along ratings. As in Experiment 1, there was no effect of the social manipulation, i.e., whether the main character was alone or in company. In addition to the story qualities studied by Heath et al., our study also included ratings of the amusing quality of stories. As shown in Table 2, this humour rating was also an independent predictor of the pass along rating.

Discussion

The concerns raised in the discussion of Experiment 1 were clarified in this study. In particular, the stories high on disgust were on average rated as less, not more, amusing. Thus a positive effect of humour on recall would have worked against our prediction. Importantly, the difference in humour ratings was driven by the dog story, which suggests that it may be a humour effect that explains why the results for this particular story broke the predicted pattern in Experiment 1.

EXPERIMENT 3

The aim of this experiment was twofold. The first was to examine emotional selection in the choose-to-receive phase of cultural transmission. To do this we had participants choose which stories to read based on headlines describing the key element of each story. The second aim was to complement the previous serial reproduction study (Experiment 1) to demonstrate the power of emotional selection in repeated transmission also outside the encode-and-retrieve phase. To achieve this, we used participants' choices of what stories to read as the first step in a novel kind of transmission chain where participants, after having read their chosen stories, choose which of these stories to pass along to the next participant in the chain. We predicted that high disgust stories would be much better retained than low disgust stories as the original pool of stories was narrowed down along the chain.

The question of what headlines make people more interested in reading a story seems surprisingly little studied. After a dated paper on how boys and girls select stories to read based on their titles (Droney, Cucchiara and Scipione, 1953), the only recent contribution we have found investigated which features a sample of Greek students chose to motivate which ten newspaper headlines they found most interesting in a pool of 36 headlines (Ifantidou, 2009). Participants in this study picked their choices from a list of features provided by the researcher. The only disgust-relevant term on this list was "shocking," which was picked by about 50% of the participants, so shocking headlines seemed to have quite general appeal. Compared to these survey studies we employed a stronger methodology where people actually chose stories to read by clicking on corresponding headlines.

Method

Participants

80 participants (52 women, 28 men; mean age 35 years) were recruited from the pool of US workers on the Amazon Mechanical Turk. The sample had a mix of educational backgrounds similar to Experiment 2.

Design and Procedure

Retention of stories was studied in 40 chains, each consisting of two participants who selected stories in two steps. Participants answered a survey on the web where they were presented with a set of headlines describing the central events of some stories. In the first generation (40 participants), there were eight stories (both the high and low disgust versions of the asocial versions of the four stories about Jasmine in Appendix A). The corresponding headlines were: "Jasmine unknowingly ate olives", "Jasmine unintentionally ate her dog", "Jasmine sold a cake that was so delicious she would rather have kept it for herself", "Jasmine ate remains of humans to survive", "Jasmine's dog was fed a delicious meal by mistake", "Jasmine sold a cake that by accident had maggots in it", "Jasmine ate expensive delicacies to avoid starvation" and "Jasmine felt sick from eating rat meat". Participants were instructed that they could click the headline if they wanted to read the entire story; on clicking, the story appeared and at the end of the story the participant was asked to choose whether to pass it on to a later participant of the same study.[5] In the same way the 40 second generation participants selected among the stories passed on by the previous participant in the same chain.

Results

In this design the original pool of stories was narrowed down in two steps (what stories to read and what stories to pass on) in each of two generations, for a total of four steps. The original pool contained four high disgust stories and four low disgust stories. The dependent variables are the numbers of high and low disgust stories that are retained in each step. As these numbers were not normally distributed, non-parametric tests were used. A related-samples Wilcoxon signed rank tests showed a difference in retention between high disgust (M=2.40, SD=1.30) and low disgust stories (M=1.20, SD=1.43) after the first step of the chain, p=.002, as predicted by emotional selection operating in the choose-to-receive phase. This superior retention

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[5] The exact instructions were: "We shall present you with headlines of stories about the travels of a girl named Jasmine. For each headline, decide if it makes you want to read the story. Only if you decide to read the story you shall click on the headline to read it, in which case you must then decide whether you found the story worthy of being passed along to other participants from your country. (I.e., is it a story you think is worth retelling to others of the same nationality as you?)"

of high disgust stories remained after step two (p=.03), step three (p=.001) and step four (p=.001). After the fourth step, low disgust stories were extinct in all the 40 chains; in contrast, at least one disgusting story survived in 14 of the 40 chains, a quite dramatic difference. Figure 3 illustrates how the retention of high and low disgust declined at different rates along the chains.

Figure 3 about here

Discussion

This simple experiment employed a novel type of transmission chain. Instead of transmitted material gradually decaying through imperfect recall as in the classic serial reproduction paradigm, there was a pool of stories that were stepwise eliminated through cultural selection in terms of participants' choices of what stories to read and what stories to pass along. The results showed emotional selection operating in each step, with a dramatic difference in retention at the end of the chain where the low disgust stories were extinct while high disgust stories survived in 14 out of 40 chains.

Although the core function of the disgust emotion is to make us avoid disgusting things, our findings in this study support the notion that disgust-bases emotional selection operates also in the choose-to-receive phase. This is in line with prior research showing that many people enjoy consuming negative emotions in certain situations (Andrade and Cohen, 2007; Tamir, 2009). Some comments by our participants highlighted individual differences in this respect, e.g., "the more shock value the titles have, the more attractive they are to read" vs. "most of these headlines were so disgusting that I had no desire to punish myself by reading them." Individual differences in emotional selection are the topic of the last study.

EXPERIMENT 4

Heath et al. (2001) proposed emotional consumption as psychological mechanism behind emotional selection. Whereas they discussed only the choose-to-transmit phase, we argued in the introduction that emotional consumption would lead to emotional selection also in the choose-to-receive phase. As mentioned in the discussion three, there are individual differences in the enjoyment of consuming negative emotions. Andrade and Cohen (2007) discussed this in terms of coactivation of positive and negative affect. Based on a

review of neuropsychological studies, they argued that the neural correlates of positive and negative emotions are largely independent and may well coactivate under specific circumstances.

To better understand how emotional selection may operate on the individual level, we here conducted a simple survey to investigate whether individual differences in the willingness to pass along stories with emotional content are robust across different emotions. Specifically, the degree of independence of negative and positive emotions (Andrade and Cohen, 2007) suggests that the willingness to pass along stories eliciting positive emotions might be unrelated to the corresponding willingness for negative emotions.

Method

Participants

160 participants (94 women, 62 men, 4 unknown; mean age 37 years) were recruited from the pool of US workers on the Amazon Mechanical Turk. The sample had a mix of educational backgrounds as in the previous experiments.

Design and Procedure

Participants answered a survey on the web. The instructions to the main part read "For each emotion below, imagine that you hear a story about someone you don't know who experienced an episode that made him or her feel this emotion. We want to know how likely you would be to pass along the story about this episode to an acquaintance." Then followed six items (in order counter-balanced in different versions): angry, amused, sad, fearful, disgusted, surprised. For each item, the willingness to pass along such an episode was reported on a Likert scale between 1 (not at all likely to pass along the story) and 5 (very likely to pass along the story).

Results

Table 2 reports the mean ratings of the willingness to pass along stories for each emotion. The two "positive" emotions (amused and surprised) received the highest ratings. Further, mean ratings were rather similar within the set of "negative" emotions (angry, sad, fearful and disgusted), compared to the difference in ratings between positive and negative emotions. A principal components analysis was computed on the

six items. The scree plot supported a two-factor solution, accounting for 48% of the variance. The two-factor solution was examined using an oblique rotation; no significant correlation was found between the two factors. The two factors corresponded to postive emotions and negative emotions, respectively. All factor loadings were between 0.53 and 0.84, and all cross-loadings were less than 0.15. In line with this, pairwise correlations between ratings of negative items were significant (all rs between .24 and .27, all ps<.003) for all pairs of negative emotions except one.[6] Similarly, the ratings for the two positive emotions were positively correlated (r=.20, p=.01).

Following this analysis, we computed average ratings separately for positive emotions (M=3.59, SD=0.91) and negative emotions (M=2.92, SD=0.80); the difference is statistically significant (related-samples Wilcoxon signed rank test, p<.001). Finally, a correlation analysis showed that average ratings for positive and negative emotions were uncorrelated (r=−.10, p=.23).

Discussion

We found that emotions differed in how willing people would be to pass along an episode with specific emotional content. In particular, out of the six emotions used in our study, pass-along ratings were highest for amusement and lowest for sadness. After the study was conducted, we have found that this exact pattern had already been predicted based on the arousal levels associated with different emotions, which are high for amusement and low for sadness (Berger, 2011).

Our study showed that individuals who are willing to pass along episodes that elicit one negative emotion, like disgust, also tend to be willing to pass along episodes that elicit other negative emotions, like anger and fear. However, this general willingness to pass along stories with negative emotions did not generalize to include also a greater willingness to pass along stories with positive emotions.

For the theory of emotional selection in the choose-to-transmit phase, this pattern of individual differences implies that emotional selection will mainly through operate through a subsample of the population. This subsample may be largely the same for different negative emotions, but different for

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[6] The pair disgusted-sad had uncorrelated ratings, r=.004, p=.96.

emotional selection based on positive emotions. To a certain extent, social networks are based on shared cultural preferences (Lewis, Kaufman, Gonzalez, Wimmer and Christakis, 2008). We might therefore expect more social ties between individuals whose preferences support emotional selection based on a given type of emotion. Such a link between emotional selection and social network structure might be act as a factor that magnifies the cultural differences between different communities, an idea left for future research.

GENERAL DISCUSSION

Heath et al. (2001) documented that disgusting elements are prevalent among American urban legends. They argued that this can be understood as the outcome of emotional selection in the cultural evolution of stories that are transmitted between individuals. Their conception of emotional selection involved only the effects of emotion on people's choices to pass along stories. Here we have substantially extended the scope of emotional selection to encompass three distinct phases of cultural transmission, complementing the choice-to-transmit phase with a choice-to-receive phase and an encode-and-retrieve phase. We found the notion that emotional selection would operate also in these two phases to be supported by evidence from the literature on consumption of emotions and the literature on memory and emotion, respectively. In a series of experiments we then strengthened the empirical evidence for emotional selection operating in all of these three phases. Taken together, our contribution points to emotional selection potentially being an even more important force in cultural evolution than what previous work has suggested.

Following Heath et al. (2001) our research focused on the case of disgusting elements in urban legends. One implication of our findings is that it is not necessarily emotional selection in the choice-to-transmit phase that is the main explanation of the prevalence of disgusting elements in American urban legends—the relative importance of selection pressures in different phases is still a wide open question for future research.

We want to emphasize that it is not necessarily the case that emotional selection works in the same direction in all phases of cultural transmission, as we found in the case of disgust. Speculatively, it may be the case that stories with erotic stimuli are commonly sought out but are neither very memorable, nor tend to give people an urge to retell them.

In the last experiment we focused on individual differences in preferences for emotional consumption and some potential implications for cultural evolution. In the case of disgust, the psychological literature suggests that individual variation in preferences may be linked to differences in sensation-seeking (Straube, Preissler, Lipka, Hewig, Mentzel and Miltner, 2010). Whatever the source of the individual variation in preferences on disgusting stories, we expect the outcome of cultural evolution in a population to be strongly dependent on the ratio of disgust-lovers to disgust-haters in the population. So far, data on disgust in urban legends and disgust-based emotional selection are limited to North America. These findings may not generalise to other cultures.

We close on a remark about the other manipulation we used. Mesoudi et al. (2006) proposed a cultural transmission bias that would favour information about interactions and relationships between several individuals over information about a single individual. However, our manipulation of whether the main character was alone or had company in our stories did not produce any significant effect on recall in Experiment 1, nor on pass along ratings in Experiment 2. More work may be needed to define the precise scope of this bias for social content.

Funding

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Appendix A: Materials

For each of the story components below, text that differed between the high disgust (H) and low disgust (L) versions is presented within brackets. As described in the paper, each of these versions was also manipulated to be either asocial (i.e., Jasmine was alone) or social (i.e., Jasmine had company). Below the asocial versions are given.

Pizza story

(Adapted from original story in af Klintberg, B. (1986). Råttan i pizzan. Stockholm: Norstedts.)

Many years ago Jasmine visited Stockholm for the first time.

She decided to go to a new pizza restaurant near her hotel.

After eating her pizza Jasmine found that something was stuck in her teeth.

She succeeded in removing the object.

She examined the object: it was a [tooth from a rat! (H) / stone from an olive! (L)]

She realized that the restaurant probably had used [rat meat (H) / green olives (L)] in her pizza.

As far as Jasmine could remember [she had never felt that sick before. (H) / they had not been listed on the menu. (L)]

Poodle story

(Adapted from original story retrieved June 2010 from http://www.snopes.com/food.)

Jasmine was travelling alone in Asia with her pet poodle called Rosa.

One evening she decided to dine out at a local restaurant.

While she was ordering Rosa trotted out to the kitchen.

Because of the language barrier Jasmine had real trouble communicating her order.

Nonetheless, she enjoyed a delicious meal of meat garnished with pepper sauce and bamboo shoots.

However, when she received the bill she saw that [the cost of meat had been deducted. (H) / she had been charged for a second meal. (L)]

Through a misunderstanding, [she had been fed Rosa – she had eaten her own dog! (H) / Rosa – her dog – had been fed an equally delicious meal! (L)]

Nepal story

(Adapted from original story in Schnall, S., Haidt, J., Clore, G. L. and Jordan, A. H. (2008). Disgust as embodied moral judgment. *Personality and Social Psychology Bulletin*, 34(8), 1096–1109.)

When travelling in Nepal Jasmine was involved in a [horrific (H)] bus crash.

 [Jasmine was the only survivor. (H) / The only person on the bus was Jasmine (L)]

She was in a remote region [and would probably not be found for several days. (H) / but would probably be found in a few days. (L)]

Without food in the adverse weather, Jasmine knew that she would [die (H) / get hungry (L)].

She persuaded herself that her only [chance of survival was to eat the remains of their fellow passengers. (H) / choice was to eat the bus's cargo of expensive vegetarian delicacies. (L)]

She argued with herself as long as she could muster the strength to resist.

To summarise: Jasmine managed to [survive. (H) /eat unusually well. (L)]

Cake story

(Adapted from original story retrieved June 2010 from http://www.snopes.com/food.)

In America, Jasmine made a cake that was featured in a newspaper.

She was involved in a privately organised charity cake sale.

Jasmine didn't have enough time to buy ingredients for the cake so she used what she could find in the kitchen cupboard.

She quickly made the cake and took it to the sale.

When returning to clean up the kitchen Jasmine [found that the flour she had used was infested with maggots. (H) / tasted the cake mix and found it tasted better than ever. (L)]

She hurried to buy the cake [for herself (L)] but it had already been sold.

Next day in the local newspaper she saw a picture of a cake being sliced up for visiting dignitaries – Jasmine's [maggot (H) / delicious (L)] cake!

Table 1. Ratings of how amusing stories were, depending on disgust manipulation (Experiment 2).

Story	Rating, low disgust version	SD	Rating, high disgust version	SD
Cake	2.72	1.70	3.68	1.95
Dog	4.70	1.60	2.00	1.32
Nepal	2.56	1.92	1.63	1.37
Pizza	2.36	1.50	2.69	1.59

Note. A total of 80 participants; 40 ratings of each version of a story.

Table 2. Results of maximum likelihood estimation of pass along ratings of stories as a function of story manipulation and ratings of story qualities (Experiment 2).

Effect	Estimate	S.E.	DF	t value	p value
intercept	−0.86	0.34	234	−2.51	0.012
disgust version	0.79	0.21	234	3.76	<0.001
social version	0.08	0.17	234	0.46	0.648
amusing	0.22	0.06	234	3.84	<0.001
interesting	0.35	0.07	234	5.03	<0.001
plausible	0.25	0.05	234	4.88	<0.001
surprising	0.18	0.06	234	2.92	0.004

Note. Disgust version is coded 1 for high, 0 for low; similarly, social version is coded 1 for social, 0 for asocial. Because each participant rated four stories, the model included an individual-specific error term to account for individual idiosyncrasies in pass along ratings.

Table 3. Willingness to pass along an episode where someone you don't know experiences a certain emotion (Experiment 4).

Emotion	Mean rating	SD
amused	3.69	1.19
surprised	3.50	1.17
angry	3.06	1.28
disgusted	2.98	1.31
fearful	2.95	1.24
sad	2.68	1.20

Figures

Figure 1. Average number, per generation, of accurately recalled sentences in high (ρ_H) vs. low (ρ_L) disgust story components (Experiment 1).
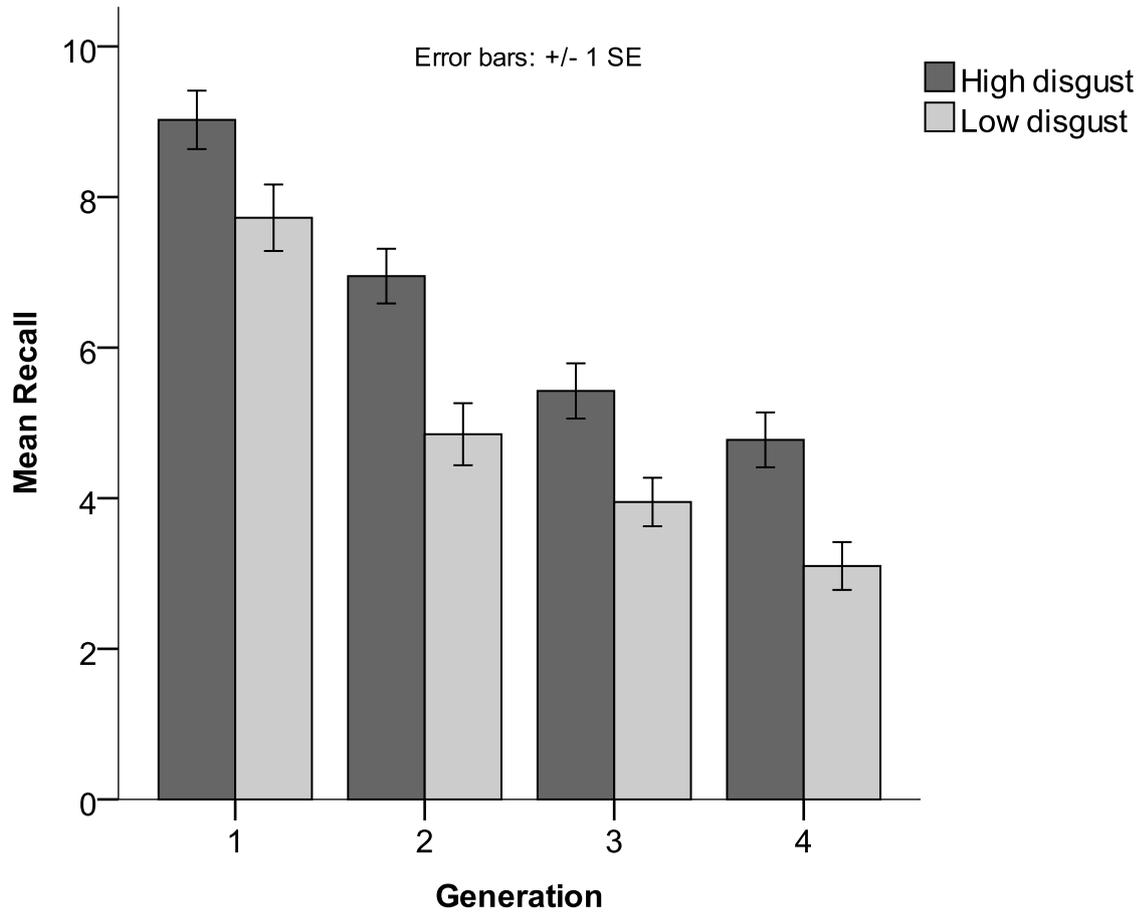
Figure 2. Chain average number of accurately recalled sentences in high vs. low disgust version of each story component (Experiment 1).
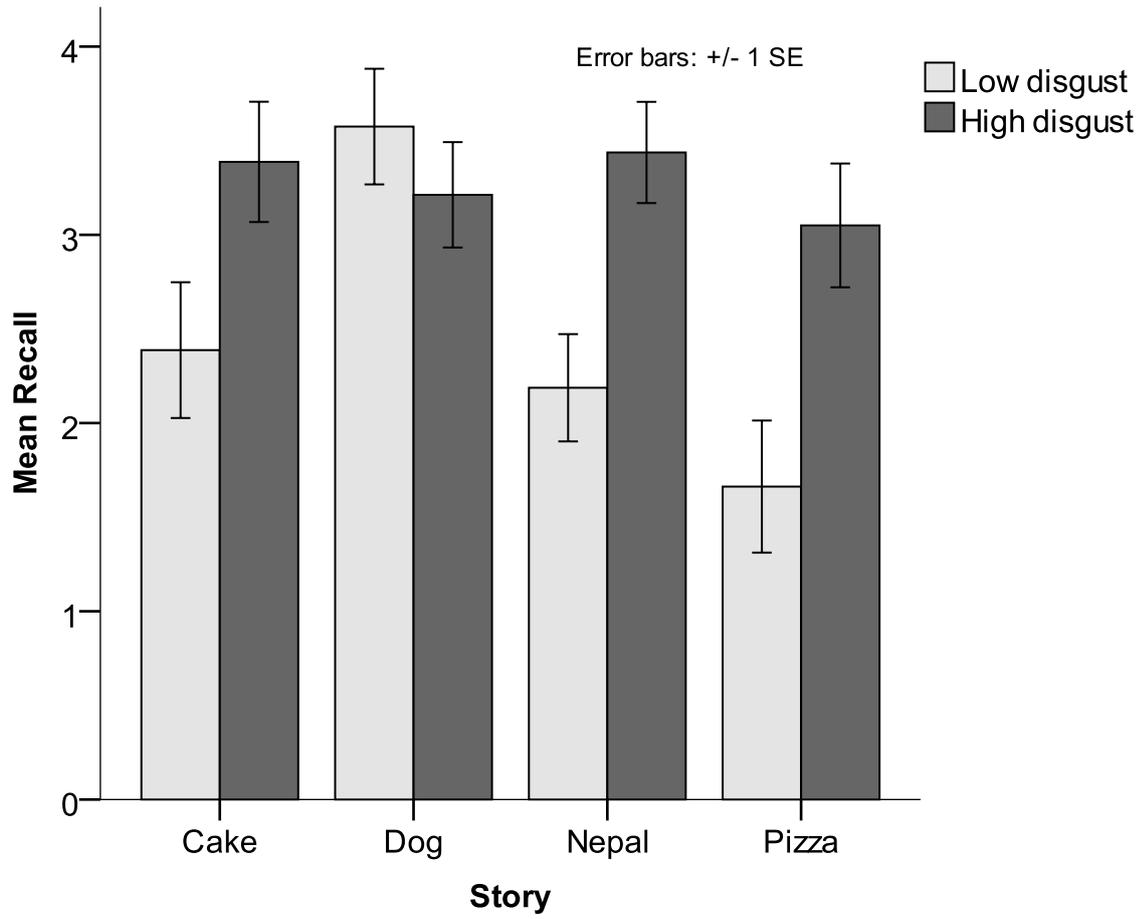
Figure 3. Average number, per step of the transmission process, of retained stories in high vs. low disgust (Experiment 3). Bars indicate standard errors.