

# Contamination, association, or social communication: An examination of alternative accounts for contagion effects

Natalie O. Fedotova\*

Paul Rozin†

## Abstract

Individuals avoid objects that have been in physical contact with morally offensive or disgusting entities. This has been called negative magical contagion, an implicit belief in the transmission of essence by physical contact. Alternatively, individuals may avoid a negatively contaminated object because: 1) the object is a strong reminder of the original contagion source (association account); or 2) the act of interacting with the object signals specific information about the self (social communication account). We report that: 1) people often prefer to interact with an entity that they believe is more associated with a negative source rather than an entity that is less associated but has made physical contact with the same negative source; 2) while an associative account requires that contact enhances association, a study of memory for visual pairings of objects indicates that when objects are touching, their associative link (recall) is no greater than when they are in proximity; and 3) subjects continue to show aversion to (prefer to wear gloves to handle) an object that contacted a negative entity even if they are handling the object in order to physically destroy it, hence strongly signaling their rejection of that object. Association and social communication are at best partial accounts for contagion effects.

Keywords: contagion, magic, association, contamination. impressions, self-presentation, memory

## 1 Introduction

People go to great lengths to avoid objects that have had contact with certain types of negative entities, even when the contact had been brief and the effects were imperceptible. In a recent public example, the Canadian Armed Forces chose to burn the military uniform of a convicted serial killer and rapist instead of following the usual practice of recycling his equipment for use by other personnel (Contenta & Zerbisias, 2010). Echoing a similar sentiment, the psychological literature and popular media contain several accounts of houses where gruesome murders were committed being not only demolished but “symbolically erased”, by removing and crushing the rubble (e.g., Coughlan, 2004; Hood, 2010; Associated Press, 2011). On the other side of the spectrum, fans and collectors pay thousands of dollars to acquire objects that were previously owned or worn by a favorite celebrity, and many of us treasure possessions of our deceased loved ones and enjoy wearing clothes of our significant others. Possessions can be seen as an extension

of the owner (Belk, 1988; James, 1890) that have come to be imbued with her essence. The value of these objects is rooted in their authenticity and cannot be reproduced in replicas that are perceptually indistinguishable (Frazier, Gelman, Wilson & Hood, 2009; Newman, Diesendruck & Bloom, 2011).

About one hundred years ago, a group of anthropologists described a set of beliefs like those illustrated above, but limited to traditional societies, and held them to be illustrative of a magical belief in contagion, sometimes summarized as the law of contagion: “once in contact, always in contact” (Frazer, 1890/1981; Mauss, 1902/2001; Tylor, 1879/1974).

More recently, contagion beliefs were shown to be robustly manifested by educated Westerners (Rozin, Millman & Nemeroff, 1986; Rozin, Nemeroff, Wane & Sherrod, 1989; see Nemeroff & Rozin, 2000, and Rozin & Nemeroff, 1990, 2002 for reviews). Subsequent research has demonstrated operation of these laws across a range of domains, such as health beliefs (e.g., Nemeroff, Brinkman & Woodward, 1994; Rozin, Markwith & Nemeroff, 1992; Rozin, Markwith & McCauley, 1994), kosher dietary practices (Nemeroff & Rozin, 1992), consumer behavior (Argo, Dahl & Morales, 2006, 2008; Mishra, 2009; Morales & Fitzsimons, 2007), attitudes toward recycled water (Callaghan, Moloney, & Blair, 2012; Rozin et al., 2014), and perceptions of physical spaces (Savani, Kumar, Naidu & Dweck, 2011). According to the principle of contagion, a source entity may transmit a part of itself, or its essence, to a target entity through physical contact. This essence appears to be strikingly similar to the conceptualization of the immutable, identity-bestowing substance in essentialist accounts of categorization (Gelman,

---

The material reported here constituted part of the Ph.D. dissertation in Psychology of Natalie O. Fedotova, at the University of Pennsylvania, 2013. We thank Hana Zickgraf for her critical comments.

Copyright: © 2018. The authors license this article under the terms of the Creative Commons Attribution 3.0 License.

\*Department of Psychiatry, Brigham and Women’s Hospital, Harvard Medical School, Boston, MA.

†Corresponding author: Department of Psychology, University of Pennsylvania, 3720 Walnut Street, Philadelphia, PA 19104-6241. Email: rozin@psych.upenn.edu.

2003; Medin & Ortony, 1989). When the source entity is perceived as positive in valence, transmission results in positive contagion (also known as transvaluation; Breckenridge, 1978; Rozin & Fallon, 1981, 1987). When the source has negative valence, the term contamination is sometimes used. The transferred essence is typically imperceptible, suggesting that what underlies contagion is an idea that appearance may not correspond to reality. Perhaps the most elaborated and fully described set of both positive and negative contagion beliefs are held by the Hua of New Guinea, where a positive or negative life essence (“nu”) is transferred through contact with substantial effects on the recipient (Meigs, 1985). In western samples, contamination (negative contagion) is generally found to be much more prevalent and robust than positive contagion (Rozin & Royzman, 2001). This is also true among the Hua, even though they show a remarkable number of instances of positive contagion.

There seem to be two different “models” of contagion effects. According to one, the transferred essence is like a physical substance, susceptible to neutralization by physical acts such as washing or sterilization. According to a second model, the transferred essence is “spiritual” and cannot be neutralized by physico-chemical acts. The same American individual can embrace one model, the other, or both (Nemeroff & Rozin, 1994).

In previous studies, investigators inferred intuitions about transmission of negative properties from rejection of innocuous objects that came into physical contact with negative entities (see Nemeroff & Rozin, 2000, and Rozin & Nemeroff, 1990, 2002 for reviews). From this perspective, a reluctance to consume orange juice into which a dead, sterilized cockroach had been dipped indicates a belief that some property of “cockroachness” had been transferred to the beverage. Similarly, discomfort wearing the sweater used by Adolf Hitler indicates a belief that some property of Hitler, presumably related to evil, has permeated the article of clothing and could “infect” the next person to wear the sweater. Yet, individuals may avoid objects that have been in contact with negative entities (displaying what we call negative contagion or contamination effects) without holding explicit or implicit beliefs about transmission of contagious essence (what we call contagion beliefs). Our aim is to examine whether beliefs in transmission of essence underlie contagion effects, or whether association or social communication accounts can serve as the primary explanations.

## 1.1 Alternative accounts of contagion effects

### 1.1.1 Association account

One of the simplest explanations for contagion effects is that the contacted items have a strong tendency to bring to mind the original sources of contagion (*association account*; Nemeroff & Rozin, 1994; Rozin & Nemeroff, 2002). For exam-

ple, a person may treasure her grandmother’s ring because it is a reminder of a beloved grandparent. Similarly, one may be disgusted by the idea of consuming recycled water, despite the fact that it is known to be chemically indistinguishable from spring water, because the person cannot help but think of the sewage from which it came. According to the association account, seeing or imagining a target object in contact with a contagion source facilitates the formation of an association between the two entities. Subsequent encounters with the target object become a form of cued-recall, where the contaminated object brings to mind the source of the contagious essence.

In order to serve as a viable theoretical framework for understanding contagion effects, associative learning has to account for the fundamental properties of contagion (Rozin & Nemeroff, 2002, and Nemeroff & Rozin, 2000). Existing evidence already suggests that this presents a difficulty: for example, relationships learned associatively, through paired-presentation, should be subject to extinction or modification through counterconditioning (i.e., pairing the target object with a positive entity), yet, aversion toward negatively contaminated objects is frequently permanent (e.g., Nemeroff & Rozin, 1994; Rozin et al., 1992). Nemeroff and Rozin (1994) distinguished between the associative and material models of essence by examining the efficacy of different purification procedures. Effects stemming from the tendency of the object to act as a reminder of the negative source (association account) should be reduced by changes in the perceptual characteristics of the object (e.g., reknitting a sweater into a scarf) but not cleaning procedures (e.g., heat sterilization, washing); in contrast, effects stemming from a perception that the object has acquired an undesirable substance through contact with a negative entity (contagion account) should be reduced by cleaning manipulations but not changes in object appearance. Nemeroff & Rozin (1994) reported that people’s conceptualization of contaminating essences related to illness or core disgust (e.g., hepatitis, feces) matched, for most individuals, a transmission of physical material model. Further, even essences that resembled spiritual entities (not much reduced by physical or chemical transformations, such as moral and interpersonal contagion; e.g., an evil person or a lover), were, for some individuals, affected by cleaning procedures. Thus, many individuals appear to conceptualize essences, especially those linked to illness and disgust, as substantive rather than primarily associative.

One approach to the contagion-association distinction in this study is to examine cases in which associative strength is high in the absence of physical contact, in comparison to cases where the opposite is true. A contagion account would predict that the more contacted but less associated object should acquire more valence. For example, a new copy of *Mein Kampf* is surely more conceptually associated with Hitler than an English Dictionary he owned and used, but only the dictionary had physical contact with Hitler. A

contagion account (as opposed to an association account) would predict more negative feelings toward the dictionary.

The present research also investigates whether association can account for another fundamental property of contagion: the critical role of physical contact in perception of essence transmission. Studies have shown that use of objects, including contact with the objects by negative figures causes much more aversion than mere ownership (e.g., Nemeroff & Rozin, 1994; Rozin et al., 1992). It seems that our models of essence transmission are constrained by a mechanical model of the world, where, with the exception of gravity and electromagnetic forces, objects affect one another through direct contact. Thus, in order to claim that associative learning accounts for contagion effects fully, one would have to show that physical contact between objects promotes the formation or strengthening of associative links.

To our knowledge, no one has investigated the effect of mere contact on paired-associate learning, but a number of previous studies have shown that encountering pairs of objects in certain interactive relations facilitates the formation of associations. Rohwer (1966) demonstrated that cued-recall performance was best when nouns were connected by verbs and worst when nouns were linked by conjunctions. Other researchers documented the facilitating effect of relational imagery on paired-associate learning: seeing pictures of the associates interacting or instructions to imagine the interaction increased cued-recall (Begg, 1973; Bower, 1970; Epstein, Rock & Zuckerman, 1960; Wollen, Weber & Lowry, 1972). For example, Bower (1970) demonstrated that instructing subjects to use interactive imagery for nouns that represent objects resulted in greater cued-recall of concrete noun paired associates than separation imagery (i.e., imagery of objects separated in space). Using pictures, Wollen, Weber and Lowry (1972) showed that the improvement resulted from the interactive relationship between objects rather than the bizarreness of the images. These studies do not separately vary mere contact and interaction; their control condition is typically the relevant pair of objects separated in space. If the effects of contagion result at least in part from association, then it should be possible to show that association is enhanced by mere physical contact. We test this proposition in Study 2.

### 1.1.2 Social communication account

The second alternative account for contagion findings explored in this paper is based on the idea that behavior, including both actions on the environment and expressive actions, can be used to convey information to other social agents or to the self. Perhaps aversion toward objects that have been in contact with negative entities is better understood as a social signal rather than as an indicator of perceived contamination. That is, to hold an English dictionary owned and used by Hitler might be aversive to individuals simply because

the act of holding the dictionary might imply, to an observer, approval of Hitler.

The social sciences have a rich history of presenting interactions in terms of dramaturgical metaphors, echoing Shakespeare's famous line that, "All the world's a stage, And all the men and women merely players." Building on the tradition of symbolic interactionists, Erving Goffman (1959) described face-to-face interactions as theatrical performances involving the presentation of specific "faces" to the audience. In social psychology, efforts to control information about the self that is communicated to others, with the goal of influencing the impressions formed by the audience, were termed *impression management* or *self-presentation* (see Schlenker, 2012, for a review). Individuals may be motivated to engage in impression management for a diverse set of reasons (see Leary & Kowalski, 1990, for review), such as minimization of punishments and maximization of rewards, self-esteem maintenance, and identity construction (Baumeister, 1982; Baumeister & Tice, 1986; Gollwitzer, 1986; Schlenker, 1980). Individuals may also communicate information about themselves indirectly, by strategically managing presentation of associations with others (Cialdini & De Nicholas, 1989; Cialdini, Finch & De Nicholas, 1990; Cialdini & Richardson, 1980). This process may be relevant to studies of contagion where subjects are asked to interact with objects that are linked to other persons (e.g., famous immoral figures), since refusal to touch a contacted object may be construed as symbolic distancing from a negative entity.

From a theoretical perspective, researchers disagree whether a social performance is necessarily targeted toward others (e.g., Leary & Kowalski, 1990) or whether a person may engage in certain behaviors to convey information to the self (Greenwald & Breckler, 1985; Schlenker, 1985). For instance, Schlenker (1985) specifies three types of audiences to the process of defining oneself as a particular type of person (*self-identification*): people with whom one interacts (others), internalized referents (imagined others), and the self.

A social communication account of contagion effects would explain a person's refusal to wear Hitler's sweater as a technique to signal rejection of his ideas and Nazi group affiliation (also see the symbolic interaction model in Nemeroff & Rozin, 1994). To abstract this example, unwillingness to consume or touch a contaminated object may serve as a way to signal: (a) unwillingness to violate social norms involving hygiene, morality, or another relevant domain; and (b) separation of the self from unsavory individuals who break such norms.

Undoubtedly, social signaling is ubiquitous and plays some role in most of our behaviors. Yet, we doubt that social communication can be a primary account of contagion. Returning to Hitler's English dictionary or *Mein Kampf*, we expect that most people would feel more aversion toward

holding the dictionary, yet it is unclear that interacting with this book would serve as a stronger signal of affiliation with Hitler. In fact, to a naïve observer who is merely reading the title of the book, seeing that another person is holding a copy of *Mein Kampf* would convey more information than seeing the same person holding a dictionary. Since many contagion studies instruct subjects to imagine performing an action in complete privacy, actual audience effects are unlikely. Despite these objections, because self-relevant norms may exert effects via internalized or imagined audiences or a self-signaling process, we propose to test predictions that would differentiate between contagion and social communication accounts.

## 1.2 Overview of current research

The goal of the present research was to investigate whether accounts such as association or social communication, that do not rely on perception of essence transmission, can explain contagion effects. Study 1 employed self-report to investigate whether people avoid objects that have been in physical contact with a negative contagion source primarily because they perceive these items to be strong reminders of the source. Study 2 relied on a cued-recall task to examine whether contact between two objects facilitates formation or strengthening of associative links. Study 3 explored whether a preference for wearing gloves during interactions with contaminated objects is rooted in the desire to communicate rejection of the negative contagion source (social communication) or a perception of negative essence in the objects (contagion).

## 2 Study 1: Can associations account for aversions based on physical contact

Under most circumstances, association and essence transfer are confounded: the occurrence of contact provides both a means of essence transfer and an opportunity for association formation (i.e., paired presentation). In order to show a potential mismatch between perceptions of physical contamination and reminder strength, we created paired descriptions of objects that were linked to the same negative source through previous physical contact or a salient association in the absence of physical contact. The goal was to maximize physical contamination in one item and reminder strength in the other. The Mein-Kampf/Hitler's-dictionary example referred to in the Introduction illustrates this approach.

We expect that both contact and association can result in a valence change for a previously neutral object. Evaluative conditioning is a specific illustration of pure associative effects. Furthermore, although there are many ways to arrange

association without contact, there are no ways to produce contact without association. In comparing an object associated with a negative source to an object briefly touched to the same source, regardless of the relative potency of the associative versus contact/essence mechanism, there will always be some instance of non-contact association that is stronger (or weaker) than some other instance of contact. To take an extreme pair of examples, we expect that, assuming an aversion to Hitler, almost everyone would be more upset about interacting with Hitler's favorite shirt (contagion) than with an out of focus black and white picture of Hitler (association). On the other hand, we are also confident that almost everyone would rather hold a restaurant plate that was once used to serve Adolph Hitler (and, of course, like any restaurant plate, had been used with hundreds or thousands of other diners) as opposed to a brand new copy of Hitler's book, *Mein Kampf*, the essence and origin source for Hitler's evil doctrines. If the association account is sufficient to explain contagion, then the critical observation would be preferences in which A is clearly more associated with a negative source than B, but B has contacted that source. Any individual who acknowledges the stronger associative link for A, but still prefers to interact with A, violates an associative account of contagion. A contagion/essence account predicts that there will be many individuals for whom this "associative inversion" occurs.

To the degree that there is a mismatch between interaction preferences and reminder strength perceptions, association is weakened as a primary account. Note that the test we propose is asymmetric, because all contact can produce associations, but not the inverse, and because contagion makes no claim to be a principal cause of association, whereas association has a case to make as a primary account of contagion.

## 2.1 Method

### 2.1.1 Subjects

One-hundred and fifty-seven American individuals were recruited on-line (via Amazon Mechanical Turk) to complete a web-based questionnaire in exchange for a small payment. Two subjects failed to complete a significant number of questions and 24 subjects failed one or more of three attention checks and were excluded from further analysis. The remaining subjects ( $n = 131$ , 68% female) ranged from 18 to 81 years of age ( $M = 36.38$ ,  $SD = 14.13$ ).

### 2.1.2 Procedure and Materials

Subjects were asked to read four paired descriptions of analogous items. Within each pair, one item was connected to a negatively-valenced source through previous direct physical contact (e.g., an English dictionary that was previously used by Adolf Hitler; *contact item*) and the other item was connected to the same source by association without a history

TABLE 1: Stimulus pairs (contact and association items) and interactions described in Study 1, organized by source of contagion.

Pair	Contagion source	Physical contact item	Association item	Interaction
1	Adolf Hitler/Nazi movement	English dictionary owned and used by Adolf Hitler	Brand-new copy of <i>Mein Kampf</i>	Hold with bare hands
2	al-Qaeda	Laundered blanket previously used by members of al-Qaeda cell	Brand-new blanket designed to look like the flag of al-Qaeda	Wrap over clothes
3	Human waste	Water recycled from human waste	Bottled water in brand-new urine collection cup	Drink 4 oz
4	Cockroach	Orange juice into which a heat-sterilized cockroach was dipped	Orange juice from a brand-new, sealed bottle with a picture of a cockroach on the label	Drink 4 oz

TABLE 2: Preferences for interaction and perceptions of reminder value expressed as percentages of total subjects selecting each item (number of subjects). N=131.

Contagion source	Item preferred for interaction			Item selected as stronger reminder		
	Association item	Physical contact item	No preference	Association item	Physical contact item	No preference
Part 1: Adolph Hitler/Nazi	47.3% (62)	42.7% (56)	9.9% (13)	68.7% (90)	20.6% (27)	10.6% (14)
Part 2: al-Qaeda	59.5% (78)	20.6% (27)	19.9% (26)	58.8% (77)	15.3% (20)	26.0% (34)
Part 3: Human waste	68.7% (90)	22.9% (30)	8.4% (11)	38.9% (51)	32.1% (42)	29.0% (38)
Part 4: Cockroach	92.4% (121)	5.3% (7)	2.3% (3)	15.3% (20)	51.2% (67)	33.6% (44)

of contact (a brand-new copy of *Mein Kampf*; *association item*). In some cases, additional information was provided to subjects to make sure that they understood the significance of the item (e.g., the content of *Mein Kampf*). The items were selected to sample a range of negative contagious essences and vehicles; sources of contagion included Adolf Hitler, al-Qaeda, human waste, and a cockroach (See Table 1 for description of the four pairs of items, listed by source of contagion).

In the first part of the questionnaire, subjects read each pair of descriptions and indicated which of the two items reminded them of the negatively-valenced source more (e.g., association strength). Subjects were allowed to indicate that the two items reminded them of the source to the same degree. The presentation order of description pairs was randomized for each subject. In the second part of the questionnaire, subjects were shown the same four pairs of item descriptions and asked with which item they would rather interact (consume, hold, or wear) or if they had no preference. The specific interaction differed depending on the item (See Table 1 for complete list of interactions).

## 2.2 Results and discussion

We selected each pair with the intention that the non-contact item would have a stronger association with the source. We assessed this directly in the first part of the questionnaire, and display the results in Table 2. *Mein Kampf* was a stronger association with Hitler (68.7%) than Hitler’s dictionary (20.6%). However, in the preference measure, the much stronger association item (*Mein Kampf*) was preferred 47.3% of the time, more than the physical contact item (42.7%). This indicates that association is insufficient to explain contagion for the Hitler exemplars.

The Al Qaeda flag blanket was a stronger association with Al Qaeda (58.8%) than the blanket used by an Al Qaeda member (15.3%). However, 59.5% of subjects preferred to interact with the more strongly associated blanket while only 20.6% preferred to interact with the less strongly associated Al-Qaeda used blanket, supporting a physical contact account.

For human waste, neither choice for the stronger association exceeded 50%, but the results show a preponderance of responses favoring a stronger association for the urine collection bottle (38.9%) than for the recycled water (32.1%). However, in comparison to the 38.9% stronger association

with the urine collection bottle, a full 68.7% preferred to interact with this bottle, in comparison to 22.9% with the recycled water bottle. For the third time, stronger association is not the principal predictor of preference. For the case of cockroach, our planned contrast failed to meet our initial criterion for strength of association. Only 15.3% of subjects reported a stronger association for the orange juice with a cockroach label than for the orange juice that had a dead-sterilized cockroach dipped into it, with 33.6% reporting no difference in association. Hence, our presumption for an association versus physical contagion effect cannot be directly tested with the cockroach exemplars (Table 2).

The most critical test of the potency of the association account is the percent of respondents who preferred to interact with the association item, even though they also rated it as having the stronger association with the source. According to an exclusive association account, that number should be close to 0%. But of the 62 individuals who preferred to interact with *Mein Kampf*, a full 39 (62.9%) rated the *Mein Kampf* the stronger association. Corresponding scores are 51.3% of the 78 individuals who preferred interacting with the Al Qaeda flag, and 30.0% of the 90 individuals who preferred interacting with the urine cup. Because an exclusive association account predicts that this number should be close to zero, the account can be rejected for all three cases, with a mean mismatch score of association preference with stronger association of 48.1%. The results of Study 1 strongly reject the claim that the principal component of contagion is association, although they are consistent with the possibility that association plays some role.

### 3 Study 2: Effects of the relationship between objects, including contact, on memory

The results of Study 1 suggested that, in many cases (though not always the majority of cases), interaction preferences are not driven by perceptions of reminder/associative strength. However, these results were based on self-report. It is possible that contact between objects promotes formation of mental associations that are outside of explicit awareness. In Study 2, we used a cued-recall task to determine whether physical contact between objects improves visual paired-associate learning. Since the process of contamination, and consequent aversion, depends on physical contact between objects, if associative learning plays a pivotal role in this phenomenon, then physical contact between objects should facilitate association formation. In contrast, if physical contact does not promote association, then an associative account would have difficulty explaining a well-documented fundamental property of contagion. As discussed in the introduction, previous work has produced evidence that im-

ages of interacting objects increase association (e.g., Bower, 1970), but these studies conflated mere physical contact and a more involved interactive relation (e.g., intertwining).

What we address in Study 2 is whether the enhancing effect of interactions on association is partially mediated by simple non-interactive physical contact of just the type that can produce the contagion effect. For this reason, we compared cued-recall of objects that were substantially separated in space (12 inches apart), to items that were in proximity (2 inches apart), objects in physical contact without interaction, and objects in physical contact but with an interactive relation. Physical proximity was included because transfer of essence, and therefore contagion, seems more likely when two objects are close to one another with no barrier present (e.g., particles can travel in the air). This effect has not been demonstrated empirically but seems intuitive. Thus, we wanted to explore whether conditions that allow for transmission of essence (physical contact and, to a much lesser extent, spatial proximity) also promote association.

## 3.1 Method

### 3.1.1 Subjects

One hundred and ninety-four persons (40% female) recruited on-line (via Amazon Mechanical Turk) completed the study in exchange for a small payment. The age of the subjects ranged from 18 to 63 years ( $M = 30.52$  years,  $SD = 9.65$  years).

### 3.1.2 Procedure

The study was completed on-line. After clicking on a web link, subjects were instructed to count the number of edible objects in a sequence of images. They were asked to pay close attention and to try to identify the objects in the images to the best of their abilities. They were also told to watch the sequence without pausing. After these instructions, subjects were presented with a sequence of 24 images depicting pairs of objects. Each image was displayed for 4 seconds before automatically progressing to the next. In order to eliminate recency effects from the last few images in the sequence, after the visual presentation was over, subjects were asked to count backwards from 100 in increments of seven and input the last number before reaching zero. In addition, they completed a demographic information section after the visual presentation and counting task. Note that there was no indication in the instructions that this was a memory/association task. A cued-recall test was then administered. Subjects were prompted with the image of one of the objects from each of the 24 pairs presented earlier and asked to indicate the second object in the pair. The 24 objects were presented in the same order as they appeared in the image sequence. Each question was accompanied by a list of ten objects, all from the original 48-object set, from

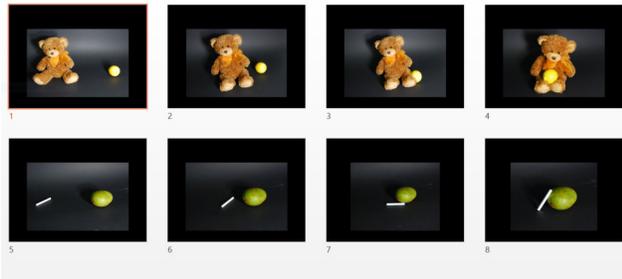


FIGURE 1: Examples of the 4 conditions for 2 of the 24 pairs of objects. 1 and 5 represent the far condition, 2 and 6 represent the near condition, 3 and 7 represent the contact condition, and 4 and 8 represent the interact condition.

which respondents could select the correct answer. For any given object pairing, in all four versions (far, near, contact, interact) the identity and sequence of the ten objects was the same.

### 3.1.3 Stimuli

For any subject, the image sequence consisted of 24 high-quality, color photographs depicting pairs of common, easily recognizable objects (e.g., teddy bear and lemon; see the footnote<sup>1</sup> for a full list of item pairs and Figure 1 for examples). Random selection, without replacement, was used to create 24 unique pairs from a set of 48 objects: that is, if a teddy bear was assigned to appear with a lemon then neither the teddy bear nor the lemon could appear with any other object. Each subject was exposed to all 24 pairs of objects in the same order.

Of the twenty-four images displayed, six images depicted two objects relatively far from each other (12 inches apart; *far* condition), six images depicted the objects near to each other but not touching (2 inches apart; *near* condition), six images depicted the objects as just touching with slight overlap (*touch* condition), and the remaining six images depicted objects that were touching with significant overlap and interaction (e.g., a belt wrapped multiple times around a pineapple; *interact* condition) (see Figure 1 for examples).

To minimize the unique effects of specific objects, the spatial relations between paired objects were varied within subjects. A total of four image sequences were created by randomly assigning each object pair within a given sequence to one of the four spatial relation conditions. That is, to create the four sequences, with the constant order of the 24 object pairs, we randomly assigned one version of the first

<sup>1</sup> Object Pairs Used in Study 2: Teddy Bear, Lemon; Umbrella, Spoon; Mango, Chalk; Tissue, Push Pin; Cell Phone, Boot; Nail Polish, Flower; Pineapple, Belt; Cup, Sunglasses; Bowl, Calculator; Peach, Sock; Apple, Highlighter; Orange, Ruler; Banana, Key; Strawberry, Money; Trash can, Handbag; Chair, Glove; Scissors, Ball; Gum; Computer mouse; iPod, Straw; Laptop, Hair brush; Light bulb, Lock; Band-Aid, Necklace; Hanger, Camera; Hair dryer, Chocolate bar.

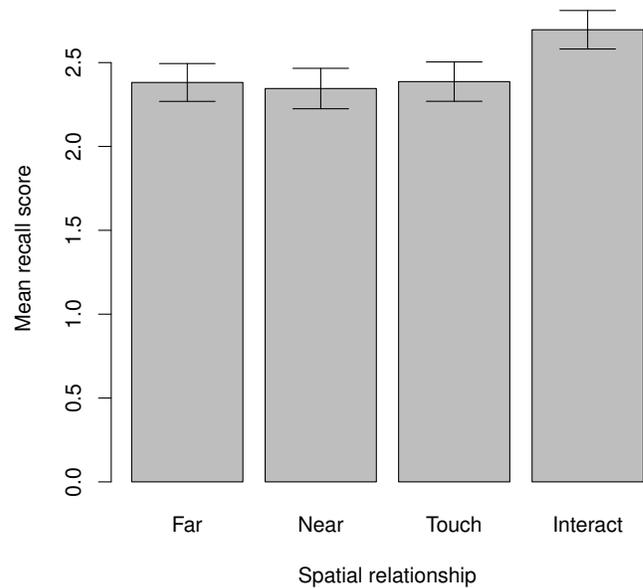


FIGURE 2: Mean scores on the cued-recall task as a function of spatial relationship between depicted objects. (Error bars represent 1 SE).

object pair to the first sequence, then randomly assigned one of the three remaining versions to the second sequence, and then randomly assigned one of the two remaining versions to the third sequence, and the fourth sequence received the remaining version. This procedure was repeated for the subsequent 23 object pairings. Thus, across the four different image sequences, each object-pair is represented once, and in only one of the four conditions. We modified this procedure (by selecting another random sequence for a particular object pairing) to assure that within each of the four specific image sequences, each of the four conditions is represented exactly six times, and the same condition does not appear three times in a row. Figure 1 illustrates the 4 versions of each of the 24 object pairs

## 3.2 Results and discussion

Four scores were created for each subject by summing the number of correct responses in the cued-recall task for each of the four conditions. These scores were analyzed using a repeated-measures ANOVA with the relation between objects in the image (*far*, *near*, *touch*, *interact*) as the within-subjects variable. The recall in the *far* condition served as the baseline: that is, a measure of paired-associate learning in the absence of facilitating relations. The physical relationship had a significant effect on recall,  $F(3, 579) = 3.77$ ,  $p = 0.011$ ,  $\eta^2 = 0.019$  (see Figure 2). Paired-sample t-tests revealed that recall in the *interact* condition ( $M = 2.70$ ,  $SD = 1.60$ ) was significantly higher than recall in the *far* ( $M = 2.38$ ,  $SD = 1.57$ ), *touch* ( $M = 2.39$ ,  $SD = 1.64$ ), and *near* ( $M = 2.35$ ,  $SD = 1.68$ ) conditions,  $t_s > 2.62$ ,  $p_s < 0.05$  (with a Bonferroni

correction for these and subsequent comparisons). Recall in the *touch* and *near* conditions did not differ from recall in the *far* condition,  $t_s < 0.29$ , *n.s.* These results suggest that the enhancing effect of interactive relations does not stem from mere physical contact. Further, since associative learning is not facilitated by physical contact, contact does not increase association.

As pointed out by a reviewer, our design in this study does not strongly argue against a reasonable interpretation of the contagion account. Although contagion is described as involving mere contact, from both the old anthropological literature and more recent experiments, most actual instances of “contact” could be described as interactive contact. Is dipping a cockroach in juice “mere contact” or an interaction, and does Hitler’s sweater merely contact him, or does it interact with him. Conservatively, although the findings in Study 2 are evidence against an associative account of mere contact, it is conceivable that many examples of contagion involve more than mere physical contact. However, one of the defining features of contagion is dose insensitivity (Nemeroff and Rozin, 2000; Rozin & Nemeroff, 1990, 2002). While the amount of contact has only a minimal effect on contagion, it should affect association, since one of the differences in this study between physical contact and interaction is amount of contact. Further work would be necessary to make the case for a primary role of mere contact in contagion and a primary role for degree of contact (as manifested, for example, by interaction) in association. It would also be desirable to measure associative strength in paradigms other than cued recall.

## 4 Study 3: Contagion or social communication

Studies 1 and 2 presented evidence that an association account cannot fully or even substantially explain contagion effects: individuals often display interaction preferences that are not based on perceptions of reminder strength, and physical contact between objects does not facilitate associative learning. In Study 3, we examined whether social communication can serve as the primary reason for avoidance of contaminated objects, in the absence of a real audience. One indicator of perceived contamination is a desire to place a barrier between the object and the self by, for example, wearing gloves. In fact, a preference for gloves when handling negatively-contaminated objects is another piece of evidence against an association account discussed in the previous two studies: a barrier between the self and the object presumably protects the self from transfer of negative essence but should not reduce the reminder value of the item. Yet, the act of wearing gloves may also serve as a social signal that one is disgusted by the source entity that had contaminated the object (social communication account).

In the present study, the instructions explicitly stated that the described tasks would be performed in complete privacy, a condition commonly included in contagion studies. To address the issue of internalized audiences, we reasoned that the communicative value of wearing gloves will be markedly reduced when the interaction itself conveys a much stronger and unambiguous rejection signal (e.g., destruction of an object). This assumption is imperfect: after all, an opportunity to signal rejection of a negative entity in one way may not reduce the desire to signal it in another way. Nonetheless, it seems that a destruction of an object conveys rejection to such a degree that making a point of wearing gloves adds marginal utility. Thus, a social communication account would predict that destroying a negatively-contaminated object will reduce the preference for using gloves over bare hands, compared to simply holding the same object. In contrast, if gloves are worn to protect the self from essence transmission, the preference will not decrease as a function of ripping up the object: the essence remains in the pieces and is still contagious.

In this study, subjects read descriptions of t-shirts that had been worn by persons who differed in terms of valence (positive vs. negative) and fame (historical vs. ordinary). Individuals were asked to rate the imagined experiences of holding or ripping the shirts (destructive/negative intention), using either their bare hands or while wearing gloves (barrier). Thus, the symbolic meaning but not the physical contact was varied between interactions. In line with a contagion account, we hypothesized: (a) that individuals will prefer to place a protective barrier between the self and the negatively-contaminated shirts but not the positively-contaminated shirts, and (b) that this desire to wear gloves will not be reduced by a displayed destructive intention behind the interaction. Although not critical to this study, we also expected that the historical/celebrity manipulation would lead to stronger negative or positive contagion effects, probably because the negative celebrity/historical manipulation would be a more extremely valenced entity.

### 4.1 Method

#### 4.1.1 Subjects

One-hundred and fifty-six undergraduate students (54.2% female) completed the questionnaire in exchange for course credit.

#### 4.1.2 Procedure and stimuli

The study consisted of a paper questionnaire administered by a research assistant in the laboratory. The questionnaire prompted subjects to imagine a series of experiences and to rate each one on a scale from  $-100$  (*extremely unpleasant*) to  $+100$  (*extremely pleasant*). Each experience consisted of handling a freshly-laundered, cotton t-shirt that had been

TABLE 3: Means and standard deviations of glove preference indices across interactive intentions

Contagion source	Intention	
	Holding (N=80) <i>M (SD)</i>	Ripping (N=76) <i>M (SD)</i>
MLK	3.88 (32.62)	-2.17 (23.34)
Hitler	10.31 (28.33)	16.87 (48.15)
Hero firefighter	2.83 (26.57)	-1.12 (28.83)
Child molester	11.56 (28.50)	25.99 (53.68)

*Note.* Higher glove preference indices indicate a greater preference for using gloves as opposed to bare hands during an interaction with a contaminated t-shirt.

\*  $ps < 0.05$  (Bonferroni correction).

worn by a particular person for three years; the shirt was described as an “undershirt” to emphasize the contact between the item and the source of contagion. Instructions prompted subjects to assume that the imagined task would occur in complete privacy: no one would ever find out about the experience and the subject would not be allowed to speak about the event. The study used a 2 (fame of contagion source: historical figure vs. ordinary person)  $\times$  2 (valence: positive vs. negative)  $\times$  2 (intention: ripping vs. holding)  $\times$  2 (barrier: gloves vs. bare hands) mixed design, where valence, fame of contagion source, and barrier were varied within subjects and intention was varied between subjects. A destructive intention was presumed to communicate rejection of the contagion source.

Subjects were asked to imagine shirts that had been worn by a positive famous historical figure (Martin Luther King, Jr.), a negative famous historical figure (Adolf Hitler), a positive ordinary figure (a hero firefighter who saved several lives), and a negative ordinary figure (a convicted child molester). All subjects were asked to rate shirts from all four figures above. To explore the effect of a protective barrier, subjects were asked to imagine handling the shirt with “fitted latex gloves” and “bare hands.” The presentation order of figure valence (positive vs. negative) and barrier (gloves vs. bare hands) was fully counterbalanced across subjects. Half of the subjects imagined an interaction that signaled disapproval and rejection (ripping the t-shirt) and the other half imagined a neutral interaction (holding the t-shirt).

## 4.2 Results

To calculate the degree of preference for wearing gloves, ratings of interactions while using bare hands were subtracted from ratings of the same interaction (i.e., same source of contagion and intention) while using gloves, creating *glove*

*preference indices*. A higher glove preference index indicated a greater preference for wearing gloves during the interaction. To determine whether subjects preferred to wear gloves for interactions with all objects, regardless of the valence of contagion source, the glove preference indices were compared to a value of 0 using single-sample t-tests. Glove preferences were significantly greater than zero for all interactions involving negatively-contaminated t-shirts,  $ts > 3.05$ ,  $ps < 0.05$ , but did not differ from zero for interactions involving positively-contaminated t-shirts,  $ts < 1.06$ ,  $ns$  (See Table 3 for means and standard deviations; Bonferroni correction for multiple comparisons). Thus, in line with a contagion account but not the association account, subjects seemed to act as though negatively-contaminated objects were infused by negative essences.

The glove preference indices pertaining to famous and non-famous sources were then subjected to separate 2 (valence: positive vs. negative)  $\times$  2 (intention: holding vs. ripping) mixed model ANOVAs. Following a contagion model account, we predicted that the preference for gloves will be higher during interactions with negatively-contaminated objects (main effect of valence) but will not be reduced by a destructive intention that signals rejection (no interaction between valence and intention).

### 4.2.1 Contagion from historical figures: MLK vs. Adolf Hitler

The analysis yielded a main effects of valence,  $F(1, 154) = 9.09$ ,  $p = 0.003$ ,  $\eta^2 = 0.055$ , where preferences for wearing gloves were higher for interactions with t-shirts contaminated by Adolf Hitler ( $M = 13.59$ ,  $SE = 3.14$ ) as opposed to MLK ( $M = 0.85$ ,  $SE = 2.28$ ; marginal means and standard errors are reported for main effects). No significant interaction between valence and intention emerged,  $F(1, 154) = 0.005$ ,  $ns$ , suggesting that the intention – or more precisely, the signaled affiliation – had no effect on the tendency to desire gloves when coming into contact with contaminated objects.

### 4.2.2 Contagion from ordinary persons: hero firefighter vs. child molester

The analysis revealed a significant main effect of valence,  $F(1, 154) = 18.58$ ,  $p < 0.001$ ,  $\eta^2 = 0.10$ , where preferences for gloves were higher when the t-shirt was contaminated by a child molester ( $M = 18.78$ ,  $SE = 3.42$ ) as opposed to a hero firefighter ( $M = 0.85$ ,  $SE = 2.218$ ). The effect was qualified by a significant two-way interaction between valence and intention,  $F(1, 154) = 4.88$ ,  $p = 0.029$ ,  $\eta^2 = 0.027$  (Table 3). The preferences for gloves did not vary with intention (ripping vs. holding) for interactions with t-shirts contaminated by a hero firefighter,  $t(154) = 0.89$ ,  $ns$ , but they were higher when a child molester’s t-shirt was ripped ( $M = 25.99$ ,  $SE = 6.16$ ) as opposed to held ( $M =$

11.56,  $SE = 3.19$ ),  $t(154) = 2.11$ ,  $p = 0.036$ ,  $d = 0.35$ . This pattern of results is opposite to what one would expect to see if signaling rejection reduced contagion effects: in this case, symbolic rejection *increased* the desire to place a barrier between self and contaminated object.

### 4.3 Discussion

The results support predictions made by a contagion account. For famous and non-famous contagion sources, subjects showed a higher preference for wearing gloves when handling negatively contaminated objects. This effect could be interpreted as a desire to avoid coming into direct contact with the negative essence permeating the t-shirt (contagion) or as a desire to avoid signaling affiliation or approval of the negative contagion source (social communication). Clarification is provided by the fact that a destructive intention, clearly communicating rejection of the negative source (person), did not decrease the preference for gloves. In one case of negative contagion, involving t-shirts worn by Adolf Hitler, the desire to place a barrier between the self and the contaminated object did not vary between interaction types. In the second case, involving t-shirts worn by a child molester, symbolic rejection of the person, communicated by ripping his t-shirt, led to an increased preference for gloves (i.e., a greater contagion effect), perhaps due to an assumption that more contact with the item was required. These results suggest that avoidance of direct contact with negatively contaminated objects is related to a desire to protect the self from similar contamination rather than to concerns about the information communicated.

Interestingly, in cases of positive contagion, no preference for gloves or bare hands emerged. One possibility is that the desire to touch positively contaminated objects has little to do with acquiring the positive essence embedded in the object. Another possibility is that positive essence has different psychological properties as opposed to negative essence, such that latex gloves do not preclude transmission. In this case, positive essence may be thought of as more spiritual in nature, and consequently unrestricted by physical barriers, while negative essence may be construed in more physical terms (Nemeroff & Rozin, 1994). A third possibility is that, in cases of positive contagion, positive contamination due to the moral status of the person is directly opposed by negative contamination resulting from the person's animalness or strangeness. Thus, the preference for using gloves or bare hands may depend on the balance between the desire for positive essence and the sensitivity to disgust or germ aversion. Since positive contagion tends to be weaker than negative contagion (e.g., Rozin, Nemeroff, Wane & Sherrod, 1989; Rozin & Royzman, 2001) and people may not agree on what constitutes a positive source, an overall preference for using bare hands may not emerge.

## 5 General discussion

The studies presented in this paper help refine our understanding of the mental processes behind contagion effects. In the past, avoidance of negatively contaminated objects and approach to positively contaminated objects have been interpreted as evidence of implicit beliefs in essence transmission through contact, an interesting idea. The indirect nature of the supporting evidence, however, left the door open for alternative explanations. The present research shows that association and social communication are unlikely to be the primary processes behind the observed effects. In Study 1, we used self-report measures to demonstrate that, given a choice of two objects, interaction choices were often incongruent with perceptions of reminder strength: a substantial proportion of subjects preferred to touch or consume the object that was perceived as the stronger reminder of a negative source of contagion, as opposed to the object that actually experienced contact with a negative entity. In Study 2, we used a cued-recall task to show that physical contact between two objects – a hallmark feature of contagion that allows for transmission of essence – does not facilitate paired-associate learning. The results of Studies 1 and 2 suggest that the tendency of a contaminated target to act as a strong reminder of the contagion source cannot be the primary factor behind reported aversion: people seem to discount the importance of reminder strength in interaction preferences, and physical contact between two objects does not lead to stronger associative links.

A recent paper (Stavrova, Newman, Kulemann & Fetchenhauer, 2016) provides additional data that argue against association as a sufficient interpretation of contagion. These authors were studying a new type of contagion, involving transfer of essence from an immoral person through an object designed by, but never touched by, the immoral person (a new concept of intention-based contagion). Although individuals showed a negative response to such an object, they did not show a negative response to a similar scenario when the designer was physically ill (where there is a negative effect from contact contagion). The same type of associations should be present in both situations. Also, association of an immoral person with an object (via evaluative conditioning, in the absence of design) did not transfer negativity.

The results of Study 3 cast doubt on the viability of social communication as the primary account of contagion effects. The desire to protect the self from negative essence, by wearing gloves, did not decrease when subjects were allowed to strongly signal rejection of a negative contagion source through a destructive interaction with the contaminated object. If gloves were worn to convey social information, then their utility would be decreased markedly by the unambiguous signal conveyed by the destruction of the object. The observed results are much more consistent with a contagion account, according to which, since physical con-

tact will lead to transmission of essence regardless of the interactive intention, the need for gloves should not decrease between holding and ripping interactions. In fact, ripping may afford more opportunity for contact, which would increase the preference for gloves. In line with this logic and contrary to the social communication hypothesis, the direction of the effect indicates greater relative glove preference in the ripping condition. Thus, symbolic distancing from a morally offensive figure, identity construction, or another component of self-presentation is unlikely to be responsible for the bulk of avoidance observed in negative contagion effects. The explicit instructions to imagine performing the tasks in complete privacy make real audience effects even less plausible. Interestingly, subjects consistently failed to show a preference for handling a positively contaminated object with bare hands. As discussed earlier, this result may stem from a lay model of positive essence transmission that does not rely on physical contact or, more likely, either the opposition between positive moral essence and negative animal or stranger essence or the generally weaker effects of positive contagion.

Although the present research makes a significant advance in our understanding of contagion as a phenomenon, our findings have a number of limitations and leave many questions unanswered. Our cued recall results, as discussed above, while distinguishing between physical contact and interaction for associative strength, leave open the possibility that most instantiations of contagion involve physical interaction, and not mere physical contact. Our data allow us to rule out association and social communication as the primary explanations behind contagion effects, but we cannot speak to their contributions as secondary factors. Undoubtedly, temporal and spatial contiguities between stimuli allow for associative learning, and people are cognizant of the social meaning attached to their actions. In fact, it may be possible to create stimuli that elicit avoidance (the usual marker of contagion) due to one or both of these processes.

From a methodological perspective, our work investigating the social communication account relied solely on self-report. Future experiments need to replicate our findings using behavioral measures. From a broader perspective, since we did not capture explicit beliefs in transmission of essence through contact, we can reasonably question whether individuals subscribe to this model of the world or whether it is only a convenient framework created by investigators in order to understand the observed effects. People seem to act as though they accept the law of contagion, yet, the specific content of their beliefs remains unknown. Even the lay conceptualization of essence remains mysterious: we only know the valence of the properties that are perceived to be transferred during the process of contamination. More work is necessary to describe these properties in more detail and pinpoint the nature of the transmitted entity.

## References

- Associated Press. (2011, December 6). Razed to the ground: 'House of horror' in which serial killer murdered and entombed eleven women is finally demolished, *Daily Mail*. Retrieved from here.
- Argo, J. J., Dahl, D. W., & Morales, A. C. (2006). Consumer contamination: How consumers react to products touched by others. *Journal of Marketing*, 70(2), 81–94.
- Argo, J. J., Dahl, D. W., & Morales, A. C. (2008). Positive consumer contagion: Responses to attractive others in a retail context. *Journal of Marketing Research*, 45(6), 690–701.
- Baumeister, R. F. (1982). A self-presentational view of social phenomena. *Psychological bulletin*, 91, 3–26.
- Baumeister, R. F., & Tice, D. M. (1986). Four selves, two motives, and a substitute process self-regulation model. In R. F. Baumeister (Ed.), *Public self and private self* (pp. 63–74). New York: Springer-Verlag.
- Begg, I. (1973). Imagery and integration in the recall of words. *Canadian Journal of Psychology/Revue canadienne de psychologie*, 27(2), 159–167.
- Belk, R. W. (1988). Possessions and the extended self. *Journal of Consumer Research*, 15(2), 139–168.
- Breckenridge, C. A. (1978). *Food handling in a Hindu temple: An analysis of sacred cuisine. 1350–1650 A.D.* Paper presented at the 10th International Conference of Anthropological and Ethnological Sciences, New Delhi, India.
- Bower, G. H. (1970). Imagery as a relational organizer in associative learning. *Journal of Verbal Learning and Verbal Behavior*, 9, 529–533.
- Callaghan, P., Moloney, G., & Blair, D. (2012). Contagion in the representational field of water recycling: informing new environment practice through social representation theory. *Journal of Community & Applied Social Psychology*, 22(1), 20–37.
- Cialdini, R. B., & De Nicholas, M. E. (1989). Self-presentation by association. *Journal of Personality and Social Psychology*, 57(4), 626–631.
- Cialdini, R. B., Finch, J. F., & De Nicholas, M. E. (1990). Strategic self-presentation: The indirect route. In M. J. Cody & M. L. McLaughlin (Eds.), *The psychology of tactical communication* (pp. 194–206). Clevedon, England: Multilingual Matters.
- Cialdini, R. B., & Richardson, K. D. (1980). Two indirect tactics of image management: Basking and blasting. *Journal of Personality and Social Psychology*, 39(3), 406–415.
- Contenta, S., & Zerbisias, A. (2010, November 19). Military burns Russell Williams's uniform, *Toronto Star*. Retrieved from <http://www.thestar.com/news/gta/article/893392-{}-military-burns-russell-williams-s-uniform>.
- Coughlan, S. (2004, April 5). What happens to the houses of horror?, *BBC News*. Retrieved from <http://news.bbc>.

- co.uk/2/hi/uk\_news/magazine/3593137.stm.
- Epstein, W., Rock, I., & Zuckerman, C. B. (1960). *Meaning and familiarity in associative learning* (Vol. 74).
- Frazer, J. G. (1981). *The golden bough: The roots of religion and folklore*. New York: Avenel Books. (Original work published 1890)
- Frazier, B. N., Gelman, S. A., Wilson, A., & Hood, B. (2009). Picasso paintings, moon rocks, and hand-written Beatles lyrics: Adults' evaluations of authentic objects. *Journal of cognition and culture*, 9(1), 1–14.
- Gelman, S. A. (2003). *The essential child: Origins of essentialism in everyday thought*. New York, NY: Oxford University Press.
- Goffman, E. (1959). *The presentation of self in everyday life*: Doubleday.
- Gollwitzer, P. M. (1986). Striving for specific identities: The social reality of self-symbolizing. In R. Baumeister (Ed.), *Public self and private self* (pp. 143–159). New York: Springer-Verlag.
- Greenwald, A. G., & Breckler, S. J. (1985). To whom is the self presented? In B. R. Schlenker (Ed.), *The self and social life* (pp. 126–145). New York: McGraw-Hill.
- Hood, B. M. (2010). *The science of superstition: How the developing brain creates supernatural beliefs*. New York: HarperCollins.
- James, W. (1890). *The principles of psychology* (Vol. 1). New York: Henry Holt.
- Leary, M. R., & Kowalski, R. M. (1990). Impression management: A literature review and two-component model. *Psychological bulletin*, 107(1), 34–47.
- Mauss, M. (2001). *General theory of magic* (R. Brain, Trans.). New York: Routledge. (Original work published 1902)
- Medin, D. L., & Ortony, A. (1989). Psychological essentialism. In S. Vosniadou & A. Ortony (Eds.), *Similarity and analogical reasoning* (pp. 179–195). New York: Cambridge University Press.
- Mishra, A. (2009). Influence of contagious versus non-contagious product groupings on consumer preferences. *Journal of Consumer Research*, 36(1), 73–82.
- Morales, A. C., & Fitzsimons, G. J. (2007). Product contagion: Changing consumer evaluations through physical contact with "disgusting" products. *Journal of Marketing Research*, 44(2), 272–283.
- Nemeroff, C., Brinkman, A., & Woodward, C. K. (1994). Magical contagion and AIDS risk perception in a college population. *AIDS Education and Prevention*, 6(3), 249–265.
- Nemeroff, C., & Rozin, P. (1989). "You Are What You Eat": Applying the demand-free "impressions" technique to an unacknowledged belief. *Ethos*, 17(1), 50–69.
- Nemeroff, C., & Rozin, P. (1992). Sympathetic magical beliefs and kosher dietary practice: The interaction of rules and feelings. *Ethos*, 20(1), 96–115. <http://dx.doi.org/10.1525/eth.1992.20.1.02a00040>.
- Nemeroff, C., & Rozin, P. (1994). The contagion concept in adult thinking in the United States: Transmission of germs and interpersonal influence. *Ethos*, 22(2), 158–186.
- Nemeroff, C., & Rozin, P. (2000). The makings of the magical mind: The nature and function of sympathetic magical thinking. In K. S. Rosengren, C. N. Johnson & P. L. Harris (Eds.), *Imagining the impossible: Magical, scientific, and religious thinking in children* (pp. 1–34). New York: Cambridge University Press.
- Newman, G. E., Diesendruck, G., & Bloom, P. (2011). Celebrity contagion and the value of objects. *Journal of Consumer Research*, 38(2), 215–228.
- Rohwer, W. D. (1966). Constraint, syntax and meaning in paired-associate learning. *Journal of Verbal Learning and Verbal Behavior*, 5(6), 541–547.
- Rozin, P., & Fallon, A. E. (1981). The acquisition of likes and dislikes for foods. In J. Solms & R. L. Hall (Eds.), *Criteria of food acceptance: How man chooses what he eats. A symposium* (pp. 35–48). Zurich: Forster.
- Rozin, P., & Fallon, A. E. (1987). A perspective on disgust. *Psychological Review*, 94(1), 23–41.
- Rozin, P., Markwith, M., & McCauley, C. (1994). Sensitivity to indirect contacts with other persons: AIDS aversion as a composite of aversion to strangers, infection, moral taint, and misfortune. *Journal of Abnormal Psychology*, 103(3), 495–504.
- Rozin, P., Markwith, M., & Nemeroff, C. (1992). Magical contagion beliefs and fear of AIDS. *Journal of Applied Social Psychology*, 22(14), 1081–1092. <http://dx.doi.org/10.1111/j.1559-1816.1992.tb00943.x>.
- Rozin, P., Millman, L., & Nemeroff, C. (1986). Operation of the laws of sympathetic magic in disgust and other domains. *Journal of Personality and Social Psychology*, 50(4), 703–712. <http://dx.doi.org/10.1037/0022-3514.50.4.703>.
- Rozin, P., & Nemeroff, C. (1990). The laws of sympathetic magic: A psychological analysis of similarity and contagion. In J. Stigler, G. Herdt & R. Shweder (Eds.), *Cultural psychology: Essays on comparative human development* (pp. 205–232). Cambridge: Cambridge University Press.
- Rozin, P., & Nemeroff, C. (2002). Sympathetic magical thinking: The contagion and similarity "heuristics". In T. Gilovich, D. Griffin & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 201–216). Cambridge: Cambridge University Press.
- Rozin, P., Nemeroff, C., Wane, M., & Sherrod, A. (1989). Operation of the sympathetic magical law of contagion in interpersonal attitudes among Americans. *Bulletin of the Psychonomic Society*, 27(4), 367–370.
- Rozin, P., & Royzman, E. (2001). Negativity bias, negativity dominance, and contagion. *Personality and Social Psychology Review*, 5, 296–320.

- Savani, K., Kumar, S., Naidu, N. V. R., & Dweck, C. S. (2011). Beliefs about emotional residue: The idea that emotions leave a trace in the physical environment. *Journal of Personality and Social Psychology*, 101(4), 684–701.
- Schlenker, B. R. (1980). *Impression management: The self-concept, social identity, and interpersonal relations*. Monterey, CA: Brooks/Cole
- Schlenker, B. R. (2012). Self-presentation. In M. R. Leary & J. P. Tangney (Eds.), *Handbook of self and identity* (pp. 542–570). New York: The Guilford Press.
- Schlenker, B. R. (Ed.). (1985). *The self and social life*. New York: McGraw-Hill
- Stavrova, O., Newman, G. E., Kulemann, A., & Fetchenhauer, D. (2016). Contamination without contact: An examination of intention-based contagion. *Judgment and Decision Making*, 11(6), 554–571.
- Tylor, E. B. (1974). *Primitive culture: Researches into the development of mythology, philosophy, religion, art and custom*. New York: Gordon Press. (Original work published 1871)
- Wollen, K. A., Weber, A., & Lowry, D. H. (1972). Bizarreness versus interaction of mental images as determinants of learning. *Cognitive Psychology*, 3(3), 518–523.