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Contagious or Not Contagious: Is that the Question? Evaluating the Effects of Disease Contagion on Memory for Word Lists

Laura Pazos

The University of Southern Mississippi

Contagious or Not Contagious: Is that the Question?

Evaluating the Effects of Disease Contagion on Memory for Word Lists

by

Laura Pazos

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Approved by

_____

Mark Huff, Ph.D., Thesis Adviser
Assistant Professor of Psychology

_____

Joe Olmi, Ph.D., Chair
School of Psychology

_____

Ellen Weinauer, Ph.D., Dean
Honors College

Abstract

Researchers have suggested that individuals possess a disease-avoidance system designed to detect and remember potential sources of harmful pathogens, a system termed the behavioral immune system. Recently, Fernandes, Pandeirada, Soares, and Nairne (2017) reported an increase in memory for objects associated with individuals that are contaminated with a disease. My thesis extends this finding by examining whether disease-related memory benefits are due to the mere presence of a disease or whether the disease needs to be perceived as contagious and thereby threatening to facilitate memory. Two experiments, one between- and one within-subjects, were designed to test memory performance in the context of diseased sources. Participants auditorily studied lists of associates read by individuals afflicted with a contagious disease (influenza), a noncontagious disease (cancer), or a healthy control. In both experiments, recall and recognition did not significantly differ across the three disease conditions providing evidence that disease-related information may not affect memory processes.

Keywords: Adaptive memory; Behavioral immune system; Free recall; Deese-Roediger-McDermott; Source monitoring; Contamination

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List of Abbreviations

ANOVA	Analysis of Variance
BAS	Backward Associative Strength
BIS	Behavioral Immune System
DRM	Deese-Roediger McDermott (associative false memory paradigm)
Min	Minute
PVD	Perceived Vulnerability to Disease Scale
RGN	Recognition

Chapter 1: Introduction

Exposure to potential sources of disease is common. Fortunately, disease exposure is rarely fatal, which is partially attributable to specialized biological processes designed to eliminate threats that can harm the body. Specifically, the *biological immune system* has evolved over time to retaliate against pathogens that enter internally to stave off illness (Schaller & Park, 2011). While the immune system is often effective, it is also costly. For instance, in response to pathogens, individuals may show an increase in mucus production and develop a cough to quarantine and clear the respiratory system of foreign particles. Further, individuals often develop a fever to raise the body temperature to create an inhospitable environment for infectious pathogens. In these cases, symptoms are uncomfortable and require considerable energy to implement. Given these costs, researchers have suggested that individuals have also evolved a *behavioral immune system* (BIS) to detect and avoid potential sources of pathogens (Schaller, 2006; Schaller & Duncan, 2007). An effective BIS likely requires a high-functioning cognitive system is needed in which to encode, store, and retrieve stimuli associated with harmful contaminants. The purpose of my thesis is to evaluate whether memory processes are indeed more sensitive to information associated with potential pathogens, consistent with the BIS. To this end, my thesis will examine memory performance for lists of words which are auditorily presented by individuals infected by contagious or non-contagious diseases and gauge these effects relative to words presented by a healthy individual.

Chapter 2: Review of Literature

Disease-Avoidance Effects on Memory

Disease-avoidant behaviors have been well documented in humans and other animals. For example, animals avoid other members of their own species who are perceived as contaminated with pathogens (Behringer, Butler, & Shields, 2006; Loehle, 1995) and attempt to remove pathogens from themselves and others through grooming behaviors (Eckstein & Hart, 2000; Zhukovskaya, Yanagawa, & Forschler, 2013). Humans similarly show avoidant behaviors. For example, individuals have shown greater repelling arm movements towards faces when primed with disease-related information (Mortensen, Becker, Ackerman, Neuberg, & Kenrick, 2010), and experience disgust towards infectious sources (Schaller & Duncan, 2007; Schaller & Park, 2011). Similarly, disgust is considered a universal emotion (Curtis & Biran, 2001) and may be indicative of disease-connoting sources. Disgust responses are triggered from a variety of stimuli including bodily functions that are often a biproduct of sickness (e.g., sneezing, itching, coughing, etc.), foods that have spoiled, and animals that may be carriers of pathogens (e.g., ticks, fleas, mosquitos, etc.; Tybur, Lieberman, & Griskevicius, 2009; Tybur, Lieberman, Kurzban, & DiScioli, 2013). Disgust responses may therefore indicate activation of the BIS which would encourage individuals to avoid stimuli that may contain pathogens.

Consistent with behavioral-avoidance systems, there is accumulating evidence that cognitive systems have adapted to process and retain information that is relevant to longevity. For instance, females better remember male faces who were once considered in a long-term dating context, versus a long-term worker context (Pandeirada, Fernandes, Vasconcelos, & Nairne, 2017). Further, there is evidence that processing information

based on its relevance towards survival is better remembered than information that has not been processed based on survival relevance. This memory improvement has been termed the *survival-processing effect* (Nairne, Thompson, & Pandeirada, 2007; Nairne & Pandeirada, 2016) and has been framed as an evolutionary process in which the cognitive system has been selectively "tuned" to remember information that can benefit survival as retention of this information can increase the likelihood than an individual may reproduce and propagate their genetic information in the future.

In an early demonstration, Nairne et al. (2007) had participants study lists of words using a survival-processing task in which participants were to imagine that they were stranded in the grasslands of a foreign land and would need to sustain their own survival. Participants then rated the words based on their relevance to the survival scenario. At test, processing words based on survival increased correct memory relative to a control task in which participants imagined that they were moving to a new city and to rate the words based on their relevance for thriving in a new location. This control task was designed to mimic many of the elements of the survival task without requiring that participants focus on survival.

Subsequent experiments have revealed that the *survival-processing effect* is robust: It holds when compared to powerful deep study tasks such as pleasantness ratings and self-referential encoding (Craik & Lockhart, 1972; Kang, McDermott, & Cohen, 2008), under different survival scenarios outside of the grasslands scene (Nairne & Pandeirada, 2010) including surviving a zombie apocalypse (Soderstrom & McCabe, 2011), and when different threats to survival are present, such as being socially isolated or around potential attackers (Kostic, McFarlan, & Cleary, 2012). Further, the survival-

processing effect occurs in both between- and within-subject comparisons, demonstrating that the benefit generalizes across different research designs (Nairne et al., 2007; Nairne, Thompson, & Pandeirada, 2008). Given the broad and reliable benefits for processing information based on survival relevance, an important question is whether information that could potentially compromise survival, such as sources of disease, may also be highly memorable to avoid contamination, potentially through activation of the BIS.

To evaluate the effects of diseased sources on memory, Fernandes, Pandeirada, Soares, and Nairne (2017) presented individuals with pictures of objects and faces in three experiments. The researchers' main interest was whether individuals would remember the items that were associated with a sick versus healthy individual. In the first experiment, drawings of everyday objects were shown along with a descriptor of an individual who had just touched the object. Descriptors of illness stated that the individual had a "constant cough" or a "high fever," while healthy control descriptors stated physical attributes, such as having a "straight nose" or "green eyes." Participants were then presented with a surprise free recall task which revealed greater memory for objects paired with sick descriptors than healthy descriptors. In a second experiment, photos of faces were used to display signs of contaminating disease instead of descriptors. Specifically, sick faces displayed facial blemishes connoting the presence of a disease (e.g., eczema, herpes, ringworm, etc.), whereas healthy faces did not. The results were consistent with the first experiment: Participants recalled more objects associated with the faces of sick than healthy individuals. Importantly, this disease-enhancing memory effect was not found in a final experiment in which the faces were

described as actors in a medical television series who were wearing makeup. Under these conditions, the memory advantage for objects paired with "sick" faces was eliminated.

Based on Fernandes et al.'s (2017) final experiment, an important factor for whether disease knowledge will affect memory processes may be whether the disease is perceived as contagious and therefore could pose a threat. According to the *law of contagion*, disease-connoting objects transfer pathogens to individuals who encounter these objects thereby inflicting harm (Frazer, 1922). Therefore, if individuals perceive objects as infectious, they may be more likely to remember them later as a means of avoiding contact—cognitive processes that are consistent with the BIS.

Given the memory benefit found for objects associated with disease, one aspect that remains to be tested directly is whether association with disease alone is sufficient for enhancing memory, or if the disease needs to be perceived as contagious. In Fernandes et al. (2017), disease-related descriptions and pictures modified to signify diseases were presented to participants; however, it was unclear as to whether these diseases were perceived as being contagious and therefore threatening to the participant, or if they were merely associated. In other words, is knowledge that the disease state is contagious and concerns about threats to one's health and wellness responsible for the memory enhancement? Or is mere presence of a disease state distinctive which results in a memory advantage? My thesis aims to disentangle these two possibilities by comparing memory for items that are associated with a source that is infected with a communicable disease containing pathogens (i.e., influenza) to a source infected with a disease that is not communicable (i.e., cancer).

Distinctive Effects on Memory

Separation of the BIS account from a *distinctiveness account* is critical given the ubiquitous effects of distinctive processing on memory. Distinctiveness refers to the "processing of difference within the context of similarity" (Hunt, 2006) and the benefits of distinctive features on memory are diverse and well-established (see Huff, Bodner, & Fawcett, 2015; Hunt & Worthen, 2006 for reviews). Examples of distinctiveness on memory range from early demonstrations, such as the von Restorff effect, to more recent experiments on the production effect. In the von Restorff paradigm (von Restorff, 1933), participants study a set of items in which one item differs perceptually from the others on the list. When tested, participants remember the perceptually distinctive item at a far greater rate than perceptually non-distinct control items, regardless of the serial position in which the perceptually distinct item is presented at study. In the production effect, participants are given lists of words in which some are read aloud, and some read silently (MacLeod, Gopie, Hourihan, Neary, & Ozubko, 2010). At test, participants remember the aloud words at a greater rate than silent words, a pattern that has been interpreted as aloud words being more distinctive and therefore, more memorable, than silent words (MacLeod & Bodner, 2017).

According to Hunt (2002), distinctive processing can benefit memory in two ways: By making studied information more memorable so that it is correctly remembered, an encoding-based process, and/or by enhancing the quality with which individuals monitor for correct items at test, a retrieval-based process. When considered in the context of Fernandes et al. (2017), it is unclear whether memory benefits found for disease-related objects were due to the activation of the BIS through disease concerns, or because disease information is more salient. By comparing two diseased sources, one that

is contagious, and the other that is not contagious, my thesis will evaluate whether the memory-enhancing effects of disease is due to disease being distinctive or due to activation of the BIS making a contagious disease more salient.

Additionally, while Fernandes et al. (2017) examined how BIS activation increased correct memory, they did not evaluate overall memory accuracy in which both correct memory and memory errors are assessed. Distinctiveness effects on memory have produced reliable effects on both correct and false memory. Specifically, the typical pattern is that, relative to a non-distinctive control, distinctive study tasks produce an increase in correct memory and a decrease in memory errors (Huff & Bodner, 2013; Hunt, Smith, and Dunlap, 2011), a pattern termed a mirror effect (Glanzer & Adams, 1990). Given the complementary benefits of distinctiveness, evaluating whether disease salience may also produce a reduction in memory errors is key.

False Memory Errors and the Effects of Distinctiveness

Memory errors have generally been classified into two broad types: Errors of omission and errors of commission. Omission errors are forgetting or failing to encode information into memory initially, while commission errors remembering events that did not happen or remembering them differently than how they originally unfolded (Roediger & McDermott,1995; Schacter, 1999). Since commission errors are common and arguably, more debilitating given they add false details to a memory, determining whether methods that can increase correct memory, such as disease salience, can also affect memory errors is important for evaluating overall effects on memory accuracy.

A powerful method for inducing commission errors in a laboratory setting is the Deese/Roediger-McDermott (DRM) paradigm (Deese, 1959; Roediger & McDermott,

1995). In this paradigm, participants study lists of strongly related words (e.g., *bed, rest, tired, dream*, etc.) that all converge upon a single non-presented critical lure (e.g., *sleep*). After study, participants then complete a memory test in which false recall often reaches 55% and false recognition often reaches 85%—rates that often meet or exceed correct memory rates. Given the powerful effects of the *DRM illusion*, researchers have explored several ways to reduce it. For instance, the DRM illusion has been reduced (but not eliminated) when participants are warned about the DRM illusion, especially before study (Gallo, Roberts, & Seamon, 1997; Gallo, Roediger, & McDermott, 2001), and when participants are given more time to study each list word (McDermott & Watson, 2001). Relevant to my thesis, the DRM illusion has also been reduced following distinctive encoding, in which participants study DRM lists using a study task designed to increase processing of the distinctive or unique features of each of the list words (Gunter, Bodner, & Azad, 2007; Huff et al., 2015; McCabe, Presmanes, Robertson, & Smith, 2004). Thus, the DRM paradigm is well-suited to separate the effects of the BIS from distinctiveness and how these processes affect both correct and false memory.

Chapter 3: Current Study

My thesis will therefore evaluate two competing accounts regarding memory benefits for objects associated with disease. The BIS account predicts that memory accuracy (i.e., improved correct memory and reduced false memory) will be enhanced only if one's well-being is threatened through the presence of a communicable disease. In contrast, the distinctiveness account posits that the presence of any disease would be distinctive and therefore, facilitate memory accuracy. In two experiments, participants studied a set of 10 DRM lists presented auditorily by a female speaker. Critically, before

the presentation of each study list, participants were informed that the speaker had either influenza, a contagious disease, cancer, a non-contagious disease, or was healthy and not afflicted with ailments. Following study of each list, participants completed a free-recall test for the list words which repeated for all 10 study lists and then a final recognition test. In Experiment 1, the disease conditions were manipulated using a between-subjects design whereas in Experiment 2, the disease conditions were manipulated using a within-subjects design.

According to the BIS account, correct memory will be enhanced for the influenza group over the cancer and healthy groups, as influenza is contagious, and avoidance of this diseased source would increase the likelihood of survival. In contrast, the distinctiveness account predicts that correct memory would be enhanced over the healthy group when the speaker had either influenza or cancer diseases due to the overall salience of those diseases. In both accounts, it is predicted that false memory will decrease as correct memory increases, consistent with mirror effect patterns reported in the literature (e.g., Huff et al., 2013).

To more effectively characterize the effects of the BIS on memory accuracy, participants in both experiments also completed the Perceived Vulnerability to Disease Scale (PVD; Duncan, Schaller, & Park, 2009). The PVD is a dispositional rating scale that assesses an individual's concerns towards pathogens. The scale is composed of two subscales: One that assesses participants' beliefs concerning their susceptibility to infectious diseases, termed Perceived Infectability, and another that assesses emotional discomfort concerning pathogen transmission, termed Germ Aversion. Based on responses to this scale, it is possible that individuals who show greater concerns towards

their own infectability and/or are more averse to germs may possess a more sensitive BIS and therefore, more exaggerated memory effects. If so, then responses on the PVD and the two subscales will be positively correlated to correct memory but negatively correlated to false memory across conditions, indicating greater memory accuracy.

Chapter 4: Experiment 1 (Between Subjects)

Methods

Participants

Sixty-seven University of Southern Mississippi Psychology undergraduates participated for partial fulfillment of course credit. Six were removed for failure to follow experimental instructions with the remaining participants randomly assigned to either the Influenza (N = 21), Cancer (N = 18), or Healthy (N = 22) groups. All were proficient English speakers and reported normal or corrected-to-normal vision.

Materials

DRM lists were taken from Roediger, Watson, McDermott, and Gallo (2001) and contained the highest levels of mean backward associative strength (BAS) from the list items to the critical lure. These lists were divided into two sets of 10 lists to create two versions which were counterbalanced across participants (see Appendix A for study materials). Each list contained 15 items and were presented in descending order of BAS. Due to experimenter error, two lists (the "Car" and "Chair" lists) were presented in a random versus descending BAS order. Lists were presented via an audio recording which consisted of two female speakers. Each word was read aloud at an approximate rate of one word every 2 s.

An 80-item recognition memory test was constructed and consisted of 30 items from study lists (from list positions 1, 8, and 10 in each list), 30 non-studied items from the lists in the non-studied version (from the same list positions), 10 critical lures from studied lists, and 10 critical lures from the lists in the non-studied version. The recognition test was once randomized and presented in the same order across participants.

The 15-item PVD scale (Duncan et al., 2009) was also administered. The PVD contains two subscales: Perceived infectability and germ aversion, which correspond to separate dispositional responses. The perceived infectability subscale contains seven items to assess susceptibility to diseases (e.g., "I have a history of susceptibility to diseases."), whereas the germ aversion subscale consists of eight items to assess an individual's aversion to pathogenic threats (e.g., "It really bothers me when people sneeze without covering their mouths."). A 7-point Likert scale was used to make responses ranging from strongly disagree (1) to strongly agree (7). Higher scores indicate greater perceptions of disease vulnerability. Six items were reverse scored.

Procedure

Following informed consent, participants were tested individually via a computer using Microsoft PowerPoint and were instructed they would be presented with lists of words auditorily and that their memory for these words would be tested. At this time, participants were presented with one of the condition-specific disease instructions. The Influenza group was informed that "the individual reading this list has recently been diagnosed with influenza, a highly contagious disease that can result in fever, sore throat, and muscle or body aches." The Cancer group was informed that "the individual reading the list has recently been diagnosed with cancer, a non-contagious disease that can result

in anemia, the development of bodily lumps, and changes in digestive movements." The Healthy group was informed that "the individual reading this list is healthy and not afflicted with ailments." Additionally, each group was presented with a photograph of a female who visually matched the description presented in each disease group to better portray the disease status of speaker reading the word lists. Specifically, the photograph in the Influenza group depicted a female who was blowing her nose next to bottles of medicine. The photograph in the Cancer group depicted a female with no hair. The photograph in the Healthy group depicted a female who was smiling at the camera. These photographs can be seen in Appendix B.

After listening to each list, participants then completed a 1-min arithmetic filler task followed by a 1-min free-recall test. The free-recall test instructed participants to write down as many words as possible from the list in any order on a provided sheet of paper. Immediately following the free-recall test, participants then completed another study/recall cycle until all 10 lists were tested. Disease information was repeated prior to each study list to ensure participants were aware of the disease status of the speaker.

After the final study/recall cycle, participants then completed an old/new recognition test. They were presented with a sheet of paper with 80 words and were to determine whether each word was "old", or studied on a previous list, or "new" and not studied on a previous list by placing a checkmark into the old or the new column. The recognition test was untimed, and participants were required to make a response for every item. Following the recognition test, participants completed the PVD, a brief demographics questionnaire, and were then debriefed regarding the purpose of the study. The experimental session lasted approximately 60 min.

Results

A $p < .05$ statistical criterion was used for all results reported unless otherwise noted. Table 1 reports recall and recognition performance as a function of disease group for Experiment 1.

Free Recall

The three disease groups (Healthy vs. Cancer vs. Influenza) were compared using a one-way ANOVA. Correct recall, false recall, and mean number of extra-list intrusions were not found to differ across disease groups, $F(2, 58) = 1.20$, $MSE = .01$, $p = .31$; $F(2, 58) = 0.80$, $MSE = .05$, $p = .45$; and $F(2, 58) = 0.30$, $MSE = .34$, $p = .74$, respectively. Therefore, disease knowledge of the individual presenting auditory word lists produced no effect on any recall measures.

Recognition

Recognition rates were first corrected for possible response bias by subtracting false alarms for control items from hit rates for list items and critical lures (in which old responses to critical lures were treated as hits) yielding an adjusted recognition score which was utilized for all recognition analyses. As was found in free recall, the one-way ANOVA yielded no effect of disease for correct recognition, $F(2, 58) = 0.05$, $MSE = .02$, $p = .95$. However, unlike recall, a marginal effect of disease group was found on false recognition, $F(2, 58) = 2.59$, $MSE = .05$, $p = .08$. A series of post hoc *t*-tests revealed that this marginal effect was due to greater false recognition in the Healthy group relative to the Influenza group (.76 vs. .60), $t(41) = 2.32$, $SEM = .07$, $p = .02$, but no differences in false recognition between the Healthy and Cancer groups (.76 vs. .66), $t(38) = 1.54$, $SEM = .06$, $p = .13$, or between the Influenza and Cancer groups (.60 vs. .66), $t(37) = 0.69$,

SEM = .06, $p = .49$. Thus, the presence of influenza may have reduced the likelihood of participants falsely recognizing critical lures; however, one must be cautious with this result given the omnibus comparison was marginal.

Correlations with the PVD Scale

Correlations were then conducted to examine the relationship between memory responses and the PVD. These correlations, including the two subscales (infectability and germ aversion) are reported in Table 2. Given the relatively low number of participants in each disease group, all analyses collapsed across groups in order to maximize sensitivity and reliability. No significant relationships were found between the overall PVD scale and subscales and correct or false recall and recognition, rs < .14, $p > .29$. Therefore, responses on the PVD were not related to memory performance on either the recall or recognition tests.

Discussion

The experimental findings of Experiment 1 failed to provide support for either the BIS account or the distinctiveness account for disease-related effects on memory: Correct and false recall were equivalent across the disease groups and the healthy control. This pattern similarly occurred on correct recognition where again, no disease effects were found. False recognition, however, was lower in the Influenza group than the Healthy group, though the omnibus comparison was marginal. This finding, however, is at odds with both the BIS and distinctiveness accounts. This data could be explained by the distinctiveness in the usage of the word "influenza," which is not as commonly used in the vernacular as the words "flu" or "healthy." Another explanation could lie in the

auditory presenters used during the studies: there might have been an incongruency between the Influenza group speaker's voice and the disease state, itself.

The effects of disease status on memory were similarly absent when correlations were computed between recall and recognition performance and the PVD scale. Here, no relationships were found, suggesting that individual dispositional responses towards disease vulnerability were not related to memory performance when word lists were studied from an auditory source.

One potential reason for these null effects may be due to how disease state was manipulated in the experiment. In Fernandes et al. (2017), participants were exposed to both disease and non-disease cues when presented with words at study through a within-subject design. A within design may be advantageous as it may have emphasized the contrast between the disease objects and the non-disease objects. It is possible that the qualitative difference in how the disease information is presented (i.e., between vs. within) is critical for whether disease affects later memory performance. Consistent with this possibility, previous research has shown that distinctive memory-enhancing tasks such as generation and production often produce larger benefits relative to control items when these tasks are manipulated within than between subjects (e.g., Begg & Snider, 1987; Fawcett, 2013). These patterns have been shown to reflect both to benefits to the distinctive task and costs to the control technique (i.e., read-only words/lists; Huff et al., 2015), suggesting that a comparison between two tasks may be necessary to produce a larger difference between the tasks. Therefore, a natural extension of Experiment 1 is to examine whether disease-related memory effects are more detectable within-subjects.

Chapter 5: Experiment 2 (Within Subjects)

Based on the preceding discussion, and to provide a closer comparison to Fernandes et al. (2017), Experiment 2 utilized a within-subject design. This design was chosen to maximize the contrast between disease conditions which would likely be more obvious to participants when exposed to two disease conditions. The major addition of this experiment is therefore the direct comparison between contagious versus non-contagious disease groups to the healthy control group (influenza vs. healthy; cancer vs. healthy) and also a direct comparison of the two disease groups (influenza vs. cancer). This latter comparison may be particularly important because one disease group may be encoded more deeply than the other, possibly due to some form of distinctiveness-type process.

In Experiment 2, participants were introduced to one of the following within-subject disease groups: Influenza/Cancer, Cancer/Healthy, or Healthy/Influenza. In each group, participants were again presented with DRM lists with the exception that they were now alternated by two separate speakers, each of whom had a different disease status. Participants completed a free-recall test after studying each list and a final recognition test after all lists were studied/recalled. Consistent with predictions for Experiment 1, the BIS account predicts that correct memory will be enhanced selectively for lists read by the infectious influenza speaker than lists read be either the cancer or healthy speakers. In this account, it is also predicted that false memory for the Influenza group will decrease and correct memory increases when compared to Cancer or Healthy groups. Separately, the distinctiveness account predicts that correct memory would be enhanced lists read by either the influenza or cancer speakers over the healthy speaker.

Here, false memory is predicted to decrease and correct memory increase in either disease condition (Influenza or Cancer) when compared to the Healthy group.

To further parse the effects of disease status on memory, a source-monitoring recognition test was used to more finely evaluate participant's recollections for the diseased source of the study lists. A source recognition test requires participants to recall the source of remembered information (Johnson, Hashtroudi, & Lindsay, 1993). Source-monitoring explores the differences in memories from various sources. Since disease-related information is presented in different contexts, such as a diseased or healthy source, this test may be more sensitive towards detecting disease-related effects.

Methods

Participants

Seventy-two University of Southern Mississippi undergraduates were participants for partial fulfillment of course credit. The participants were randomly assigned and evenly distributed across 3 within-subject groups: Healthy/Influenza, Healthy/Cancer, or Influenza/Cancer. All participants were proficient English speakers and reported normal or corrected-to-normal vision.

Materials and Procedure

Participants were presented with the same 10 lists from Experiment 1 with the exception that half of the lists were presented by a female speaker who was said to be afflicted with one health condition and the other half by a separate female afflicted with another health condition. Speakers and disease conditions were interleaved across the 10 lists with all health status information presented prior to the presentation of each list. The pictures presented in Experiment 1 were again used in Experiment 2 to further indicate

the health status of the speaker. The ordering of the lists/speakers were counterbalanced across conditions. Like Experiment 1, participants completed a free-recall test using the same test instructions, however after the completion of all 10 study/recall cycles, participants completed a source-monitoring recognition test. On this test, participants were presented with the same 80 items that were presented on the recognition test in Experiment 1, with the exception that they were required to specify the disease state of each speaker who said each item, if it was said at all. Participants were provided with three response options. Two of these options corresponded to the two disease conditions they were presented with in the experiment, and the other was a "neither" option. For each item, participants were to select one of the three options to denote the source of their memory for the item by placing a checkmark in a response labeled box. After completion of the source-recognition test, participants were debriefed and awarded credit for their participation. The experiment was approximately 60 min in length.

Results

Free Recall

Correct recall of list items and false recall of critical lures are presented in Table 3. Beginning with the Healthy/Influenza group, no significant difference in correct recall was found between lists that were presented by the healthy speaker or lists presented by the influenza speaker (.50 vs. .47), $t(23) = 1.21$, $SEM = .02$, $p = .24$. A similar equivalence was found for correct recall in the Healthy/Cancer group where correct recall for healthy lists was similar to cancer lists (.58 vs. .53), $t(23) = 0.90$, $SEM = .06$, $p = .38$. Interestingly however, for the Influenza/Cancer group, correct recall was found to be greater for influenza lists than cancer lists (.52 vs. .47), $t(23) = 2.83$, $SEM = .02$, $p = .01$,

suggesting that information associated with influenza may be more memorable than information associated with cancer when both disease conditions directly contrast each other. Since this comparison is not relevant to either the BIS or distinctiveness accounts, I will discuss this pattern further below.

Turning to false recall, no significant difference was found in the Healthy/Influenza group for lists presented by the healthy and influenza speakers (.58 vs .58), $t(23) = 0.11$, $SEM = .07$, $p = .91$, in the Healthy/Cancer group for the healthy and cancer speakers (.58 vs. .53), $t(23) = 0.90$, $SEM = .05$, $p = .38$, or in the Influenza/Cancer group for influenza and cancer speakers (.57 vs. .66) $t(23) = 1.59$, $SEM = .05$, $p = .13$. Therefore, no differences in false recall were found across any of the disease lists.

Finally, extra-list intrusions were also analyzed across disease conditions in each within group. There were no differences in extra-list intrusions between healthy and influenza lists in the Healthy/Influenza group (.48 vs. .65), $t(23) = 1.75$, $SEM = .10$, $p = .10$, the healthy and cancer lists in the Healthy/Cancer group (.60 vs. .59), $t(23) = .074$, $SEM = .11$, $p = .94$, or the influenza and cancer lists in the Influenza/Cancer group (.88 vs. .72), $t(23) = 1.05$, $SEM = .16$, $p = .30$. Thus, like false recall, there were no differences in intrusions reported as a function of disease condition.

Source Recognition

Table 4 reports mean proportions of source recognition attributions for influenza, cancer, and healthy sources as a function of within group. Correct attributions (computed as the proportion of studied items correctly attributed to the studied disease source) were first analyzed within each disease group. Beginning with the Healthy/Influenza group, participants were marginally more likely to correctly attribute items to the healthy than

the influenza source (.64 vs. .52), $t(23) = 1.97$, $SEM = .06$, $p = .06$. In the Healthy/Cancer group, there was no difference between correct source attributions to the healthy and cancer lists (.64 vs. .63), $t(23) = .39$, $SEM = .03$, $p = .70$. Finally, in the Cancer/Influenza group, correct attributions were marginally lower for cancer than influenza lists (.48 vs. .56), $t(23) = 1.75$, $SEM = .05$, $p = .09$.

Source attributions for critical lures were also examined by computing proportions of lures that were "correctly" attributed as originating from the source that presented the list of associates. For the Healthy/Influenza group, attributions of critical lures to the appropriate source was marginally greater for healthy than influenza lists (.68 vs. .52), $t(23) = 2.06$, $SEM = .08$, $p = .05$, suggesting that participants were more likely to recollect critical lures as originating from healthy than influenza lists. No difference was found in critical lure attributions between healthy and cancer lists in the Healthy/Cancer group (.66 vs. .68), $t(23) = .40$, $SEM = .06$, $p = 70$, nor between the cancer and influenza lists in the Cancer/Influenza group (.48 vs. .56), $t(23) = 1.03$, $SEM = .06$, $p = .31$. Therefore, when taken together with correct source attributions, there is a trend for participants in the Healthy/Influenza group to recollect the source of healthy lists more frequently than influenza lists, a pattern that is not predicted by either the BIS or distinctiveness accounts. However, one should be cautious with this interpretation given the statistical comparisons were only marginal.

Correlations with the PVD Scale

Correlations were then conducted to evaluate the relationships between the PVD, the two subscales, and recall and source attributions across participants (see Table 5). For this analysis, proportions of correct recall and correct source attributions and false recall

and source attributions of critical lures to the correct list were collapsed across disease condition given there were no statistical differences found either recall or source recognition analyses above. As was found in Experiment 1, recall or source attributions were not significant correlated with the overall PVD scale or the infectability or germ aversion subscales, $rs < .19$, $ps > .11$.

Discussion

In this experiment, a within-subjects design was used to provide participants with a greater contrast between each disease condition by directly comparing healthy, influenza, and cancer disease conditions to each other. The equivalence in correct recall and correct source attributions when comparing the healthy lists to the influenza and cancer lists were not consistent with either the BIS nor the distinctiveness accounts.

The results revealed some evidence for differences between the two disease groups. Specifically, correct recall was greater for influenza lists than cancer lists in the Influenza/Cancer group which suggests that when directly compared, information associated with influenza is more memorable than that associated with cancer. Perhaps when compared directly to each other, the two diseases influenced the participant to become more aware of their survival chances, and because influenza is contagious, this might have made it more memorable. Regardless, this disease-related difference does not support either account. For these accounts to be supported, effects would need to be seen in Influenza/Healthy and Cancer/Healthy groups. However, no effects were found in correct recall, false recall, and extra-list intrusions when comparing the Influenza or Cancer groups to the Healthy group. In source recognition, there was a trend for greater source recollection for healthy list items in the Healthy/Influenza group and influenza list

items in the Influenza/Cancer group (as was found in recall), but again, neither of these patterns are predicted by the BIS or distinctiveness accounts.

Chapter 6: General Discussion

The purpose of my thesis was to directly compare the BIS and distinctiveness accounts for the effects of disease information on enhancing memory. According to the BIS account, correct memory should be enhanced for the Influenza group over the Cancer and Healthy groups because influenza is highly contagious and therefore more threatening than the other two disease states. In contrast, according to, the distinctiveness account, correct memory should be enhanced for either disease group over the healthy group as disease states are more salient or distinctive than the control healthy condition. These accounts were evaluated using the DRM false memory paradigm.

In Experiment 1, which utilized a between-subject design, no differences were found across disease groups in correct recall, false recall, or mean number of extra-list intrusions. On recognition, no effect of disease group was found in correct recognition; however, false recognition was found to be greater in the Healthy than Influenza group, though the omnibus was marginal. Results from this experiment therefore failed to support either account, as recall and recognition were equivalent across all groups. As a secondary examination of the effects of the BIS on memory accuracy, participants completed the PVD which included the perceived infectability and germ aversion subscales. Correlations with correct and false recall and recognition failed to yield reliable relationships with the overall PVD scale or the two subscales, demonstrating dispositional disease concerns were not related to memory performance. The net results of these comparisons failed to support either the BIS nor the distinctiveness accounts.

In Experiment 2, a within-subjects design was used to provide a closer comparison to earlier literature and to maximize the contrast between disease conditions. This was accomplished by directly comparing the contagious and non-contagious disease groups to the healthy control group, and it also comparing the disease groups to each other. While this design was used to more closely evaluate the disease groups, the data were again inconsistent with the two accounts. For correct recall, correct recall was greater for influenza lists than cancer lists in the Influenza/Cancer group. No differences were found across any of the three groups for false recall and extra-list intrusions. For source recognition, participants were marginally more likely to correctly attribute items to the healthy when compared to the influenza source in the Healthy/Influenza group and to the influenza versus cancer source in the Cancer/Influenza group, though both comparisons were marginal. Similar to Experiment 1, no relationships were found between correct and false recall and source recognition and the PVD scale. Overall, these results suggest that the BIS is not as powerful in enhancing memory as originally thought, at least when memory items are auditorily presented.

The findings of my experiments are clearly at odds with the findings of Fernandes et al. (2017). A possible reason for the discrepancies may be due to a lack of direct contact between the diseased source and memory items. In Fernandes et al., participants were explicitly told that objects were touched by individuals with characteristics consistent with diseases, thereby producing a physical "vector" allowing disease to infect studied objects which may have been perceived as threatening to participants. In my experiments, participants were auditorily provided with their word lists and descriptions of the presenters' disease states and did not provide a direct vector between the disease

state and the studied item. The physical interaction between the diseased speaker and a palpable object might therefore be critical to enhancing memory performance.

Relatedly, another reason why the above experiments did not show a disease effect on memory could have been due to participants not believing or being heavily affected by the disease manipulation. According to Nairne et al. (2007), only information that is relevant to an individual's survival chances will enhance retention. In this experiment, participants may not have perceived the disease state of the speaker as threats to threatening to their well-being, Indeed, word lists were presented through computer speakers and the speakers spoke with clear voices that were likely incongruent with the expectations of a diseased state. The information provided about influenza and cancer disease states may therefore have been rendered ineffective. Future research could examine this possibility by presenting words lists read aloud by speakers who are frail and nasally to better match the appropriate disease condition.

Disease potency could also have been a key player. In Fernandes et al. (2017), the diseases presented to participants were not specified. Without this detail, subjects may have perceived the disease characteristics to be extremely potent. Our experiments clearly stated the disease state of each presenter, leaving little room for imagination. We used influenza as our contagious disease state due to its common occurrence in the population that would have been experienced by most participants. While influenza may be easily recognizable, the actual word might not have been, as the word "flu" is more readily recognized and used in the common vernacular. Influenza may have also been perceived as too trivial to be considered a serious threat. Disease-related effects of memory may

have occurred if the disease was more severe, such as Ebola or measles—a possibility that is currently being explored.

Of course, my study is not without limitations that may restrict some of the conclusions that can be drawn. For instance, the study utilized a relatively small sample size, using 61 individuals in Experiment 1 and 72 in Experiment 2, with a total of 133 subjects. In contrast, Fernandes et al. (2017) had a sample size of 138 in Experiment 1, 46 in Experiment 2, and 35 in Experiment 3, with a total of 219 subjects. A larger sample may therefore have revealed disease-related effects across conditions.

While this study had its limitations, there is also the possibility that Fernandes et al.'s theory of mnemonic tuning and the BIS are not real effects. Fernandes et al. claims that the BIS is specifically tuned to enhance survival, and this can affect cognitive responses through attention and memory. To support the BIS, Fernandes et al. performed only a few experiments. They state that the mnemonic advantage relies not on visual cues but on the context that provides an opportunity for contamination. My thesis project attempt at replicating these disease-related effects did not use visual cues but did provide an opportunity for contamination through auditory means. From my data, it can be suggested that disease-related memory effects are, at the very least, not found on auditorily presented word lists.

Chapter 7: Conclusion

In summary, my thesis further examined the role of adaptive memory and how it may be moderated by the effects of the BIS when individuals are faced with potential disease-related threats. In two experiments, modeled after prior work from Fernandes et al. (2017), participants were presented with word lists read by individuals with either an

infectious disease, a non-infectious disease, or was healthy. Memory for these word lists showed no differences as a function of disease state, failing to replicate the effects of Fernandes et al. This discrepancy could be due to a variety of methodological differences discussed above, but at the very least, my experiments demonstrate that disease effects on memory are not always consistently found. Additional research is therefore needed to establish the reliability of disease effects on memory and whether these effects are due to activation of the BIS or due to the effects of more general distinctiveness on memory.

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Table 1

Mean (SE) Recall and Recognition Proportions for Studied List Items, Critical Lures, and Extra-List Intrusions per List as a Function of Influenza, Cancer, and Healthy Disease Groups in Experiment 1.

Disease Group/ Test Type	Influenza	Cancer	Healthy
N	21	18	22
Recall Test			
List Items	.50 (.02)	.47 (.02)	.45 (.02)
Critical Lures	.48 (.04)	.59 (.05)	.50 (.05)
Extra-List Intrusions	.76 (.13)	.73 (.13)	.67 (.12)
Recognition Test			
List Items	.81 (.02)	.85 (.02)	.83 (.02)
List Item Controls	.09 (.02)	.12 (.02)	.11 (.02)
Adjusted List Items	**.72 (.03)**	**.74 (.04)**	**.72 (.03)**
Critical Lures	.79 (.04)	.74 (.04)	.72 (.03)
Critical Lure Controls	.19 (.03)	.21 (.05)	.13 (.03)
Adjusted Critical Lures	**.60 (.06)**	**.66 (.05)**	**.76 (.03)**

Note. Boldface indicates adjusted recognition proportions (i.e., List Items and Critical Lures minus Control Items) used in the statistical analyses.

Table 2

Perceived Vulnerability to Disease Scale Correlations for Experiment 1

	1	2	3	4	5	6	7
1. Correct Recall	-						
2. False Recall	-.09	-					
3. Correct RGN	.71**	-.01	-				
4. False RGN	.07	.34**	.39**	-			
5. PVD	-.11	-.06	.05	-.04	-		
6. Infectability	-.07	.08	-.09	-.12	.71**	-	
7. Germ Aversion	-.09	-.14	.13	.03	.85**	.23^	-

Notes. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). ^ Correlation is marginal (p = .05-.10).

Table 3

Mean (SE) Recall Proportions for Studied List Items, Critical Lures, and Extra-List Intrusions per List as a Function of Influenza, Cancer, and Healthy Disease Within Conditions in Experiment 2.

Within Disease Group	Healthy/Influenza		Healthy/Cancer		Cancer/Influenza	
	Healthy	Influenza	Healthy	Cancer	Cancer	Influenza
List Items	.50 (.02)	.47 (.02)	.53 (.02)	.53 (.02)	.47 (.02)	.52 (.02)
Critical Lures	.55 (.05)	.52 (.06)	.58 (.06)	.53 (.05)	.64 (.05)	.58 (.05)
Extra-List Intrusions	.48 (.11)	.65 (.12)	.60 (.10)	.59 (.11)	.72 (.13)	.88 (.20)

Notes. $N = 24$ in each within-subjects group.

Table 4

Mean (SE) Proportions of Source Attributions for Studied List Items, Critical Lures, and Extra-List Intrusions per List as a Function of Influenza, Cancer, and Healthy Disease Within Conditions in Experiment 2.

Item Type	List Items		Critical Lures		Non-Studied Critical Lures	Non-Studied
Healthy/Influenza Group	Healthy Lists	Influenza Lists	Healthy Lists	Influenza Lists		
"Healthy"	.64 (.04)	.36 (.04)	.68 (.06)	.38 (.05)	.08 (.02)	.13 (.03)
"Influenza"	.25 (.04)	.52 (.04)	.27 (.06)	.52 (.05)	.09 (.02)	.17 (.03)
"Neither"	.11 (.02)	.12 (.02)	.06 (.02)	.11 (.07)	.83 (.03)	.70 (.06)
Healthy/Cancer Group	Healthy Lists	Cancer Lists	Healthy Lists	Cancer Lists		
"Healthy"	.64 (.04)	.24 (.04)	.66 (.05)	.25 (.05)	.04 (.01)	.08 (.02)
"Cancer"	.22 (.03)	.63 (.04)	.22 (.04)	.68 (.05)	.05 (.01)	.08 (.02)
"Neither"	.14 (.03)	.13 (.04)	.13 (.07)	.07 (.02)	.90 (.02)	.83 (.03)
Cancer/Influenza Group	Cancer Lists	Influenza Lists	Cancer Lists	Influenza Lists		
"Cancer"	.48 (.04)	.32 (.03)	.48 (.04)	.46 (.05)	.05 (.02)	.08 (.02)
"Influenza"	.39 (.04)	.56 (.03)	.32 (.03)	.56 (.03)	.07 (.02)	.05 (.03)
"Neither"	.13 (.02)	.13 (.02)	.08 (.02)	.13 (.03)	.88 (.04)	.86 (.04)

Notes. $N = 24$ in each within-subjects group.

Table 5

Perceived Vulnerability to Disease Scale Correlations for Experiment 2

	1	2	3	4	5	6	7
1. Correct Recall	-						
2. False Recall	-.08	-					
3. Correct Source	.13	-.13	-				
4. False Source	-.03	.08	.70**	-			
5. PVD	.07	.05	.05	-.01	-		
6. Infectability	.00	.02	.19	.15	.82**	-	
7. Germ Aversion	.10	.06	-.10	-.16	.82**	.35**	-

Notes. ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Appendix A

The 15-Item DRM Study Lists (from Roediger, Watson, McDermott, & Gallo, 2001) for Version A and B Counterbalances with Mean BAS Values used in Experiments 1 and 2.

Version A

"Cold" List; Mean BAS: .353

	Hot	Shiver	Arctic	Frigid	Freeze	Chilly	Frost	
BAS	.676	.669	.642	.570	.461	.395	.370	
	Warm	Ice	Winter	Snow	Heat	Wet	Weather	Air
BAS	.364	.364	.277	.199	.169	.108	.032	.000

"Chair" List; Mean BAS: .303

	Table	Sit	Legs	Seat	Couch	Desk	Recliner	Sofa
BAS	.756	.183	.000	.543	.288	.290	.547	.132
	Wood	Cushion	Swivel	Stool	Sitting	Rocking	Bench	
BAS	.012	.086	.593	.320	.096	.593	.109	

"Smell" List; Mean BAS: .290

	Aroma	Scent	Whiff	Stench	Reek	Sniff	Perfume
BAS	.678	.625	.577	.562	.510	.442	.393
	Fragrance	Nose	Rose	Salts	Breathe	Hear	See
BAS	.389	.108	.034	.028	.000	.000	.000
	Nostril						
BAS	.000						

"King" List; Mean BAS: .230

	Throne	Queen	Crown	Reign	Monarch	Royal	Palace
BAS	.759	.730	.471	.383	.317	.315	.159

	Prince	Chess	Leader	Dictator	George	Rule	England	
BAS	.134	.092	.034	.023	.020	.020	.000	
	Subjects							
BAS	.000							
"Needle" List; Mean BAS: .203								
	Thread	Syringe	Haystack	Injection	Pin	Thimble	Sewing	
BAS	.758	.520	.418	.331	.289	.218	.181	
	Knitting	Prick	Sharp	Thorn	Point	Eye	Hurt	Cloth
BAS	.135	.108	.030	.028	.024	.000	.000	.000
"Shirt" List; Mean BAS: .186								
	Blouse	Sleeves	Collar	Shorts	Button	Pants	Polo	
BAS	.647	.347	.342	.252	.240	.185	.177	
	Jersey	Vest	Cuffs	Tie	Pocket	Iron	Belt	
BAS	.174	.143	.143	.074	.058	.010	.000	
	Linen							
BAS	.000							
"City" List; Mean BAS: .185								
	Metropolis		Town	New York	Urban	Suburb	County	
BAS	.536		.529	.383	.358	.265	.195	
	Chicago	State	Capital	Country	Streets	Village	Crowded	
BAS	.152	.117	.095	.068	.054	.020	.000	
	Subway	Big						
BAS	.000	.000						

"Soft" List; Mean BAS: .179

	Hard	Loud	Tender	Fluffy	Pillow	Downy	Plush	
BAS	.564	.333	.297	.266	.236	.221	.178	
	Cotton	Skin	Fur	Touch	Furry	Feather	Kitten	Light
BAS	.166	.161	.061	.061	.061	.045	.033	.000

"Slow" List; Mean BAS: .172

	Fast	Snail	Turtle	Sluggish	Quick	Molasses	Lethargic	
BAS	.598	.486	.372	.340	.272	.170	.142	
	Speed	Delay	Hesitant	Cautious	Traffic	Stop	Listless	Wait
BAS	.061	.059	.034	.027	.020	.000	.000	.000

"Smoke" List; Mean BAS: .167

	Cigar	Cigarette	Pipe	Tobacco	Puff	Chimney	Lungs	
BAS	.507	.449	.419	.338	.240	.240	.119	
	Pollution	Billows	Ashes	Fire	Blaze	Stink	Flames	Stain
BAS	.068	.061	.052	.018	.000	.000	.000	.000

Version B

"Sleep" List; Mean BAS: .431

	Nap	Doze	Bed	Awake	Drowsy	Snooze	Slumber	Tired
BAS	.730	.682	.638	.618	.551	.520	.514	.493
	Rest	Snore	Wake	Dream	Yawn	Blanket	Peace	
BAS	.475	.439	.304	.247	.235	.024	.000	

"Car" List; Mean BAS: .346

Truck	Bus	Train	Automobile	Vehicle	Drive	Jeep	

BAS	.264	.252	.058	.709		.740	.480	.240
	Ford	Race	Keys	Garage	Highway	Sedan	Van	Taxi
BAS	.331	.043	.360	.519	.115	.519	.448	.129

"Doctor" List; Mean BAS: .245

	Physician		Nurse	Stethoscope		Surgeon	Patient
BAS	.804		.547	.520		.479	.365
	Clinic	Dentist	Medicine	Lawyer	Health	Sick	Cure
BAS	.300	.214	.152	.149	.049	.031	.028
	Hospital	Office	Ill				
BAS	.027	.014	.000				

"Music" List; Mean BAS: .227

	Band	Concert	Jazz	Symphony	Orchestra	Rhythm	Radio	
BAS	.432	.395	.367	.329	.309	.277	.270	
	Melody	Piano	Sound	Instrument	Note	Sing	Art	Horn
BAS	.243	.230	.205	.148	.132	.330	.020	.014

"Bread" List; Mean BAS: .200

	Rye	Loaf	Toast	Butter	Dough	Crust	Flour	
BAS	.791	.552	.364	.362	.310	.243	.142	
	Sandwich	Jam	Jelly	Slice	Milk	Food	Eat	Wine
BAS	.067	.054	.053	.048	.012	.000	.000	.000

"Fruit" List; Mean BAS: .202

	Kiwi	Citrus	Pear	Berry	Vegetable	Banana	Orange
BAS	.709	.426	.347	.298	.220	.215	.194

	Cherry	Apple	Ripe	Basket	Juice	Bowl	Salad	
BAS	.168	.154	.151	.084	.035	.028	.000	
	Cocktail							
BAS	.000							

"Window" List; Mean BAS: .184

	Pane	Sill	Shutter	Curtain	Door	Ledge	Glass	View
BAS	.833	.682	.480	.189	.156	.152	.144	.048
	Screen	Shade	Open	Frame	House	Breeze	Sash	
BAS	.027	.021	.014	.014	.000	.000	.000	

"Foot" List; Mean BAS: .177

	Toe	Inch	Ankle	Shoe	Sandals	Sock	Hand	Boot
BAS	.605	.473	.364	.321	.209	.172	.158	.142
	Yard	Kick	Knee	Walk	Soccer	Arm	Mouth	
BAS	.126	.039	.032	.016	.000	.000	.000	

"Sweet" List; Mean BAS: .172

	Honey	Bitter	Sugar	Sour	Candy	Tart	Chocolate	Nice
BAS	.451	.435	.433	.405	.336	.223	.101	.095
	Taste	Cake	Good	Tooth	Soda	Heart	Pie	
BAS	.071	.027	.000	.000	.000	.000	.000	

"Spider" List; Mean BAS: .159

	Web	Tarantula	Arachnid	Creepy	Bug	Insect	Fright	Fly
BAS	.845	.744	.704	.058	.040	.000	.000	.000
	Crawl	Poison	Bite	Animal	Ugly	Feelers	Small	

BAS	.000	.000	.000	.000	.000	.000	.000

Appendix B

Photographs of Disease States

Cancer

Healthy

Influenza

Appendix C

IRB Approval

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI

INSTITUTIONAL REVIEW BOARD
118 College Drive #5147 | Hattiesburg, MS 39406-0001
Phone: 601.266.5997 | Fax: 601.266.4377 | www.usm.edu/research/institutional.review.board

NOTICE OF COMMITTEE ACTION

The project has been reviewed by The University of Southern Mississippi Institutional Review Board in accordance with Federal Drug Administration regulations (21 CFR 26, 111), Department of Health and Human Services (45 CFR Part 46), and university guidelines to ensure adherence to the following criteria:

- The risks to subjects are minimized.
- The risks to subjects are reasonable in relation to the anticipated benefits.
- The selection of subjects is equitable.
- Informed consent is adequate and appropriately documented.
- Where appropriate, the research plan makes adequate provisions for monitoring the data collected to ensure the safety of the subjects.
- Where appropriate, there are adequate provisions to protect the privacy of subjects and to maintain the confidentiality of all data.
- Appropriate additional safeguards have been included to protect vulnerable subjects.
- Any unanticipated, serious, or continuing problems encountered regarding risks to subjects must be reported immediately, but not later than 10 days following the event. This should be reported to the IRB Office via the "Adverse Effect Report Form".
- If approved, the maximum period of approval is limited to twelve months.
  Projects that exceed this period must submit an application for renewal or continuation.

PROTOCOL NUMBER: 16112208
PROJECT TITLE: The Effects of Contamination on Memory for Word Lists
PROJECT TYPE: New Project
RESEARCHER(S): Laura Pazos
COLLEGE/DIVISION: College of Education and Psychology
DEPARTMENT: Psychology
FUNDING AGENCY/SPONSOR: N/A
IRB COMMITTEE ACTION: Expedited Review Approval
PERIOD OF APPROVAL: 02/15/2017 to 02/14/2018
Lawrence A. Hosman, Ph.D.
Institutional Review Board