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The current study was designed to test whether the systematic/contextual perspective would successfully account for lateralized responses to framed health messages. Accordingly, gain or loss framed messages promoting sunscreen use were presented to participants' left or right hemisphere via a dichotic listening task. After listening to the message, participants rated how likely they were to use sunscreen. A 2 X 2 ANOVA conducted on these likelihood ratings revealed a significant interaction between Hemisphere and the Message Frame, such that loss versus gain framed messages were rated significantly higher in the right hemisphere but there was virtually no difference when the same messages were presented to the left hemisphere. These results were consistent with the systematic/contextual perspective and recent work on ostensibly distinct framing manipulations.

DOES LATERAL ATTENTION AFFECT HEALTH BEHAVIOR?:

INVESTIGATING HEMISPHERIC INFLUENCES

IN FRAMED HEALTH MESSAGES

by

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CHAPTER I

INTRODUCTION

A considerable portion of the literature on "framing" has focused on message framing, in which a message that remains factually equivalent is varied in its positive or negative valence (e.g., Rothman & Salovey, 1997). Typically, participants in these studies are asked to read either a positively or negatively framed message that promotes some behavior (e.g., sunscreen use, HPV vaccination) and then rate how likely they are to engage in the behavior. The difference in message ratings between frames constitutes the "framing effect" for message framing. Meanwhile, lateralization research has shown that the left hemisphere has an advantage in processing information systematically and inferentially, whereas the right hemisphere is more sensitive to global information and contextual cues (e.g., Ley & Bryden, 1982; Hellige, 1993; Ivry & Lebby, 1993; Ornstein, 1997; Banich, 2004; Friedman & Forster, 2005). As a result, the right hemisphere may be relatively more sensitive to framing manipulations which vary the context of a message. Consistent with this reasoning, research on both risky-choice and attribute framing (discussed in greater detail later) has found typical framing effects when information is initially presented to the right hemisphere but little or no framing effects when the same information is presented to the left hemisphere (McElroy & Seta, 2004; Gallagher & Dagenbach, 2007; Seta & McCormick, manuscript under review). While the different types of framing are thought to involve different psychological processes, it

follows that if two types of framing manipulations (risky-choice and attribute framing) are similarly affected by selective hemispheric activation then the same might be found for a third type - message framing. If this reasoning holds then message designers may find it useful to frame messages (either positively or negatively) that are intended to be presented to the right hemisphere but that the effort is largely wasted when the same information is presented to the left hemisphere. However, the effect of hemispheric activation on framed health messages has not been previously tested. The current study was designed to address this issue.

CHAPTER II

LITERATURE REVIEW

Framing.

Most of the research investigating the framing effect has focused on risky-choice framing (see Kuhberger, 1998 for review). In risky-choice framing, participants are asked to decide between two alternatives that are equal in terms of their expected value – a risk-free option or a risk-seeking option. The options are either framed in terms of gains (e.g., lives saved) or losses (e.g., lives lost). For instance, in the classic Asian disease vignette, participants are told that they must choose between two programs designed to combat a disease. They tend to choose the risk-free option when framed in terms of gains (e.g., they prefer saving 200 individuals for sure over a 1/3 chance of saving 600 people and a 2/3 chance that no one will be saved). However, they tend to be risk-seeking when options are framed in terms of losses (e.g., they prefer a 1/3 chance that no one will die and a 2/3 chance that 600 people will die over allowing 400 people to die for sure). Even though the expected value of each option is equal, preference shifts have consistently been found based on the way in which the options are framed (e.g., Tversky & Kahneman, 1981; Kuhberger, 1998).

In another type of framing, known as attribute framing, the positive or negative valence of a product's attributes is varied while the information provided remains objectively equivalent (see Levin, Schneider & Gaeth, 1998 for review). For example, a

positively valenced attribute frame for the product of beef might describe it as 85% lean whereas the negatively valenced frame would describe the same beef as 15% fat. Individuals are typically asked to provide preference ratings for the framed products, and positively framed attributes tend to elicit higher product ratings (e.g., Levin, 1987; Levin & Gaeth, 1988; Levin, Schnittjer & Thee, 1988).

Compared to either risky-choice or attribute framing, relatively little research has focused on message framing. Message framing refers to varying the positive (gains) or negative (losses) valence of a message that remains factually equivalent throughout (e.g., Rothman & Salovey, 1997). For example, a gain framed message might state "The higher the SPF you use, the less you will be harmed by the sun's rays." The corresponding loss framed message would then state "The lower the SPF you use, the more you will be harmed by the sun's rays." While both messages provide the same information about the relationship between SPF level and the amount of harm the sun's rays can do, they do so in subjectively different ways. In studies involving message framing, it is typically the case that participants read either a gain or loss framed message and then rate how likely they are to adopt the behavior being promoted; this rating is used to indicate which message is the most persuasive.

Rothman and Salovey (1997) proposed that the relative effectiveness of gain and loss framed messages depends on how people view the behavior being promoted, especially in terms of risk. While individuals tend to vary in this regard, society actively shapes the way in which we view many health behaviors and this leads to generally held attitudes about the amount of risk associated with those behaviors (e.g., Rothman &

Salovey, 1997). For example, the BSE is considered by most women to be a risky behavior because they run the risk of detecting a lump even though not performing the BSE may allow cancer to develop into its later, more lethal stages (e.g., Rothman & Salovey, 1997. Also, despite information to the contrary, many people consider the HPV vaccination to be a risky behavior because of efficacy concerns or that it may introduce new harms such as an increase in promiscuous behavior (e.g., Gerend & Shepherd, 2007). As Rothman & Salovey (1997) note, these generally held beliefs allow for reliable predictions to be made regarding the effectiveness of framed messages. Accordingly, they divide health behaviors into two groups (prevention or detection) based on commonly held perceptions of risk. Prevention behaviors (e.g., sunscreen use) are those that prevent the onset of a disease and offer a relatively certain, desirable option. As such, they are typically perceived to be relatively risk-free. Conversely, detection behaviors (e.g., breast self-examination) seek to uncover diseases in their early stages so that treatment can be more effective. Because these behaviors are performed to detect the presence of an illness (undesirable outcome) they are typically perceived to be relatively risky to engage in. Thus, prevention behaviors are thought to offer a relatively risk-free option whereas detection behaviors are thought to offer a relatively risky option.

Drawing upon the logic of prospect theory (e.g., Kahneman & Tversky, 1979; Tversky & Kahneman, 1981), Rothman & Salovey (1997) predicted that people would tend to be risk-averse when presented with gain framed messages but risk-seeking when presented with loss-framed messages; that is, they would be more likely to choose an option that involves little or no risk when information is framed in terms of gains but

more likely to choose an option that does involve risk when information is framed in terms of losses. Consequently, when a behavior is viewed as relatively risk-free, as it is for prevention behaviors, people should be more responsive to gain framed messages, but when it is viewed as risky, as it is for detection behaviors, they should be more responsive to loss framed messages. Consistent with this theorizing, research has shown that gain framed messages elicit greater behavioral intentions for prevention behaviors whereas loss framed messages elicit greater behavioral intentions for detection behaviors (e.g., Rothman, Salovey, Antone, Keough & Martin, 1993; Rothman & Salovey, 1997; Salovey, Rothman & Rodin, 1998; Detweiler, Bedell, Salovey, Pronin & Rothman, 1999; Rivers, Salovey, Pizzaro D., Pizzaro J. & Schneider, 2005; Kiene, Barta, Zelenski & Cothran, 2005; Gerend & Shepherd, 2007). Thus, distinguishing between health behaviors based on the amount of risk they are generally perceived to entail has proven to be useful for predicting whether gain or loss framed messages will be relatively more effective. The current study was designed to test how these findings would be affected by presentation to either the left or right hemisphere; it has recently been found that two other types of framing manipulations (discussed below) are affected in a similar way by presentation to the left or right hemisphere, which may have implications for framed health messages.

Brain activity.

Recently, research employing functional magnetic resonance imaging (fMRI) has begun to elucidate the neurological basis of one type of framing - risky-choice framing (e.g., De Martino, Kumaran, Seymour & Dolan, 2006). In this work, significant

activation in the bilateral amygdala was observed for individuals who demonstrated strong framing effects. Later analysis by De Martino et al. (2006) showed that amygdala activation was similar between frames, indicating that the amygdala plays a comparable role in the evaluation of both positive and negative frames. Activation in the anterior cingulate cortex was observed, however, for individuals who did not demonstrate strong framing effects. Thus, amygdala activation was associated with the risky-choice framing effect, whereas activation of the anterior cingulate cortex was associated with a lack of risky-choice framing effects.

De Martino, Kumaran, Seymour and Dolan (2006) also created a "rationality index," based on individuals' susceptibility to the framing effect, and found that as activation in the orbital and medial prefrontal cortex (OMPFC) increased, susceptibility to the framing effect decreased. Susceptibility to the framing effect was defined as the extent to which choices depended on the way in which the options were described, a violation of the invariance principle which is incorporated into all theories of rational choice (e.g., Kahneman & Tversky, 1984). Thus, activation in the OMPFC was associated with more rational decision making. De Martino et al. (2006) interpret this finding as indicating that the OMPFC integrates input from the amygdala and evaluates the expected value of outcomes to guide future behavior.

Research on the global functions of the left and right hemispheres also provides support for a differential processing account of framing effects. Although risky-choice and attribute framing are thought to involve different psychological processes, for both manipulations, "typical" framing effects were found when information was initially

presented to the right hemisphere but little or no framing effect was found when the same information was presented to the left hemisphere (e.g., McElroy & Seta, 2004; Gallagher & Dagenbach, 2007; Seta & McCormick, manuscript under review). Thus, two out of the three framing manipulations described by Levin et al., (1998) have been found to be similarly influenced by lateralization to either the left or right hemisphere, even though each is thought to be functionally distinct. In both cases, the theoretical explanation given was based generally on the systematic/contextual perspective (discussed below). Accordingly, the current study was designed to test whether the systematic/contextual perspective would account for lateralized responses to a message framing manipulation.

The systematic/contextual perspective.

A growing body of research suggests that the left hemisphere processes information systematically and inferentially, whereas the right hemisphere is more sensitive to global information and contextual cues (e.g., Banich, 2004; Bergson, 1965; Cacioppo, Petty & Quintanar, 1982; Friedman & Forster, 2005; Ivry & Lebby, 1993; Ley & Bryden, 1982; McElroy & Seta, 2003; Ornstein, 1997; Stanovich & West, 2000). Ornstein (1997) suggests that the primary role of the right hemisphere is in understanding context. Extending these findings to the area of decision making, McElroy and Seta (2004) proposed that the right hemisphere is relatively more responsible than the left for determining the framework within which decisions are analyzed; when contextual cues such as gain or loss framed information are encountered by the right hemisphere, they are incorporated into a reference frame that influences subsequent decision making. Because of this, framing effects should emerge when information is presented to the right

hemisphere. The left hemisphere, however, decontextualizes information and breaks it down into its analyzable parts. Accordingly, it should be relatively less sensitive to global information and contextual cues, such as gain and loss framed information, and framing effects should be diminished or non-existent when information is presented to this hemisphere. Thus, framing effects should be greater when the right, contextual hemisphere is activated than when the left, systematic hemisphere is activated.

To test their predictions, McElroy and Seta (2004) presented participants with either a gain or loss framed risky-choice decision problem (the Asian disease problem) in either the left or right hemisphere. An audio recording of the problem was presented monaurally via headphones in participants' left or right ear, activating the right or left hemisphere, respectively. As expected, when the right hemisphere was activated typical framing effects were found, but when the left hemisphere was activated no framing effects were found. Similar results have been found for alternative methods of hemispheric activation, such as finger tapping or relatively high and low auditory frequencies (e.g., McElroy & Seta, 2004, Study 1; Gallagher & Dagenbach, 2007). Thus, across a range of hemispheric activation manipulations, findings consistent with a systematic/contextual perspective have been observed for risky-choice framing, which speaks to the robustness of the effect.

Based on the work of McElroy & Seta (2004), Seta & McCormick (manuscript under review) tested whether relative hemispheric activation would have a similar effect on attribute framing. Using a binaural listening procedure (e.g., Gallagher & Dagenbach, 2007), participants were presented with a classic attribute framing manipulation in either

their left or right ear. A framing effect was found when the information was initially processed in participant's right hemisphere but not when the same information was initially processed in participant's left hemisphere. Specifically, a beef product was evaluated as being less fat and more greaseless when it was described as 75% lean than when it was described as 25% fat when the information was initially processed in the right hemisphere; there was no difference when the information was initially processed in the left hemisphere. Hence, evidence supporting a systematic/contextual perspective has been found for both risky-choice and attribute framing.

One question that arises then is whether similar findings would be observed for framed health messages. Because message framing, like risky-choice and attribute framing, varies the positive or negative valence of information that remains objectively equivalent, attentiveness to the context in which information is given seems likely to be important for message framing as well. On the one hand, individuals who initially process the message in the right-contextual hemisphere should be affected by the frame (gain vs. loss) because contextual cues are especially salient in this hemisphere. On the other hand, when the message is initially processed in the left- systematic hemisphere, the frame should not matter or should have less of an influence because contextual information is incorporated into the decision making process to a lesser extent in this hemisphere.

Given, however, that considerable differences also exist between risky-choice, attribute and message framing, it is unclear whether these results would emerge. Risky-choice and attribute framing are different from message framing in that numeric

information is not typically present in framed messages but is an integral part of risky-choice and attribute framing. Attribute framing differs from message and risky-choice framing in that risk is not a component of attribute framing but is a central aspect of the other two types (e.g., Levin et al., 1998). Message framing also differs from risky-choice framing in the type of information contained in their messages – in risky-choice framing two options are presented (one is risk-free and the other involves risk) and the expected value of each option must be computed to determine that they are numerically equal, but in message framing only one option is promoted and there are no numerical values to compute. This lack of numeric information typically present in message framing versus both risky-choice and attribute framing may result in a different pattern of hemispheric activation. If so, a different pattern of responses may be observed. The current study was designed to investigate this issue.

Summary and predictions.

Based on perceived levels of risk, researchers have distinguished between relatively risk-free prevention behaviors and relatively risky detection behaviors (e.g., Rothman & Salovey, 1997). Studies have generally found that gain framed messages are more effective in promoting prevention behaviors, such as sunscreen use, whereas loss framed messages are more effective in promoting detection behaviors, such as the BSE. Meanwhile, the systematic/contextual perspective has been found to account for lateralized responses to both risky-choice and attribute framing tasks. According to this view, the relative effectiveness of framed information depends on whether it is processed systematically in the left hemisphere or globally/contextually in the right hemisphere.

Because the context of a message has less of an influence when information is processed in the left hemisphere, framing effects should be diminished or non-existent, and gain and loss framed messages (prevention or detection) should be equally effective. When the same information is processed contextually in the right hemisphere, however, individuals should be especially sensitive to the context and framing effects should be enhanced. This should result in an advantage for gain versus loss framed-prevention messages, but an advantage for loss versus gain framed-detection messages.

To test these predictions, participants in the current study were presented with either a gain or loss framed prevention message regarding sunscreen use in either their left or right ear, creating a 2 X 2 between subjects design. A dichotic listening task with white noise played in the unattended ear was used to present the message. Evidence supporting a systematic/contextual account of hemispheric influences on the persuasiveness of framed health messages would be found if a significant framing effect was observed when messages were initially processed in the right hemisphere but little or no framing effect was observed when the same messages were initially processed in the left hemisphere.

Dichotic vs. Monaural presentation.

Because the proposed study was originally intended to test whether the findings obtained by McElroy & Seta (2004) would be found for framed messages, a monaural listening task was initially considered for message presentation. As discussed earlier, McElroy & Seta (2004) used monaural listening to present a risky-choice framing task and observed substantial differences in the magnitude of the framing effect between left

and right hemispheric conditions. Further, in a recent comparison between monaural, binaurall, and two forms of dichotic listening tasks, monaural presentation was found to produce the greatest amount of relative activation in the contralateral hemisphere (e.g., Stefanatos, Joe, Aguirre, Detre, & Wetmore, 2008). However, dichotic listening has been the most commonly used method to examine hemispheric asymmetries in speech probes (e.g., Stefanatos et al., 2008). In one study, Ley & Bryden (1982) used a dichotic listening task in which a competing sentence was played in the unattended ear and found that the right hemisphere has an advantage in detecting the emotional tone of sentences whereas the left hemisphere has an advantage in detecting the content of sentences. Since these differences were observed, another type of dichotic listening task in which white noise is played in the unattended ear has been found to produce a greater amount of activation in the contralateral hemisphere (e.g., Stefanatos et al., 2008). Thus, the findings of Ley & Bryden (1982) may have been even stronger if this method had been used. Given these findings, and the prevalence of dichotic listening tasks in studying lateralization effects, a dichotic listening task in which white noise is played in the unattended ear was used in the current study.

CHAPTER III

METHOD

Subjects, Design and Procedure.

One-hundred fifty nine undergraduate students received partial course credit for their participation in the current study; two were excluded from the analysis, however, because they reported hearing loss in one ear, and three others were removed as the result of an outlier analysis[1]. Thus, 154 participants were included in the main analysis. Individuals generally participated in groups of 4, although some groups were smaller due to no-shows. The message frame (gain or loss) and the hemisphere in which the message was initially processed (left or right) were varied in a 2 X 2 between subjects design.

Upon entering the lab, participants completed a consent form and the experimenter informed them of the procedure and essentials for taking part in the experiment. They were told that we would like them to listen to an audio file and answer some questions about it, but that we are just interested in their opinion and there are no right or wrong answers. Consent forms were collected at this time and participants were told that this was to ensure that their responses would remain anonymous. Then, to reduce any distractions, they were asked to wait outside of the lab while one person at a time, selected randomly, listened to the audio file and answered the questions.

All participants sat in the same desk and listened to the message using the same headphones. Before the message was presented, handedness was assessed using the

Edinburgh handedness inventory (e.g., Oldfield, 1971). A dichotic listening task with the message played in the target ear and white noise played in the unattended ear was used to present a gain or loss framed message to the desired hemisphere – the message was played in the left ear and white noise was played in the right ear when the message was intended to be processed in the right hemisphere, and the reverse was true in the left hemisphere condition. This procedure has been shown to be a reliable means of inducing relative activation of the contralateral hemisphere (e.g., Stefanatos et al., 2008). The message promoted the prevention behavior of sunscreen use (see Appendix A). Some information from the website of the American Cancer Society was included to ensure that the information was current[2]. When the message finished playing, participants completed a five item measure of behavioral intentions and several comprehensibility items to ensure that the messages did not differ between conditions. They were then asked to wait in a separate area outside of the lab until each person in the group completed the task. When all participants were finished, they were brought back into the lab, debriefed and released.

Materials.

Recordings. The audio files were recorded using a Logitech USB Headset 350 and mixed with Audacity, a free downloadable digital editing program (http://audacity.sourceforge.net). Messages that were intended to be processed initially in the right hemisphere were mixed so that the message only played in the left channel while white noise played in the right channel. Conversely, messages that were intended to be processed initially in the left hemisphere were mixed so that the message only

played in the right channel while white noise played in the left channel. The audio recordings were presented using Windows Media Player loaded on a Dell PC.

Measurement items. A five item questionnaire similar to the one used by Detweiler, et al. (1999) was used to assess behavioral intentions. Participants were first asked "How likely are you to use sunscreen at the beach this summer?" Responses to this question, given on a 9-point scale where 1 represented "Not At All Likely" and 9 represented "Very Likely", served as the main dependent variable of the study – this question was chosen not only because it came first but also because it seemed to be the most relevant to participants' intentions to adopt sunscreen use. Next, they were asked "How often do you intend to use sunscreen during daily activities." Responses to this item were also given on a 9-point scale, but here, 1 represented "Never" and 9 represented "Always." Subsequent questions included "How many times would you apply sunscreen during the course of a full day at the beach (i.e., 10am to 4pm)," "What type of skin product do you intend to use this summer? Circle one: None, Tanning Oil or Sunscreen" and, if they circled Sunscreen, "what SPF do you plan to use?"

Comprehensibility items. Four additional items were included to ensure that both the task and the messages were understandable and that there were no systematic differences between conditions. These items were: "How difficult was it to hear the message on the headphones?" (1 = very easy, 9 = very difficult), "Were you distracted from listening to the message?" (1 = not at all, 9 = extremely), "Did you understand what your task was?" (1 = completely, 9 = not at all), and "Overall, how comprehensible was the message?" (1 = completely, 9 = not at all).

CHAPTER IV

RESULTS

A MANOVA conducted on the four comprehensibility items revealed that, overall, the recordings did not differ between conditions (all *F*'s < 1). Follow-up ANOVAs confirmed that there were no differences in terms of how difficult the message was to hear (*M* = 2.57), how distracted participants were (*M* = 2.95), how much they understood what their task was (*M* = 2.33), and the overall comprehensibility of the message (*M* = 2.23), all *F*'s < 2.1 and all but 2 *F*s < 1. Thus, differences in message ratings between conditions should not be due to differences in message comprehensibility.

Because I was interested in how responses to gain and loss framed messages would differ between the left and right hemispheres, participants' likelihood ratings were submitted to an ANOVA with Hemisphere (left or right) and the Message Frame (gain or loss) entered as between subjects factors.[3] This analysis revealed a main effect for Hemisphere $F(1, 150) = 6.5$, $p < .02$, qualified by a significant Hemisphere X Frame interaction $F(1, 150) = 4.4$, $p < .04$ (see Appendix A for means). Follow-up comparisons performed to decompose this interaction revealed that, as predicted by the systematic/contextual perspective, a significant effect for the message frame was observed when messages were presented to the right hemisphere $t(77) = -2.2$, $p < .04$., but no framing effect was observed when the same messages were initially presented to

the left hemisphere $t(73) < 1$. Later analyses in which the subject pool was restricted to right-handers only, women only or to right-handed women only proved to be substantively similar, with no change in the overall pattern of means; these results attest to the reliability of the current findings in that no meaningful difference was observed when the population was more or less homogeneous. The direction of the framing effect observed in the right hemisphere (loss > gain), however, was in reverse of that previously found for sunscreen use.

CHAPTER V

DISCUSSION

Because message framing research focuses on predicting when gain or loss framed messages will be relatively more effective, and because recent studies suggest that the different types of framing manipulations may be similarly affected by selective presentation to the left or right hemisphere, the current study tested whether the systematic/contextual perspective would successfully account for hemispheric differences in the message framing effect. It was predicted from this perspective that when messages were presented to the right hemisphere a significant effect for the frame would be found but that when the same messages were presented to the left hemisphere little or no framing effect would emerge; that is, responses to loss framed messages would be significantly different from responses to gain framed messages in the right but not the left hemisphere. Given that the specific behavior promoted (i.e., sunscreen use) was a low-risk prevention behavior, it was expected that gain versus loss framed messages would be relatively more effective in the right hemisphere.

Consistent with these predictions, the difference in participants' responses to gain versus loss framed messages was significantly greater when initially presented to the right than the left hemisphere. Specifically, loss frame messages (M = 6.97) were rated significantly higher than gain framed messages (M = 5.70) in the right-contextual hemisphere, but virtually no difference was observed for the same messages in the left-

systematic hemisphere (*Ms* = 7.13 and 7.38, respectively). This relative difference in framing magnitude is consistent with previous work on both risky-choice and attribute framing, supporting evidence that suggests the hemispheres differ in their attention to contextual cues (e.g., McElroy & Seta, 2004; Seta & McCormick, manuscript under review). Apparently, because the left hemisphere is relatively insensitive to contextual cues the frame had little impact and ratings did not differ between conditions. Conversely, because the right hemisphere is especially sensitive to contextual cues the message frame did have an impact and ratings differed between conditions. At least in terms of framing magnitude then, the systematic/contextual perspective seems to provide a reasonable account of hemispheric influences on framed health messages.

Right hemisphere framing effect.

The framing effect observed in the right hemisphere (loss > gain) was not as predicted based on perceived levels of risk and is in reverse of that previously reported in the literature; however, it should be noted that Detweiler et al. (1999) conducted their study on a warm summer day at the beach, whereas the current study was completed during the winter. Thus, while speculative, the direction of the framing effect may have depended upon the context in which the message was presented. Notwithstanding, the key finding obtained in the current study was that framing effects were observed in the right but not the left hemisphere.

Alternate inferential/contextual interpretation.

An alternative interpretation of the current data is possible, based more specifically on the inferential versus contextual properties of the left and right

hemispheres, respectively (e.g., Levy, 1974; Van Lancker & Kempler, 1987). According to this view, as in the systematic/contextual perspective, the right hemisphere has an advantage in processing information contextually – it evaluates contextual elements as a whole. Given this similarity between perspectives, predictions made for the right hemisphere are the same and are based on similar reasoning from either a systematic/contextual or an inferential/contextual view. Predictions made for the left hemisphere, however, are not as conceptually similar. From an inferential/contextual perspective, the left hemisphere has an advantage in processing information inferentially – it breaks information down into smaller units or builds larger units from smaller ones. Because of this, the left hemisphere is especially likely to respond to a message framed one way (positively or negatively) as logically and functionally equivalent to a message framed in the opposite way, thereby reducing the frame's effectiveness. Thus, rather than the gain or loss frame having less of an influence because the left hemisphere is less sensitive to contextual cues, as predicted by the systematic/contextual perspective, framing effects are predicted to be diminished because the left hemisphere is able to suppress the implications of the frame.

While it is not possible to determine which view is superior in the present study, future work may be able to answer this question using fMRI analysis. If the systematic/contextual perspective is more correct and the left hemisphere is less sensitive to contextual cues than the right hemisphere then the change in activation in response to framed messages should be less in the left than right hemisphere. If, however, the inferential/contextual view is more correct and the left hemisphere is simply able to

recognize the equivalence of alternative frames then the change in activation should be similar across hemispheres.

Alternate valence hypothesis interpretation.

Another line of lateralization research that may ultimately prove to be more accurate in describing how the left and right hemispheres differ in their responsiveness to framed messages is the valence hypothesis. According to this view, the sensitivity to and mediation of positive and negative information is lateralized in the left and right hemispheres, respectively (e.g., Davidson, 1992, 1995; Canli, Desmond, Zhao, Glover & Gabrieli, 1998; Alfano & Cimino, 2008). Because of this, gain versus loss framed messages should be rated higher when presented to the left hemisphere but loss versus gain framed messages should be rated higher when presented to the right hemisphere. Although the overall pattern of means descriptively followed these predictions, gain framed messages presented to the left hemisphere (M = 7.38) were not rated significantly higher than loss framed messages (M = 7.13), $p > .6$. Moreover, while the analysis does not change substantively from a systematic/contextual perspective when the removed outliers are included, the descriptive advantage observed for gain framed-left hemisphere messages does cease, which violates a basic assumption of the valence hypothesis; based on this view, loss framed messages should not have been rated higher than gain framed messages in the left hemisphere because the left hemisphere is more sensitive to positive than negative information. The only clear support for this view was observed in the right hemisphere where loss versus gain framed messages were rated significantly higher; however, these loss framed messages were rated descriptively lower than when the same

messages were presented to the left hemisphere, which does not directly follow from the valence hypothesis and reduces the usefulness of the finding. Thus, in the current study, relatively little support was found for the valence hypothesis.

Hemispheric main effect.

The effect for hemisphere, in which messages presented to the left hemisphere were rated higher overall than messages presented to the right hemisphere, may be worth investigating further. The same effect was found when participants indicated the number of times that they would use sunscreen and how important the issue of skin cancer is to them, making it the most consistent finding overall ($ps < .02$). Although speculative, one possible explanation is that the left hemisphere has a relative advantage in processing language and this allowed participants in the left hemisphere condition to process the message more efficiently and thoroughly than those in the right hemisphere condition. Certainly, a left hemisphere advantage in processing language has been well documented (e.g., Foundas, Corey, Hurley & Heilman, 2006; Gregory, Kalkhoff, Harkness & Paull, 2009). If messages were processed more efficiently/thoroughly in the left hemisphere and this mimicked elaboration effects (e.g., Petty & Cacioppo, 1984) then message ratings should be expected to increase. Future work will be need, however, to discern whether this reasoning is correct.

Limitations.

Some limitations of the current study are worth noting. First presenting a sunscreen message to participants in freezing or near freezing weather may have lowered the relevance of the message and reduced participant's willingness to thoroughly process

it. If this occurred then responses would be somewhat more at random and any small effects, such as an advantage for gain versus loss framed messages in the left hemisphere, may have been obscured. Also, it is possible that the message was less relevant to some ethnicities than others. While race was not measured, it stands to reason that a message concerning sunscreen use may have been more relevant to Caucasians than African Americans who burn more easily. If so then responses may have differed for Caucasian and African American participants. While both of these issues should have been attenuated by random assignment to condition, future work should measure ethnicity and/or focus on behaviors that are weather and ethnicity neutral to increase confidence in the current findings. Nevertheless, in the end, the predicted interaction between the message frame and hemispheric activation was obtained – the framing effect was significantly greater in the right versus left hemisphere.

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Footnotes

1. Initial analysis of the data using the Explore function in SPSS identified three outliers via boxplots and stem and leaf plots, and a residual analysis showed them to have the largest residuals in the entire dataset ($z > 2.5$). When the data was analyzed with these observations included, the overall Hemisphere X Frame interaction did not remain significant but a pointed contrast between the magnitude of the framing effect in the left and right hemispheres did remain significant when message comprehensibility was controlled for, suggesting that a substantively similar interpretation of the data would be given either way.

2. Information from the American Cancer Society included "According to the American Cancer Society, currently, more than 1 million skin cancers are diagnosed each year in the United States, most of which are caused by too much exposure to ultraviolet (UV) rays" and "UVB rays alter the DNA of your skin."

3. Similar analyses conducted with the other measurement items as the dependent variable were not significant with the exception of a main effect for Hemisphere - participants reported that they would use sunscreen more often and that the issue of skin cancer was more important when messages were presented to the left versus right hemisphere, $F = 8.7$, $p < .01$ and $F = 5.5$, $p = .02$, respectively.

Appendix A. Average behavioral intentions.

Hemisphere Activated:	Valence: Positive N	Positive Mean	Negative N	Negative Mean
Right	40	5.70	39	6.97
Left	37	7.38	38	7.13

Appendix B. The Framed Message

Please read the following message concerning sunscreen use. Then answer the questions at the bottom of the page.

According to the American Cancer Society, currently, more than 1 million skin cancers are diagnosed each year in the United States, most of which are caused by too much exposure to ultraviolet (UV) rays. Exposing yourself to the sun is the surest way to get skin cancer. If you use[don't use] sunscreen with SPF 15 or higher, you decrease[increase] your chances of damaging your skin and bringing on an early death. UVB rays alter the DNA of your skin. If this affects the genes that control skin growth, skin cancer may be the result. Basically, protecting[not protecting] yourself from the sun will[won't] help you stay healthy. UVA rays help age skin cells, so using[not using] sunscreen also decreases[increases] your risk for prematurely aged skin. The higher[lower] the SPF you use, the less[more] you will be harmed by the sun's rays. Are you protecting[not protecting] yourself and preventing skin damage[causing damage to your skin] right now?