The Interaction of Emotion and Cognition in Memory Biases across the Life Span

Eugenie Lehembre-Shiah

Cornell University

Author Note

Eugenie Lehembre-Shiah, Department of Human Development, Cornell University.

Correspondence concerning this article should be addressed to Eugenie Lehembre-Shiah, Department of Human Development, Cornell University, Martha Van Rensselaer, Room B59, Ithaca, NY 14853. E-mail: eal79@cornell.edu

Abstract

Much research has looked into the various information processing changes that occur as we age. Most cognitive processes decline with age, while emotion regulation may remain intact. This study attempts to better understand biases that occur in recognition memory as we age. Socioemotional selectivity theory suggests that older adults attend to the positive valence more than the negative valence due to a shift in time perspective and an increased motivation to capitalize on more emotionally satisfying experiences. Fuzzy trace theory posits that we have two information processing streams: the gist stream, which captures the overall meaning of the information, and the verbatim stream that takes in the details. In this study, recognition memory was assessed for valenced (positive and negative) as well as sentence-type (verbatim or gist) processing in order to study the combined effects of emotion and cognition in memory across the life span. Older adults were found to remember more "positive gist" statements than any other type suggesting a bias towards the positive valence and gist-type processing. The results show that both of the above theories combine to illuminate what type of information older adults attend to, process and retain.

The Interaction of Emotion and Cognition in Memory Biases across the Life Span

Due to the estimated increase in life expectancy and the imminent aging of the baby boomers, it is extremely important to better understand issues central to successful aging and memory. We know that as we age our cognitive processes decline, yet these deficiencies appear to be met by intact emotional processes (Blanchard-Fields, 2005; Charles, Mather, & Carstensen, 2003). In fact, aging appears to be related to improved emotion regulation and higher emotional satisfaction (Carstensen & Mikels, 2005). Despite these positive age-related improvements, there may also be downsides to the combination of increased emotion regulation and decreased cognitive abilities in older adults. Age-related information and memory-processing changes could lead to biases that affect how information is encoded, what is remembered, and, consequently, decision-making quality and behavior.

For example, older adults were found to misremember negative health-related information as positive in a surprise recognition task when the information was in fact presented in a negative frame (Shamaskin, Mikels, & Reed, 2010). Additionally, older adults remembered positive information more accurately than negative information. The study shows that with older adults positive information resonates more than negative information. In the current study, we attempt to explore not only what information is held in memory, but also how information is encoded. We use valence as a between-subject measure as opposed to a within subject measure to tease apart the hypothesis that older adults might actually encode information presented in the negative, in a positive light. We additionally vary sentence type to test what kind of information is processed across the age groups. Potential biases in memory may have large implications for health-related

marketing of information for older adults and may further elucidate the memory-related and information-processing mechanisms that change as we age.

Socioemotional Selectivity Theory and the Positivity Effect

One well established theoretical approach to understanding age-related changes in information processing is socioemotional selectivity theory (SST). Socioemotional selectivity theory, a life span theory of motivation, posits that as we age, our perspective of time invariably changes. Time perspective is integral to goals and motivation. Goals, and thus the motivation to achieve these goals, are inherently set in a temporal context because they are something that we are striving for in the future. As one's future time perspective changes, so will one's goals. Because as age increases one's "future" necessarily shrinks, age is related to a change in goals and motivation. Goals change from gathering information and resources for the future, to being present in the moment and cultivating emotionally meaningful experiences (Carstensen, Isaacowitz, & Charles, 1999).

Insofar as SST posits that older individuals are motivated to cultivate emotionally meaningful experiences, it follows that they would seek out experiences that are positive. We may also be motivated to optimize neutral experiences, by focusing on the positive. In fact, research has found older adults have enhanced memory for positively-valenced autobiographical events (Kennedy, Mather, & Carstensen, 2004). Other studies have found that older adults attend to and recall more positive images relative to negative images (Charles, Mather, & Carstensen, 2003; Mikels, Larkin, Reuter-Lorenz & Carstensen, 2005). This phenomenon has been referred to as the positivity effect (Carstensen, & Mikels, 2005).

While some studies have found that older adult's ability to regulate their emotions can protect them from detrimental effects of negative emotions on working memory for younger adults (Scheibe, & Blanchard-Fields, 2009), there may be negative consequences of increased emotion regulation in older adults. First, the motivation to maintain positive emotional states may lead older adults to overemphasize positive information to maintain their end goals of emotional positivity, even to the point of falsely remembering a negative piece of information as positive. For example, in one study, older adults recalled past autobiographical information more positively than it was in reality (Kennedy, Mather, & Carstensen, 2004). Additionally, when told to recall memories, older adults recalled more falsely positive than false negative memories in a study by Fernandes, Ross, Wiegand, & Schryer, (2008). The primary hypothesis in that study was that the age-related increase in false recall would reflect in part an increasing tendency to produce false memories that are positively-valenced rather than negatively-valenced. Older people's propensity for false recall should reflect emotional self-regulation and thus false memories that are positively biased. Thus, we hope to see a similar trend in this study. Older adults should more often accurately recall positively framed information than negative information and perhaps and shift from negative to positive in their mistaken recalls.

Fuzzy Trace Theory

Another theoretical approach that can be used to provide background into age-related changes in information processing is fuzzy trace theory (FTT). This theory has been found to align with ideas of cognitive decline throughout the life span. FTT posits the existence of dual process information streams. According to the theory, as items are

encoded, two types of memory traces are created. One of these is a verbatim stream that is information rich and item-specific; the other is a gist stream which is tied to the overall meaning of the information. More specifically, "[v]erbatim traces are episodically instantiated representations of the surface forms of experienced items…and gist traces are episodic interpretations of concepts, (meanings, relations, patterns) that have been retrieved as a result of encoding items' surface forms" (Brainerd & Reyna, 2002, p. 164). With the cognitive decline in effortful deliberative processes, there is a shift away from verbatim processing and toward easier modes of processing such as gist. Since FTT proposes that verbatim processing declines alongside cognitive abilities as people age, the theory suggests that perhaps gist retrieval will dominate the memory process in older adulthood whereas for younger adults, neither processing stream will dominate (Brainerd & Reyna, 1991, 2002).

According to Brainerd and Reyna (2002), "gist retrieval supports false memories because item's meanings seem familiar" (p. 3). Thus the authors suggest that older adults prefer gist information and lose verbatim processing abilities. Another study by Dennis, Kim, Cabeza, (2007) found that older adults are more likely to forget past events as well as remember events that never occurred. The authors suggest that this is due to the effects of gist versus item-specific processing. They mention that gist processes might help to enhance older adult memory, but it is also likely to increase instances of older adult false memory. If, according to FTT, older adults are prone to gist memories due to changes in information-processing over the life span, and if, according to SST, older adults are also prone to show a memory bias towards the positive via emotion-regulation and priority shifts across the life span, then the combination of both theories should support the

potential for the production of strong and consistent predictions of older adult memory biases due to the type and valence of information presented to them. Older adults might be prone to misremember negative information as positive and might also rely heavily on gist processing. Younger adults, on the other hand, might also be affected by valence of the information presented to them but they should not rely on one type of processing. Instead, results should indicate no effect of sentence-type on younger adults' accuracy.

Goal-Framing

To understand how certain information processing and emotion-regulation memory biases could affect decision-making quality and future behavior, it is useful to consider framing. The "framing effect" refers to the different choices that people make based on how alternatives are presented to them. The classic example of framing involves the study done by Tversky and Kahneman (1981), which showed that people encode information in terms or gains or losses. Based on how factually equivalent information was presented, it was possible to predict how a participant would respond when given a forced-choice risky decision making task. For example, when given the option between choosing to save 200 people for sure or having a 33% chance of saving all 600 people and a 66% possibility of saving no one, most people choose the first choice. These two choices are presented in a gain frame. However, when given the option to allow 400 people to die for sure, or having a 33% chance that no people will die and a 66% probability that all 600 will die, most people choose the second option. These two choices are presented in a loss frame. Both of these scenarios present factually equivalent information yet individuals favor different decisions depending on the frame.

This example describes risky-choice framing. Another kind of framing, goal framing informs people of the possible consequences of their behavior and introduces the information in a positive or negative light. Meyerowitz and Chaiken (1987) used goal framing in a pamphlet study stressing the positive and negative consequences of performing self breast-examinations. For example, reading "the earlier it is detected, the better one's chances are for full recovery" would constitute a positive frame. While "the later it is detected, the poorer one's chance are for full recovery" would constitute a negative frame. The results of the study showed that the negative frame was found to be more influential in affecting later health behavior in this study done on adult women. In our study we too use goal framing to emphasize either receiving a health benefit by performing a particular behavior or avoiding a negative consequence by performing that same behavior.

According to SST, older adults are more motivated to pursue emotionally meaningful goals. Since goal-framing tactics seem to target the goals that are personally meaningful, healthcare promotion tactics can be an effective approach in exploring the effect of framing meaningful goals for older relative to younger adults. These biases may strongly impact healthcare decision-making and health-related behavior. If older adults show these strong biases towards positive valence and gist processing, it is possible to deduce that older adults might show instances of creating false memories. In this study we look at positively and negatively framed healthcare messages. These healthcare messages are presented in gist versus verbatim-form. We are looking at the combined effect of gist versus verbatim and positive and negative frames.

We hypothesize that older adults will demonstrate the positivity effect and recognize more positively framed messages. We also hypothesize that older adults will recognize more information presented in gist form in accordance with FTT. We are unsure, however, whether older adults go as far as to switch negative and verbatim messages to positive gist messages. This double error could support the creation of false-memories due to the biases mentioned above.

The Present Study

This study attempts to elucidate the mechanisms that contribute to how information is encoded and remembered by older adults. There are no studies to date that have looked at the role of socioemotional selectivity theory, the positivity effect, and fuzzy trace theory as having a combined effect on older adults memory. In order to ensure that these theories indeed play a part in this process we must check that our sample replicates the results of other studies done regarding these theories. According to the positivity effect, older adults should remember more positively framed information than negatively framed information.

According to Shamaskin, Mikels, and Reed (2010), the results of the positivity effect go as far as to allow for older adults to actually misremember negative information as positive information. This finding suggests that older adults do not just remember positive information more easily, but that they might actually encode most information in a positive frame. This bias would mean that older adults actual remember some negatively framed information as positive. By exploring this possibility in our study, we will also check that this finding is replicated in our sample.

Finally, fuzzy trace theory posits that older adults rely more on gist processing than verbatim processing when compared to younger adults who should have both of these processing streams intact. Younger adults will ideally show no difference in reliance on either type of processing stream and thus there should not be an effect of sentence type on younger adults' memory. If this theory holds true in our sample, older adults should remember more gist information than verbatim information and perhaps they might even misremember verbatim information as gist information.

In the event that all of these assumptions hold in our sample, we expect to see a combined effect of valence and sentence-type on older adult memory. We would expect to see a valence effect on memory for younger adults but no sentence-type effect on younger adults. We further hope to see older adults misremember negative, verbatim information as positive, gist information more often than any other type of error. This kind of bias would support the hypothesis that older adults can actually produce false memories specifically because of the biases created from positivity effect and fuzzy trace theory.

In sum, older adults are inundated with health information and have to make many healthcare decisions. In the Meyerowitz and Chaiken (1987) study, they found that negatively framed information was more influential in affecting behavior. If healthcare providers used this information to make decisions on how to market healthcare materials it is important to elucidate if perhaps different tactics would work better for targeting older adults. What if this negative framing really only works for younger adults who are already more inclined to focus on the negative? It is crucial to understand what health information is actually retained by older adults.

The pamphlets, taken from another study (Shamaskin, Mikels, & Reed, 2010) were created to be comparable. They resembled pamphlets one might find at a doctor's office or health clinic. The pamphlets on a certain topic were identical except for how the four sentences that were framed. We chose to use skin cancer and flu as the healthcare issues for this study. We were hoping to use healthcare issues that were salient to both age groups. With the recent flu epidemic of 2009, we felt that flu was salient to both age groups. Skin cancer has also become a widely discussed health issue and is discussed in both age groups. Of course it is still possible that healthcare issues are generally more salient to older populations overall but both of these domains showed no age difference in importance across the age groups in the Shamaskin, Mikels, & Reed (2010) study.

Method

Participants

Thirty older adults ranging from 64-86 years of age (*M*=73.03*, SD*=12.09; 20 females) and thirty younger adults ranging from 18-23 years of age (*M*=20.35, *SD*=1.39;14 females) participated in this experiment. We have 15 males and 34 females participate. The remaining individuals did not indicate their sex. We recruited older adults from Tompkins County in New York through an existing database in the Emotion and Cognition Laboratory of interested older adult research participants. They were given $15 of monetary compensation as an incentive to participate. Younger adults were undergraduate Cornell students recruited through an electronic system called SUSAN that matches individuals with experiments offered for extra credit. Participants received one credit for participating in the experiment. For younger adults, participant characteristics are representative of those of the demographics of the university. For older adults,

participant characteristics were representative of the older adult population of the Ithaca community (see Table 1). Additionally, age-appropriate results were reported for our cognitive measures.

The pamphlets on a certain topic were identical except for how the four sentences that were framed. . We were hoping to use healthcare issues that were salient to both age groups. With the recent flu epidemic of 2009, we felt that flu was salient to both age groups. Skin cancer has also become a widely discussed health issue and is discussed in both age groups. Of course it is still possible that healthcare issues are generally more salient to older populations overall but both of these domains showed no age difference in importance across the age groups in the Shamaskin, Mikels, & Reed (2010) study.

Materials

Based on the Shamaskin, Mikels, & Reed (2010) study we chose skin cancer and flu because we were hoping to choose two domains that were salient to both age groups and these domains. With the recent flu epidemic of 2009, we felt that flu was salient to both age groups. Skin cancer has also become a widely discussed health issue and is discussed in both age groups. Additionally, in the Shamaskin, Mikels & Reed (2010) study, these domains showed no age difference in importance across the age groups. The pamphlets were designed to be comparable and mimic a pamphlet that might be found in a physician's office and included very general information about the particular health domain. The information included in the pamphlet was based upon the CDC online health database (Centers for Disease Control and Prevention; "Cholesterol", 2007; "Key Facts About Seasonal Influenza (Flu)", 2008). Each pamphlet contained four boxed and

emphasized goal-framed statements. These statements, modeled after Meyerowitz and Chaiken (1987), refer to behaviors the individuals can change with regard to their health. Identical information was presented in all of the pamphlets in a certain health domain; however, these pamphlets were either positively or negatively framed. For example, reading "the earlier it is detected, the better one's chances are for full recovery" would constitute a positive frame. While "the later it is detected, the poorer one's chance are for full recovery" would constitute a negative frame. We used a between-subjects design to avoid having participants notice the difference in valence between two pamphlets.

Additionally, pamphlets contained gist and verbatim statements. For simplicity, we utilized numbers to represent verbatim. Gist statements were much more vague and overarching. For example, "[i]f you detect it early, you have more than a 55 percent chance for full recovery" is an example of a positive verbatim sentence whereas, "[i]f you detect it early, you increase your chances for full recovery" would be an example of the positive gist version of the same sentence (see Table 2). Participants saw two gist and two verbatim sentences in each pamphlet. These sentences were emphasized because they were presented in framed boxed and the font for these sentences was enlarged. The rest of each pamphlet contained information about the healthcare issue and was identical across all pamphlets in that health domain (see Figure 1). We counterbalanced whether participants saw gist and verbatim statements first so as to be sure that the order in which individuals saw the gist or verbatim statements had no effect on results.

Procedure

Participants first signed a consent form explaining the premise of the experiment and then completed demographic information questions presented on the computer

screen. Participants were then handed two pamphlets that provided information on different healthcare issues. All instructions were administered using a computer screen via E-Prime Experimental Software. Participants were randomly assigned to read two positively or two negatively valenced pamphlets, one on skin cancer and one on influenza. Both pamphlets had alternating gist and verbatim statements. Four statements in each pamphlet were highlighted and emphasized both by font size and by a border around the statement (see Figure 1).

Each participant viewed a total of eight emphasized statements, four in each pamphlet. Participants were given an unlimited amount of time to read the pamphlets and were told to let the experimenter know when they were finished. Following standard procedures utilized in Shamaskin, Mikels & Reed (2010) and other work using similar paradigms, participants were then given a surprise recognition task based on the information included in the four boxes in the pamphlets earlier in the experiment. Recall that each pamphlet had four sentences that were highlighted and emphasized by larger font and having a box around the sentence (see Figure 1 for example of pamphlet). In the recognition portion, we used a forced-choice task where a positive gist, positive verbatim, negative gist, and negative verbatim version of one of the four emphasized sentences were shown on the screen (see Table 2 for examples of sentences used for a recognition task question). The participant only saw one version of these sentences in their pamphlet. The participant was made to choose the answer they most remember seeing in the pamphlet. The order of the sentences tested followed the order in which they appeared in the pamphlet for the participant, and the recognition task also followed pamphlet order. The four statements shown were equivalent in terms of factual information.

Results

Part I: Accuracy Statistics

Responses were coded for accuracy (0=incorrect, 1=correct) based on whether participants chose the correct statement from the recognition task as they saw when they read the pamphlet. In order to consolidate the eight participant recognition responses, we created average accuracy scores per participant. Utilizing these composite scores we ran a general linear model with age group and valence as between-subject factors and sentence type (gist and verbatim) as the within subject factor.

We found a significant main effect for age such that older adults overall performed more poorly than younger adults $F(1,56)=26.82$, $p=.000$. Overall, older adults were accurate 39.6% (SE=.032) of the time while younger adult were accurate 63.3% (SE=.032) of the time. We also found a main effect for sentence type indicating that accuracy was higher for gist vs. verbatim statements overall $F(1,56)=9.085$, $p=.004$. Accuracy for verbatim sentences was found to be 45.4% (SE=.029). Accuracy for gist statements was 57.5% (SE=.032).

These effects were qualified by a significant interaction between sentence type and age group $F(1,56)=14.689$, $p=.000$. In older adults, gist accuracy ($M=.5333$, $SD=.326$) was significantly higher than verbatim accuracy ($M=.258$, $SD=.231$), $t(29)=4.557$, $p=.000$. In younger adults, there was not a significant difference between gist accuracy ($M=.6167$, $SD=.284$) and verbatim accuracy ($M=.6500$, $SD=.283$), $t(29)=-.583$, $p=.564$ (see Figure 2). These results suggest that older adults rely more on gist processing streams for memory while younger adults utilize both processing streams (see Table 3).

Even more revealing is the finding that older adults matched younger adult accuracy when looking at gist accuracy $t(58)=-1.054$, $p=.296$. When looking at verbatim accuracy however, younger adults were significantly more accurate than older adults $t(58)=-5.861$, $p=.000$. These additional findings clarify the previous interaction in that it becomes apparent that for older adults, gist processing actually remains intact instead of the alternate hypothesis that both processing streams decline but that verbatim processing declines more rapidly. These interactions suggest that it is perhaps older adult's gist accuracy that drives the main effect of sentence type on accuracy (see Figure 2).

We also found that accuracy for positively-valenced sentences was higher than for negatively-valenced sentences $F(1,56)=43.98$, $p=.000$. Overall, accuracy in the positive valence was 66.7% (SD=.032) and 36.2% in the negative valence (SE=.032). In the positive valence, older adults have an average accuracy of 54.17% (SE=.045). In the negative valence, older adults have an average accuracy of 25% (SE=.047). Younger adults, had an average accuracy of 79.17% (SE=.13) in the positive valence and 47.5% (SE=.03378) in the negative valence.

Given that the three-way interaction approached significance $F(1,56)= 3.90$, $p=.053$, we examined the means broken down by age and valence and then by sentence type in order to better understand the above effects. When the data was split by age, the interaction between valence and statement type became significant for older adults $F(28)=6.568$, $p=.016$ whereas it remained insignificant for younger adults $F(28)=.082$, $p=.776$. These results suggest that older adult's performance may be due to an interaction between valence and sentence type, while this might not be the case for younger adults (see Table 4).

Positive valence alone produced higher accuracy in older adults $t(28)=-4.466$, $p=.000$ and younger adults $t(28)=-4.918$, $p=.000$ compared to accuracy in the negative valence. Moreover, positive valence produced stronger gist accuracy $t(58)=-5.764$, $p=.000$ and verbatim accuracy $t(58)=-3.093$, $p=.003$ compared to sentence type accuracies in the negative valence. We found negative gist and negative verbatim accuracies overall to be insignificantly different $t(29)=1.126$, $p=.269$. In the positive valence older adults had similar gist accuracies to younger adults $t(28)=-.202$, $p=.842$. From these t-tests we notice that positive valence uniformly enhances memory for both younger and older adults, yet, gist accuracies seem to combine with positive valence to produce higher accuracies in older adults. Only positive valence affects younger adult memory accuracy (see Figure 3).

In further support of these findings, we see that in the negative valence, older adults only do marginally better on gist statements versus verbatim sentences $t(14)=2.086$, $p=.056$. In the positive valence however, older adults do much better on gist statements $t(14)=4.620$, $p=.000$. Younger adults on the other hand, do not show gist or verbatim accuracy differences between positive $t(14)=-.587$, $p=.567$ or negative valence $t(14)=-.211$, $p=.836$ (see Figure 3). While positive sentences show higher accuracy overall, gist statements in the positive may further enhance or induce memory for older adults.

Older adults even matched younger adult accuracy in gist statements in the negative valence $t(28)=-1.570$, $p=.128$, indicating that gist processing might override some of the dampening effects of the negative valence on older adult memory. The effect

of gist may actually be more crucial than the positive valence effects when seen in this light.

Part II: Error Analysis

Then participant responses were further coded for error type. There are twelve error codes and four accurate answer codes (see Table 5). In order to consolidate the multiple participant recognition responses, we created average inaccuracy scores per participant per error type. Utilizing these composite scores we ran split file t-tests to compare error scores between older and younger adults.

In line with our hypothesis we found that older adults chose a positive gist statement when in fact they had seen a negative verbatim sentence significantly more often than younger adults $t(28)=2.719$, $p=.011$. Older adults chose positive gist versions of the sentences when they actually saw positive verbatim sentences 23% of the time (*SD=.14*). Younger adults made this kind of error 9% (*SD=.12*) of the time. In the forced-choice recognition task, all versions of the sentence were available as choices. Thus, a consistent gravitation towards the positive gist suggests that information is actually encoded and retrieved differently in older and younger adults.

In addition older adults also switch positive verbatim statements into positive gist statements significantly more than younger adults $t(28)=2.966$, $p=.006$. In other words, older adults mistakenly chose a positive gist sentence when they actually saw a positive verbatim sentences ($M=.183$, $SD=.132$) more often than younger adults ($M=.075$, $SD=.079$). This result indicates that older adults are not remembering the verbatim components of the emphasized statement due potentially to an over-reliance on gist processing.

Finally, older adults chose negative gist statements when they actually saw positive verbatim sentences significantly more often than younger adults $t(28)=3.998$, $p=.000$. Older adults chose negative gist versions of the sentences when they actually saw positive verbatim sentences 11% ($SD=.099$) of the time. Younger adults made this kind of error .8% ($SD=.032$) of the time. Clearly valence and sentence type have an impact on older adults. Though these analyses are not comprehensive these additional results indicate the relative strength of the gist-processing stream versus verbatim stream in older adults compared to that in younger adults.

Discussion

Our first hypothesis was rooted in socioemotional selectivity theory. As people age, a shift in time perspective motivates a shift towards prioritizing emotionally satisfying goals. Studies have shown an enhanced orientation towards the positive as we age. In this study, we found that older adults were significantly more accurate in the positive valence compared to the negative valence. Despite the findings for older adults, younger adults too had higher accuracy in the positive valence.

Our second hypothesis was based on fuzzy trace theory. The dual process theory suggests that we have two information processing streams: gist and verbatim. The theory predicts that as we age, the gist-processing stream may become more dominant as cognitive abilities decline and older adults must compensate. Our results were consistent with this hypothesis and revealed some additional findings that may provide insight into some of the underlying processes that work to preserve and enhance memory as we age.

Motivation for this study arose from previous studies on healthcare issues demonstrating a memory bias in older adults towards positively-valenced information in

comparison to negatively-valenced information (Shamaskin, Mikels, & Reed, 2010). In order to integrate SST and FTT, we examined both sentence-type and valence. We wondered if and how these two theories might work together enable or disable older adults' ability to remember health-related information. Our approach, drawing from these two varying perspectives, resulted in several interesting and consistent insights.

First of all, we found a main effect of age on accuracy. Older adults are significantly less accurate than younger adults overall. This finding is consistent with previous findings that cognitive abilities decline as we age. In contrast to this notion that all cognitive abilities decline as we age, however, is the finding that older adults' memory for gist statements is just as strong as younger adults' memory in this category. We found that older adults remember gist statements significantly better than verbatim sentences whereas younger adults did not show a difference in their memory for verbatim and gist statements. More specifically, it seems to be in the positive valence that older adults are performing better on gist statements compared to younger adults who still show no difference between verbatim and gist accuracy in the positive valence.

Yet, older adults' strength in gist statement memory even extends to the negative valence where older adults are marginally significantly stronger at remembering gist statements again but not to the same degree as when in the positive valence. Although older adults' gist accuracy was stronger than verbatim accuracy, there was still no difference between young adults' memory for gist or verbatim sentences in the negative valence. These findings suggest that gist is not inconsequential.

Firstly, we see strong support for fuzzy trace theory in that it is clear that there are multiple information processing streams at work. Gist processing streams were

effectively isolated in older adults. According to Brainerd & Reyna (2002), fuzzy trace theory might suggest a reliance on gist processing as we age and verbatim processing declines. Younger adults outperformed older adults in verbatim memory as fuzzy trace theory might suggest. These additional findings indicate that older adults do not only rely on gist memory traces more as they age, but that gist processing may actually remain wholly intact throughout the life span.

When we look at the negative valence across age groups, gist sentence type fails to enhance older adults' memory relative to younger adults. While older adults still perform better in gist versus verbatim in the negative, their overall performance declines substantially relative to the young. Whereas positive valence seems to enhance older adults' memory when compared to negative valence in most cases, it does so most robustly when combined with gist sentence types. These findings are interesting because they show that the significant finding that older adults remember more positive sentences than negative may in fact be rooted in their incredibly robust memory for gist statements.

Meyerowitz and Chaiken (1987) found a negativity bias in younger adults when dealing with healthcare issues. Our study did not replicate these findings. Instead, younger adults seem to favor the positive valence. However, because younger adults did not show this effect we are unable to detect whether or not a positivity effect occurred for older adults. Because the younger group is already doing better in the positive, this finding over shadows any positivity effect for older adults. Still, we did find evidence that positive valence was enhancing older adults' memory, especially for gist statements. This clear indication that positive versus negative valence is strengthening older adults' memory provides nuance support for a positivity effect in older adults.

One limitation of this study is its sample size. A larger sample could increase the power of our findings. Future studies should attempt to reproduce these samples with a large sample size. Additionally, it would be useful to lengthen the time between the pamphlet-reading and recognition task to further understand how the information gained is perceived and then remembered. It would be also interesting to see if there are any real behavior changes after processing this healthcare information.

These findings have far-reaching implications for the type of information that older adults process, retain, recall, and perhaps act upon. Clearly, emotion plays a role in information processing for older adults. Likewise, the type of information, be it gist or verbatim, is also important for older adults. When attempting to impact the behavior of older adults, framing information in the positive valence and focusing on utilizing gist sentence types may change the way healthcare and other important information is conveyed to the older population. From a practical point of view, these findings inform the design of communications created to disseminate information to the older adult population. As the elderly population expands, it is critical to understand more about how to effectively reach this segment of the population.

References

Blanchard-Fields, F. (2005). Introduction to the special section on emotion–cognition interactions and the aging mind. *Psychology and Aging,* 20(*4),* 539–541. doi: 10.1037/0882-7974.20.4.539

Brainerd, C. J., Reyna, V. F., Howe, M. L., & Kevershan, J. (1991). Fuzzy-trace theory and cognitive triage in memory development. *Developmental Psychology, 27*, 351-369.

Brainerd, J. C., & Reyna, F. V. (2002). Fuzzy-trace theory and false memory. *Current Directions in Psychological Science (Wiley-Blackwell), 11*(5*),* 164-169. Retrieved from Academic Search Alumni Edition database.

Carstensen, L. L., Isaacowitz, D. M., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity theory. *American Psychologist, 54,* 165-181.

Carstensen, L. L., & Mikels, J. A. (2005). At the intersection of emotion and cognition: Aging and the positivity effect. *Current Directions in Psychological Science, 14(*3), 117-121. doi: 10.1111/j.0963-7214.2005.00348.x

Charles, S. T., Mather, M, & Carstensen, L. L. (2003). Aging and emotional memory: The forgettable nature of negative images for older adults. *Journal of Experimental Psychology, 132*(2), 310-324.

Dennis, A. N., Kim, Hongkeun., Cabeza R. (2007). Effects of aging on true and false memory formation: An fMRI study. *Neuropsychologia, 45*, 3157–3166.

Fernandes, M., Ross, M., Wiegand, M., & Schryer, E. (2008). Are the memories of older adults positively biased? *Psychology and Aging, 23*(2), 297-306. doi: 10.1037/0882-7974.23.2.297

Field, D. (1997). Looking back, what period of your life brought you the most satisfaction. *International Journal of Aging & Human Development, 45,* 169-194.

Kennedy, Q., Mather, M., & Carstensen, L. (2004). The role of motivation in age-related positive effect in autobiographical memory. *Psychological Science, 15*(3), 208-214. doi:10.1111/j.0956-7976.2004.01503011.x

Mather, M., & Carstensen, L. L. (2005). Aging and attentional biases for emotional faces. *Psychological Science, 14,* 409-415.

Meyerowitz, E. B., & Chaiken, S. (1987). The effect of message framing on breast self-examination attitudes, intentions and behavior. *Journal of Personality and Social Psychology.* 52(*3)*, 500-510.

Mikels, J. A., Larkin, G. R., Reuter-Lorenz, P. A., & Carstensen, L. L. (2005). Divergent trajectories in the aging mind: Change in the working memory for affective versus visual information with age. *Psychology & Aging, 20,* 542-553.

Piquet, O., Connally, E., Krendl, C. A., Huot, R. J., & Corkin, S. (2008). False memory in aging: Effects of emotional valence on word recognition accuracy. *Psychology and Aging, 23(*2), 307-314. doi: 10.1037/0882-7974.23.2.307.

Reyna, V. F., & Brainerd, C. J. (1995). Fuzzy-trace theory: An interim synthesis. *Learning and Individual Differences, 7*, 1-75.

Scheibe, S. & Blanchard-Fields, F. (2009). Effects of regulating emotions on cognitive performance: What is costly for young adults is not so costly for older adults. Psychology and Aging, Vol 24(1), Mar 2009, 217-223. doi: 10.1037/a0013807

Shamaskin, M. A., Mikels, A. J., Reed, E. A. (2010). Getting the message across: Age differences in the positive and negative framing of health care messages.

*Psychology and Aging, 25(*3*),* 746-751. doi: 10.1037/a0018431

Tversky, A. & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science New Series*, *211*(4481), 453-458. doi: 0036-807518110130-0453$01.501

Zhang, X., Fung, H., & Ching, B. (2009). Age differences in goals: Implications for health promotion. *Aging & Mental Health*, *13*(3), 336-348. doi:10.1080/13607860802459815

Author Note

I would like to thank Dr. Joseph Mikels and Dr. Marianella Casasola for their guidance, feedback and support with this thesis. I would also like to thank Andrew McClintock for his statistical support and encouragement throughout this process. This research was conducted as fulfillment of the undergraduate honors program.

Correspondence concerning this article should be addressed to Eugenie Lehembre-Shiah, Department of Human Development, Cornell University, Ithaca, NY 14850.

Email: [eal79@cornell.edu]

Table 1

Participant Characteristics

	Younger Group		Older Group	
Measure	*M*	*SD*	*M*	*SD*
Age (years)	20.35	1.387	73.03	12.093
Education (years)	14.38	2.915	15.93	2.721
SES (1-5)	2.89	.994	2.90	.939

*SES was rated on a 5 point scale from 1-lower to 5-upper

Table 2. Example of the four types of sentences used for Forced-Choice recognition task

Negative gist	If you fail to detect it early, you decrease your chances for full recovery
Negative verbatim	If you fail to detect it early, there is less than a 55 percent chance for full recovery
Positive verbatim	If you detect it early, you have more than a 55 percent chance for full recovery
Positive gist	If you detect it early, you increase your chances for full recovery

Table 3.

Age by Valence and Age by Sentence Type

		Older		**Younger**	
		M	***SE***	***M***	***SE***
Valence	Positive	.542	.046	.792	.046
	Negative	.250	.046	.475	.046
Sentence Type	Gist	.553	.045	.617	.045
	Verbatim	.258	.041	.650	.041

Table 4.

Estimated Marginal Means: Age by Valence by Sentence-type

Age	**Valence**	**Sentence-Type**	**Mean**	**Std. Error**
Old	Negative	Verbatim	.183	.059
		Gist	.317	.063
	Positive	Verbatim	.333	.059
		Gist	.750	.063
Young	Negative	Verbatim	.483	.059
		Gist	.467	.063
	Positive	Verbatim	.817	.059
		Gist	.767	.063

Table 5. Coding for Inaccuracy Statistics

Code	**Type of Error**
11	PV to PV-Correct
12	PG to PV
13	NV to PV
14	NG to PV
21	PV to PG
22	PG to PG-Correct
23	NV to PG
24	NG to PG
31	PV to NV
32	PG to NV
33	NV to NV-Correct
34	NG to NV
41	PV to NG
42	PG to NG
43	NV to NG
44	NG to NG-Correct

PV=Positive verbatim

PG=Positive gist

NV=Negative verbatim

NG=Negative gist

Figure 1. Example of Skin Cancer Pamphlet

Skin Cancer

What is skin cancer?

- Skin cancer is the most common form of cancer in the United States.
- The chance of developing skin cancer increases with age, but this disease affects people of all ages.
- Melanoma accounts for only a small percentage of skin cancer, but it is far more dangerous than other skin cancers and causes most skin cancer deaths.

If you fail to detect it early, you have less than a 65% chance of full recovery.

Am I at risk for getting skin cancer?

You are at higher risk for getting skin cancer if you have:

- Exposure to the sun through work and play and/or a history of sunburns early in life.
- Certain types of moles and/or a large number of moles or "beauty marks."

People who have had a blistering sunburn in the past are more likely to get skin cancer during their life than those who have avoided getting a blistering sunburn.

How do I know if I have skin cancer?

- The first sign of skin cancer is a change in the size, shape, color, or feel of an existing mole.
- A new or existing mole may be "ugly looking," asymmetric, or have uneven color.

People who fail to routinely check their own skin for changes or new growths have less than a 54% chance of noticing potential signs of skin cancer.

Is there anything I can do to protect myself against skin cancer?

- The best way for a person to prevent skin cancer is to protect him or herself from the sun.
- Seek shade, wear protective clothing, and rub on sunscreen with SPF 15 or higher.

By failing to use sunscreen you significantly increase your chances of ultimately getting skin cancer.

Figure 2. Age by Sentence Type

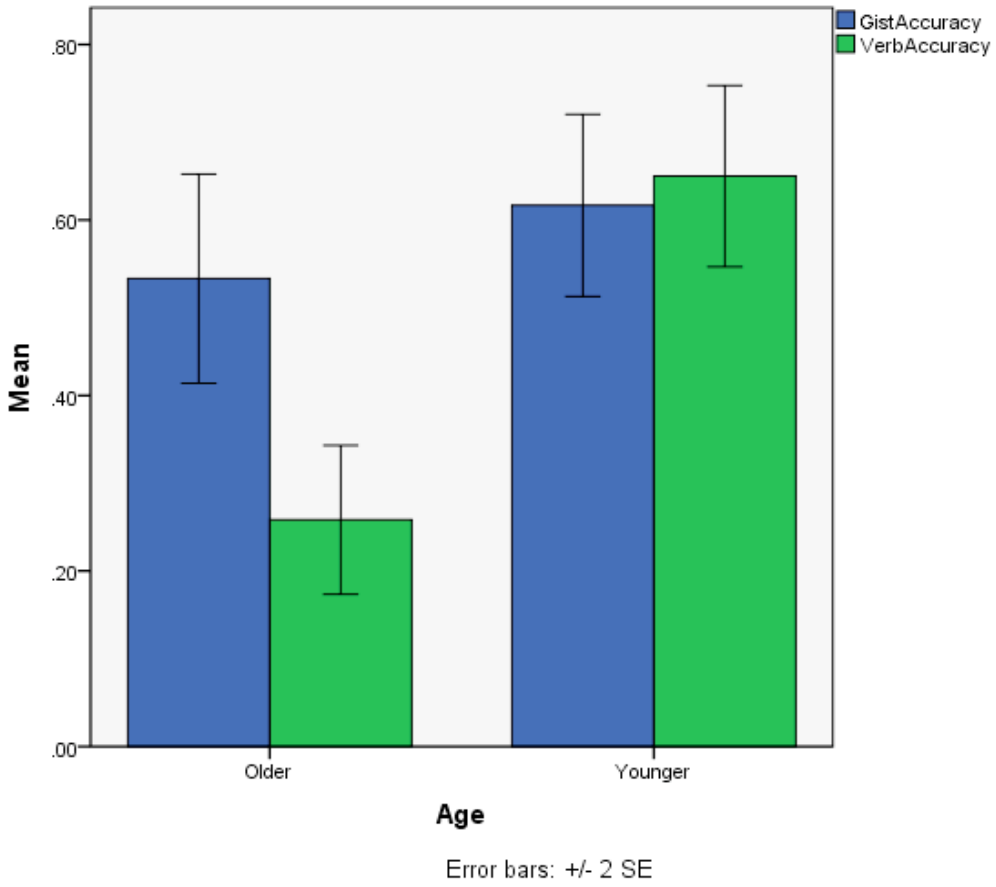

Figure 3. Valence by Sentence Type by Age