The Effect of Emotional Valence of Stimuli on Lexical Retrieval in Younger and Older
Adults

THESIS

Presented in Partial Fulfillment of the Requirements for the Degree Master of Arts in the
Graduate School of The Ohio State University

By

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2016

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Abstract

The current study aims to determine if the emotional valence of pictures impacts naming latencies in healthy younger and older adults. Eighteen healthy young adults and 18 healthy older adults were asked to name images with positive, negative, or neutral valence. Participants' reaction times for positive and negative images were significantly longer than reaction times for neutral images. Reaction times for positive and negative images were not significantly different. Whereas older adults had significantly longer naming latencies than younger adults, results showed that the discrepancy in latency with age is greater when naming positive and negative pictures, than with neutral pictures.

I would like to dedicate this Master's thesis to my incredibly supportive and accomplished parents, Rick and Zeinab Schwen, my exceptionally accommodating and supportive husband, Jacob Blackett, and my brilliant academic advisor, Dr. Stacy Harnish, who were all instrumental in helping me to achieve this goal.

Acknowledgments

I would like to acknowledge Dr. Stacy Harnish for her guidance and assistance throughout this project. Thank you for being generous with your time, for being there whenever I had questions, helping me to collect data, and for providing the support and assistance I have needed throughout the past three years. I would also like to acknowledge Dr. Eric W. Healy for agreeing to be on this thesis committee. Thank you for your advice and flexibility throughout this process. I would like to acknowledge Jenny Lundine and Ally Zezinka for their assistance collecting data and overall support. Thank you for all your help, for answering my random questions while sitting next to me in the Aphasia Lab, and for your friendship. Finally, I would like to thank Erin Rundio and Mallory Sharp for the hours they put in helping me analyze the data. Thank you very much for all your hard work and assistance in this project.

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Chapter 1: Introduction

Emotion and Lexical Processing

There is a large body of evidence that has investigated the impact of emotion on cognitive processes. Emotion has generally been defined as having two dimensions: valence and arousal. Valence is defined as the degree of positivity or negativity of a stimulus (how pleasant/appetitive vs. unpleasant/aversive), whereas arousal is defined as the degree of excitability of a stimulus (how calming vs. emotionally intense). There is evidence that emotional valence has a facilitative effect on cognitive-linguistic processes due to motivation. A motivational model proposes that emotional stimuli are adaptively important for self-preservation, leading to a faster processing of emotional information (Lang, Bradley, & Cuthbert, 1990). For example, Kousta, Vinson, and Vigliocco (2009) found that young adults distinguished words from non-words in a lexical decision task faster than when they were emotional words (both positive and negative) compared to when they were neutral words. Kousta et al. (2009) suggest that their data supports the motivational hypothesis of emotion: that there is a processing advantage for positive and negative words over neutral words. Analyzing data from the widely-used linguistic database, the British Lexicon Project, Vinson, Ponari, and Vigliocco (2014) also found that after controlling for non-emotional variables, such as number of letters and orthographic neighborhood, lexical decisions were made faster for emotional words than

for neutral words. Yap and Seow (2014) replicated Kousta et al. (2009)'s findings, however, and provide a different theory as to why emotional stimuli resulted in faster processing times. They suggest that because we have richer semantic representations for emotional words, our ability to process them is greater. The authors parallel the effect of emotionality on lexical processing to the effect of word frequency: words that are higher frequency result in faster processing times because we have richer semantic representations for them due to our familiarity with high frequency words. So, because emotional words tend to have richer semantic networks, they result in faster lexical processing.

It is important to note, however, that the evidence for the effect of emotionality on lexical processing tasks is inconsistent. There has been evidence to show that negative and positive stimuli impact lexical processing differently. Kuperman, Estes, Brysbaert, and Warriner (2014) presented evidence that showed negative stimuli were recognized more slowly than neutral and positive stimuli in a lexical decision task. This study lends support to the automatic vigilance effect described by Estes and Adelman (2008). The automatic vigilance effect states that negative stimuli result in longer processing times and naming latencies due to an attentional preference for negative stimuli. In other words, the automatic vigilance effect purports that it takes longer for humans to withdraw attention from negative or threatening stimuli given its evolutionary importance, thus it takes longer to process negative stimuli. In addition, in support of an automatic vigilance effect, several studies have shown increased attentional interference effects for negative words as compared to positive and neutral words when completing an emotional Stroop

task (McKenna & Sharma, 1995; Compton et al., 2003; Kahan & Hely, 2008). The original Stroop task asks participants to identify the color of the font of a word, while inhibiting the written word itself, which is the name of a color. The emotional Stroop task includes emotionally valenced words (e.g., fear, love) as the stimuli instead of color names for which participants name the color of the word. Algom, Chajut, and Lev (2004) suggest that the interference effects of the original Stroop task and the emotional Stroop task are distinct and independent from each other, in that, the emotional Stroop task effect for negative stimuli is "threat-driven" and not simply due to a failure to selectively attend to only word color in the presence of interference. Further, Estes and Verges (2008) suggest that the automatic vigilance effect may vary depending on the nature of the task. The authors explain that for tasks for which the valence response is task-irrelevant, lexical processing is slowed because it takes individuals longer to disengage attention from negative or aversive stimuli as compared to neutral or positive stimuli. For example, for a lexical decision task, individuals are asked to decide between words and non-words; attending to the valence of the words in this task is irrelevant to one's decision. However, Estes and Verges (2008) suggest that for valence response-relevant tasks, such as if someone were to judge the valence of a word, the automatic vigilance effect has a facilitative effect on lexical processing. These studies show that the effect of emotion may be different for positive and negative stimuli and the effects may also depend on the relevance the emotion has to the task itself.

Some studies suggest that emotional stimuli, regardless of valence, may inhibit lexical processing. For example, Ihssen, Heim, and Keil (2007) found that emotional

stimuli interfered with lexico-semantic processes for tasks in which non-task relevant emotionally arousing pictures were shown between trials of a lexical decision task. The authors suggest that emotional stimuli could facilitate or inhibit cognitive processes depending on the level of arousal and the type of the task (e.g., complexity). They found that emotional images that were more arousing had an inhibitory effect on subsequent lexical processing. Given that both negative and positive images are typically more arousing than neutral images; this suggests there may be an inhibitory effect for both positive and negative images in comparison to neutral images. Again, these findings were derived from a task for which valence was irrelevant. Overall, lexical processing appears to be affected by emotional valence, but various methods producing inconsistent results makes the evidence unclear. Additional research is warranted to clarify this effect and its modulating factors.

Aging and Emotion

The aging literature has consistently shown a decline in cognitive-linguistic abilities, such as working memory, attention, and inhibition, as part of the normal aging process. For instance, Commodari and Guarnera (2008) found that older adults, ages 60-65, demonstrated a decline in tasks targeting immediate attention, selective attention, and attention shifting when compared to adults ages 55-59. Additionally, Andrés, Parmentier, and Escera (2006) found that older adults demonstrated more difficulty with frontal attentional tasks; however, maintaining alertness to the task, which is thought to be a more basic, posterior function of the brain, was shown to be preserved. They found that

older adults were more easily distracted by non-relevant sounds than were younger adults. The authors attribute this attentional deficit to frontal neuronal atrophy that occurs with aging and lend support for the "frontal lobe hypothesis", which states that the majority of atrophy occurs with aging occurs in the frontal lobe (West, 1996; West 2000).

Similarly, Borella, Carretti, and De Beni (2008) used a variety of measures that revealed age-related decline in verbal and visual-spatial working memory performance, as well as inhibition, with the former showing a greater decline than the latter. Thus, the authors suggest that the overall decline in cognitive performance with aging is more likely to be attributed to the decline in working memory than to the decline in inhibition. In sum, researchers have shown there is a decline in cognitive-processes as part of the normal aging process.

Despite the large body of evidence supporting a decline in various cognitive processes with age, researchers have shown that emotion can influence or modulate cognitive aging effects. For example, Mammarella, Borella, Carretti, Leonardi, and Fairfield, (2013) found that working memory performance in older adults was enhanced when emotional stimuli (positive and negative) were used. That is, the decline in working memory performance was smaller for emotional stimuli. Moreover, in comparison to neutral and negative stimuli, others have shown that there may be a relative preservation of working memory abilities in older adults for positive stimuli (Charles, Mather, & Cartenson, 2003; Mather & Cartenson, 2005). This has been attributed to the socioemotional selectivity theory, which states that emotional regulation improves with age. Mather and Cartenson (2003) define emotional regulation as, "the maintenance of

positive affect and the decrease of negative affect" (p. 310). These authors suggest that older adults may attend more to positive stimuli and thus show superior working memory for positive stimuli than for negative stimuli. Given the evidence that emotion may modulate the aging effects on working memory and that aging effects are seen with other cognitive-linguistic processes, such as attention and inhibition, it is of interest to explore whether emotion may impact these and other cognitive-linguistic processes with age as well.

Aging and Lexical Retrieval

Lexical retrieval is a cognitive-linguistic skill that has consistently shown a decline with aging (Borod, Goodglass, & Kaplan, 1980; Nicholas, Olber, Albert, & Goodglass, 1985). Older adults have shown an increase in errors and reaction time when naming pictures (Feyereisen, 1997). Whereas most aging studies have been cross-sectional, this decline in naming has also been demonstrated in longitudinal studies as well (Au et al., 1995). Burke and Shafto (2004) hypothesized that lexical retrieval breakdowns in older adults are attributable to a breakdown in the phonological system rather than the semantic system, suggesting that phonological connections become weaker with age because they are less interconnected. Au et al. (1995) showed that older adults required significantly more phonemic cues for a lexical retrieval task than younger adults, providing supporting evidence for a primarily phonological retrieval breakdown in older adults.

An alternate view is that the decline in lexical retrieval with aging may be attributed to an overall decline in cognition. Baciu and colleagues (2015) demonstrated evidence of this decline in lexical retrieval using functional magnetic resonance imaging (fMRI). The authors found that in older adults, brain regions specialized for word retrieval and production were less active, and showed overall different activation patterns than younger adults. The authors explain these findings by proposing that older adults activate supplemental brain regions to compensate for the decline in word finding secondary to the decline in cognition. This suggests that the decline in lexical retrieval seen in older adults could be due to a decline in domain-general cognitive processes.

The Present Study

Although the literature examining the impact of aging on lexical retrieval is rather robust, there has been little investigation into the effect of emotion on lexical retrieval in younger and older adults. As the literature above has shown, emotion has an effect on various cognitive-linguistic processes. The effects of emotional stimuli appear to be dependent on several factors such as valence, arousal, relevance to the task, and age. Whereas much of the literature focuses on the effect of emotion on tasks such as working memory of words and lexical decision making, there has been a paucity of research investigating the effect of emotional valence on lexical retrieval, and any potential modulatory effect of emotion on cognitive-linguistic abilities with aging. There is an interest in investigating the effect of emotion on lexical retrieval for the theoretical applications. That is, the relationship between emotion and language may be clarified

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further and may advance understanding of the neural underpinnings of emotion and language. Moreover, the results of this study may have clinical applications, especially considering that lexical retrieval is an important, real-world task employed in daily life. For example, if emotion does appear to have an impact on lexical retrieval, findings may provide insight into the assessment and treatment of language disorders that include word-finding deficits such as with aphasia or traumatic brain injury.

The current study aims to determine whether the emotional valence of pictures 1) impacts naming latencies in healthy adults and 2) differentially impacts naming latencies in younger and older adults. As proposed in the motivational hypothesis, we hypothesize that positively- and negatively-valenced stimuli will result in faster naming reaction times than neutral stimuli. We also expect, as has been seen in previous studies, that younger adults will have faster naming reaction times than older adults. Finally, we expect that the effect of emotion on lexical retrieval will be greater for the older adults than for the younger adults due to age-related differences in cognitive-resources.

Chapter 2: Methods

This study used a mixed between- and within-subjects design, with age as the between-subject factor and emotional valence of pictures as the within-subject factor. The dependent variable was picture naming reaction time in milliseconds.

Participants

Forty-eight participants were recruited to participate in the study. Eighteen healthy young adults (18 to 27 years; Mean = 22.11 years) and 18 healthy older adults (60 to 80 years; Mean = 68.67 years) met inclusion criteria and completed the study. Older adults were excluded if they demonstrated mild cognitive impairment, as determined by scoring below a 27 on the Standard Version of the Mini Mental State Examination-Version 2 (Folstein, Folstein, & McHugh, 1975). By self-report, both younger and older adults were native speakers of English, right-handed, had no history of neurological disease or impairment, had no history of psychological disorders, had no history of language impairment, were not currently taking any drugs or medication that could impair judgement or thinking, and had no uncorrected vision or hearing impairments. See Table 1 for demographic data.

Table 1. *Demographics of Participants*

Age Group	Gender		Age		Education	
	n	% female	*M*	*SD*	*M*	*SD*
Young	18	67	22.11	2.61	15.58	1.97
Old	18	67	68.67	6.19	15.33	2.93

Note. All participants identified as White/Caucasian with the exception of two participants who identified as African American and Asian, respectively.

Stimuli

Positive, negative, and neutral pictures were obtained from the International Affective Picture System, ([IAPS]; Lang, Bradley, & Cuthbert, 2008), a widely used and standardized set of pictures that are rated for emotional valence and emotional arousal. Pictures were chosen based on concreteness, valence (positivity vs. negativity), and arousal (excitability). Three lists of pictures were created with 20 items each for blocks of negative, neutral, and positive images, respectively. The three blocks of positive, negative, and neutral images did not differ in concreteness ratings (F = 1.92, p = .161) taken from the MRC Psycholinguistic Database (Coltheart, 1981). Negative, neutral, and positive images differed significantly on emotional valence ratings (F = 648.11, p < .001) and arousal (F = 57.73, p < .001). Pairwise comparisons revealed that neutral images had a significantly lower arousal rating than positive and negative pictures (p < .001), however, pairwise comparisons demonstrated that arousal ratings for positive and negative images were not significantly different (p = .152). The three blocks also did not differ in terms of word frequency (F = .143, p = .87) or number of syllables (F = .156, p

= .86). Log-transformed Hyperspace Analogue to Language (HAL; Lund & Burgess, 1996) frequency norms taken from the English Lexicon Project (Balota et al., 2007) were used in the analysis.

Procedure

Participants were asked to view and name 60 colored photographs from the IAPS including a target object that were presented electronically on a Dell laptop with a 14 or 15.6 inch display using E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA). Picture dimensions were 1024 pixels wide by 768 pixels high. Participants were instructed to name each item "as quickly and accurately as possible". Pictures were presented in three blocks according to emotional valence (20 positive, 20 negative, and 20 neutral). Order of block and image presentation were randomized across participants. Pictures were blocked according to valence to ensure arousal and valence effects did not carry over trial to trial. Each picture was presented for 5000 milliseconds (ms) with a blank screen following for 2000ms, allowing participants a total of 7000ms to name each item. All sessions were audio-recorded with an Olympus Digital Voice Recorder. An audible "ding" sound was programmed to trigger at the moment the picture was presented to provide an audible start time captured by the audio recorder. Between each block, participants completed portions of the Spatial Span subtest of the Wechsler Memory Scale (Wechsler, 1997) as a distractor task in an attempt to avoid emotional valence carry over between blocks and/or fatigue.

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Measurement and Reliability

Reaction time (RT) and accuracy were measured for each item. Average RTs of each block of pictures for each participant were calculated to include in the analysis. Names were considered accurate if they matched the target word, were synonyms of the target word, or varied in plurality from the target (e.g., dolphin for dolphins) and were provided before the onset of the following picture. Trials in which participants gave an inaccurate answer or were unable to name the picture in the allotted time were excluded from the analysis.

Reaction times for each of the 60 trials were measured using Praat acoustic analysis software (Boersma & Weenink, 2015) to precisely determine the elapsed time from presentation of the picture (the audible "ding") to the onset time of the participants' correct response. Three college students were recruited as raters to make RT measurements. Data from 25% of participants were randomly selected to include in intra- and inter-rater reliability measurements. Reliability was calculated utilizing the method reported by Kuhl et al. (1997), which consists of calculating the mean percentage difference between RT measurements between raters for intra- and inter-rater reliability. The mean intra-rater difference was 1.50% and mean inter-rater difference was 2.12%, both of which indicate high reliability.

Statistical Analysis

There were five pictures that were frequently missed and were thus excluded from the analysis, as they were judged to be outliers. Given that participants were healthy adults, a picture was considered an outlier if fewer than 90% of participants named the

item correctly. Thus, whereas the neutral block consisted of 20 trials, the negative block

consisted of 16 trials, and the positive block consisted of 19 trials.

Chapter 3: Results

A two-way, repeated measures ANOVA was conducted to determine if the mean reaction times for positive, neutral, and negative images differed by age. Data were plotted across age groups to evaluate the assumptions for ANOVA. A relatively random display of points around zero provided evidence that the independence assumption was met. The assumption of normality was examined via the residuals within and between groups. Two out of six Shapiro-Wilk tests ([*SW*]; Shapiro & Wilk, 1965) were significant (*SW* = .877, *df* = 18, *p* = .023; *SW* = .882, *df* = 18, *p* = .028) indicating a deviation from normality. All skewness statistics fell between -2 and 2, suggesting that normality is a reasonable assumption, whereas two out of six kurtosis statistics fell outside of this range, suggesting some deviation from normality (3.602; 2.806). Given that ANOVA is robust to minor violations of normality, especially for equal groups (Lomax & Hahs-Vaughn, 2012), we proceeded with the analysis. To attempt to further reduce the chance for Type I/Type II error, an α of .01 was chosen for the analysis. The homogeneity of variance assumption was examined via Levene's test and revealed inhomogeneity of variance for the positive group (*p* = .004). In addition, results of Box's *M* test were significant, also indicating inhomogeneity of variance (*p* = .003). However, it has been shown that ANOVA is robust to violations of homogeneity of variance for small groups of equal size (Lomax & Hahs-Vaughn, 2012). Finally, the assumption of sphericity was met ($\chi2$ =

.791, Mauchly's $W = .976$, $df = 2$, $p = .673$) and further upheld in that the same results were obtained for the usual, Geisser-Greenhouse and Huynh-Feldt F tests.

Results revealed a statistically significant within-subjects main effect for emotional valence at an alpha level of .01 ($F = 53.70$, $p < .001$) with a large effect size (partial $\eta^2 = .61$) indicating that there were significant differences between reaction times for pictures with different emotional valence. The between-subjects main effect of age was statistically significant as well ($F = 55.67$, $p < .001$) with a large effect size (partial $\eta^2 = .62$) indicating there was a significant difference between age groups for reaction time. The within-subjects interaction between emotional valence and age-group was also statistically significant ($F = 14.57$, $p < .001$) with a large effect size (partial $\eta^2 = .30$) indicating that there was a significant difference by age in reaction times of emotionally valenced images. See Table 2 for descriptive statistics.

The statistically significant main effect for the within-subjects factor of emotional valence suggests that there are mean differences in RT by emotional valence. Bonferroni pairwise comparisons revealed statistically significant differences in RT between positive and neutral images ($p < .001$) as well as between negative and neutral images ($p < .001$). However, pairwise comparisons revealed a nonstatistically significant difference between naming RTs for positive and negative images ($p = .818$) (See Table 3).

The statistically significant main effect for the between-subjects factor of age suggests, as has been previously shown, that there are mean differences in RT of naming by age. Upon examination of group means, RTs of older participants were longer than those of younger participants. Finally, the significant interaction between age and

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emotional valence suggests that the effect of emotional valence was significantly different for younger and older participants. Upon examination of the profile plot, the effect of emotion appears to be greater for older adults than for younger adults. Figure 1 provides a bar graph of mean reaction times by age, clustered by emotional valence. This figure shows that overall, reaction times of older adults were longer than of younger adults, and that the difference between emotional and neutral pictures was greater for older adults. Error bars represent a 95% confidence interval. Figure 2 is a profile plot of the group means that shows the interaction effect between valence and age.

Given the minor violations of normality, two outliers (one young and one old) were eliminated to explore whether results would differ. After exclusion of these two outliers, all six Shapiro-Wilk tests were non-significant and all skewness and kurtosis statistics fell between -2 and 2. Thus, the normality assumption was met after exclusion of the outliers. The two-way repeated measures ANOVA was re-conducted to determine if elimination of the outliers changed the results. After outlier exclusion, both the within- and between-subject main effects and the interaction remained significant, the effects sizes remained large and were, in fact, slightly higher. Since there was no meaningful difference in results after outlier exclusion, the initial ANOVA was likely robust to the slight deviations in normality with outliers included.

Table 2. *Descriptive Statistics*

Emotional Valence	Age Group	Mean	SD
	Young	1017.04	257.57
Negative	Old	1594.24	370.82
	Total	1305.64	429.75
	Young	912.92	151.04
Neutral	Old	1601.98	325.76
	Total	1257.45	429.79
	Young	785.15	140.78
Positive	Old	1048.05	141.41
	Total	916.60	192.65

Note. Dependent Variable: Reaction Time (ms); SD = standard deviation

Table 3. *Bonferroni Multiple Comparisons*

Emotional Valence		Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Negative	Neutral	389.04	41.53	< .001	257.93	520.16
	Positive	48.19	43.23	.818	-88.29	184.67
Neutral	Negative	-389.04	41.53	< .001	-520.16	-257.93
	Positive	-340.85	37.83	< .001	-460.27	-221.43
Positive	Negative	-48.19	43.23	.818	-184.67	88.29
	Neutral	340.85	37.83	< .001	221.43	460.27

Figure 1. *Mean Reaction Times with 95% Confidence Interval Bars by Valence and Age Group*

Figure 2. *Effects of Emotional Valence and Age on Picture-Naming RT*

Chapter 4: Discussion

The present study aimed to determine if emotional valence of pictures impacted naming latencies in healthy adults and if it impacted younger and older adults differently. Results indicated that contrary to our predictions, based on the motivational hypothesis, participants' reaction times for positive and negative images were significantly longer than their reaction times for neutral images. Reaction times for positive and negative images were not significantly different. As demonstrated in other studies (Borod, Goodglass, & Kaplan, 1980; Nicholas, Obler, Albert & Goodglass, 1985; Au et al., 1995; Baciu et al., 2015), overall reaction times were significantly longer for older adults than for younger adults. The present study provides novel evidence that emotional valence of pictures has a larger impact for older adults than for younger adults. That is, the difference between naming latencies for neutral and emotional pictures was found to be greater in older adults.

These results replicated the finding that aging adults demonstrate a decline in naming latencies. Contrary to our predictions, however, positive and negative images resulted in longer (rather than shorter) reaction times than neutral images and this emotion effect was greater for older adults. It is possible that the emotional processing component of the pictures interfered with lexical retrieval for both younger and older adults. Consistent with some previous studies, it may be that since the emotional valence

of pictures was not directly relevant to the task at hand (i.e., attending to the emotional valence of the pictures was not relevant or required for the task of picture-naming), it interfered with and slowed lexical retrieval (Estes & Verges, 2008; Ihssen et al., 2007; Citron, 2012). In addition, Ihssen et al. (2007) suggest that more arousing stimuli inhibit lexical processing. Given that positive and negative stimuli are more arousing than neutral stimuli, as demonstrated by the arousal ratings of images from the IAPS, and that reaction times for positive and negative stimuli were not significantly different from one another, our data suggests that the emotional *arousal* of emotional pictures likely led to inhibition of or interference with lexical retrieval.

Additionally, since we found no difference between reaction times for positive and negative stimuli, we did not find evidence consistent with the "automatic vigilance" effect, which states that negative stimuli result in longer processing times and naming latencies due to an attentional preference for negative stimuli as compared to positive and neutral stimuli. However, there is some debate about the source of extended naming latencies for negative stimuli. Citron (2012) proposes that negative stimuli may be inherently more arousing than positive stimuli, making it more difficult to separate out the effects of emotion (positive versus negative) from arousal. The present study may not have shown an automatic vigilance effect because positive and negative image blocks were matched for arousal ratings. It is worth noting, that in several studies reporting data in support of the automatic vigilance effect, authors presented data obtained from a naming task in which participants see the written word and read it aloud (Balota et al.,

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2007). It may be that the automatic vigilance effect may not apply to an inherently different lexical task such as picture-naming.

Although support for the automatic vigilance effect was not found in the current study, the idea that slower lexical processing of negative stimuli occurs because it is more difficult to disengage attention from negative stimuli may be applicable to the current results. It is possible that difficulty with attentional disengagement (e.g. switching attention from the emotionally arousing quality of the images to the naming task at hand) could be the mechanism by which lexical retrieval was inhibited for both negative and positive stimuli. Further, this interference effect of emotional stimuli may have been more pronounced for the older adults due to decreased cognitive resources, particularly attentional resources. This is consistent with previous research reporting a decline in attention switching and an increase in distractibility by non-relevant stimuli (Andrés et al., 2006; Commodari & Guarnera, 2008).

The results of this study further support the idea that the effect of emotion on lexical processes may be task-dependent. As Ihssen et al. (2007) suggest, the effect of emotion may depend on the relevance of the emotion to the task as well as the complexity of the target task. Given that the many research studies dedicated to investigating the impact of emotion on lexical processing utilize a lexical decision task as their primary measure, the current study, which utilizes a picture-naming task and therefore a different type of lexical process (lexical retrieval), adds to the exploration and discussion of under which circumstances emotional stimuli facilitate or interfere with lexical processes. Our data support that for picture-naming, non-task relevant, emotionally arousing stimuli

interfere with lexical retrieval. Future research should seek to replicate these findings and further investigate the impact of task-*relevant* emotional stimuli on lexical retrieval.

Future research may build on the present results by investigating the effects of emotional stimuli on lexical retrieval in persons with aphasia. Although the present data suggest that positive and negative emotional valence result in longer naming latencies than neutral valence in healthy individuals, the effects of emotional valence on naming accuracy in individuals with aphasia is unclear. Studies have investigated targeting neural substrates for language rehabilitation, including engaging intentional mechanisms in the right hemisphere (Crosson, 2008; Crosson et al., 2009; Benjamin et al., 2014) and melody and rhythm housed in various bilateral brain regions (Albert, Sparks, & Helm, 1973; Schlaug, 2008). Emotion may be another mechanism that could help 1) re-lateralize language driven by emotion centers that tend to be more heavily right-lateralized in the brain, or 2) engage the limbic system as a lower level cognitive resource to facilitate higher level language function.

Limitations

Although stimuli in the current research study were matched for word concreteness, frequency, and number of syllables, images were not matched for visual complexity. It is possible that more visually complex images could have resulted in longer visual processing time resulting in longer naming latencies. Future studies should control for visual complexity of stimuli. In addition, the small sample size and relatively homogenous sample in regards to demographics could limit generalizability of results.

Conclusions

In conclusion, results from the current investigation show that emotional arousal of pictures impacts naming latency in younger and older adults. As shown in other research, older adults take significantly longer to name pictures than younger adults. Results from this study indicate that the discrepancy in latency with age is greater when naming pictures with positive and negative emotional valence, than with pictures with neutral emotional valence. We theorize that this increase in naming latency for emotional stimuli is the result of a necessary disengagement of attentional resources from the emotional arousing images prior to completion of the naming task. Further, we theorize that the larger impact of emotional arousal on naming latency of older adults is due to a decline in attentional resources that is seen with the normal aging process.

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Appendix A: Word Lists

Picture Target Words

Negative Valence	Neutral Valence	Positive Valence
Airplane Crash	Basket	Baby
Bear*	Book	Beach*
Bomb	Buttons	Bride
Cemetery	Clock	Brownies
Cigarette Butts	Fan	Bunnies
Cockroach	Fork	Butterfly
Dog	Hammer	Children
Electric Chair*	Lightbulb	Cruise Ship
Fire	Mug	Cupcake
Gun	Plate	Deer
Rat	Rolling Pin	Dolphins
Shark	Rubberbands	Fireworks
Skulls	Scissors	Flowers
Snake	Sewing Machine	Ice Cream
Spider	Shoes	Kittens
Stitches	Suitcases	Money
Tank*	Tissue	Monkeys
Tombstone	Towel	Parrot
Tornado	Umbrella	Puppies
Garbage*	Whistle	Sunset

Note. Pictures of the above were taken from the International Affective Picture System (Lang, Bradley, & Cuthbert, 2008). All negative pictures had negative valence ratings, all neutral pictures had neutral valence ratings, and all positive pictures had positive valence ratings. *Less than 90% of participants correctly named these items in the time allotted, so they were excluded from the analysis.