2019

A Matter of Priority: Exploring Attentional Resource Allocation as the Proximal Cause of the Animacy Effect

Heather Courtney Rawlinson

FLORIDA STATE UNIVERSITY

COLLEGE OF ARTS AND SCIENCES

A MATTER OF PRIORITY: EXPLORING ATTENTIONAL RESOURCE ALLOCATION AS THE PROXIMAL CAUSE OF THE ANIMACY EFFECT

By

HEATHER COURTNEY RAWLINSON

A Thesis submitted to the
Department of Psychology
in partial fulfillment of the
requirements for the degree of
Master of Science

2019

Heather Courtney Rawlinson defended this thesis on July 19, 2019.
The members of the supervisory committee were:

Colleen M. Kelley
Professor Directing Thesis

Walter R. Boot
Committee Member

Colleen Marie Ganley
Committee Member

The Graduate School has verified and approved the above-named committee members, and certifies that the thesis has been approved in accordance with university requirements.

TABLE OF CONTENTS

LIST OF TABLES

ABSTRACT

People recall and recognize animate words better than inanimate words, possibly because memory systems were shaped by evolution to prioritize memory for predators, people, and food sources. However, the proximal cause of this animacy advantage is not yet known. Attentional paradigms show an animacy advantage in change detection tasks and in attentional blink tasks, which suggests that the animacy advantage in memory could stem from a prioritization of animate items when allocating attentional resources during encoding. In a series of three experiments, I replicate the animacy effect in a remember-know paradigm (Experiment 1), and test whether better recognition (Experiment 2) and better recall (Experiment 3) for animate items can be traced to enhanced attention at encoding by comparing the animacy effect under conditions of full versus divided attention at encoding. Results demonstrate that word type does not interact with attention condition, suggesting that attention is not the proximal cause of the animacy effect in memory.

CHAPTER 1

INTRODUCTION

Human memory has long been identified as a highly intricate process, and is sensitive to factors such as affective state (Kensinger, 2007), depth of processing (Craik & Tulving, 1975; Jacoby, Shimizu, Daniels, & Rhodes, 2005), and context (Godden & Baddeley, 1975). Recently, researchers have also begun to explore the impact of human evolutionary history on memory, which has led to some intriguing results.

The evolutionary approach to memory is centered around fitness-relevant information, information critical to human survival in a given context, and includes a wide variety of factors such as those relating to mate selection (Pandeirada, Fernandes, Nairne, Marinho, & Vasconcelos, 2015; Sandry, Trafimow, Marks, & Rice, 2013) fear, threats, social status (Sandry *et al.*, 2013), and survival (Nairne & Pandeirada, 2008). Several studies have suggested that memory is biased towards fitness-relevant information, meaning that information encoded under a fitness-relevant context is more easily recalled in the future (Nairne & Pandeirada, 2008; Nairne, Thompson, & Pandeirada, 2007; Nairne, Pandeirada, Gregory, & Van Arsdall, 2009; Weinstein, Bugg, & Roediger, 2008). A bias towards fitness-relevant information has been seen in studies examining disgust (Charash & McKay, 2002; Croucher, Calder, Ramponi, Barnard, & Murphy, 2011; Chapman, Johannes, Poppenk, Moscovitch, & Anderson, 2013; Fernandes, Pandeirada, Soares, & Nairne, 2017), spatial memory (New, Krasnow, Truxaw, & Gaulin, 2007), basic survival (Nairne & Pandeirada, 2008; Sandry *et al.*, 2013), and animacy (Nairne, Vanarsdall, Pandeirada, Cogdill, & Lebreton, 2013).

From an evolutionary perspective, the animacy effect, or the observation that animate items such as “dog” and “man” are better remembered than inanimate items such as “box” and “flute” (Nairne *et al.*, 2013), can be easily explained. Surviving in an ancestral environment required that early humans be able to find food, avoid predators, form alliances, and reproduce. In most cases, animate items are more likely to be relevant to these goals than inanimate items because animate items can be a food source, a threat, and a potential friend or mate. In a 2013 study of the animacy effect, Nairne *et al.* asked participants to study a list of words, half of which referred to animate items and half of which referred to inanimate items. Participants were later given a free recall task and were asked to list all of the words that they could remember from the original study list. Significantly more animate items were recalled than inanimate items, even though the words were equated on many other dimensions, such as concreteness, imageability, and number of letters.

The animacy effect is not limited to free recall, but extends to cued recall as well. VanArsdall, Nairne, Pandeirada, and Cogdill (2014) showed participants Swahili-English word pairs, and asked them to learn the word pairs such that they could give the English word when shown the Swahili word at test. Half of the English words were animate items, and half were inanimate items. At test, participants were significantly better at cued recall of the English words when they were animate compared to when they were inanimate.

VanArsdall, Nairne, Pandeirada, and Blunt (2013) examined the animacy effect by showing participants a list of nonwords (such as ‘‘FRAV’’ or ‘‘JOTE.’’), each paired with an object description. These descriptions were either animate in nature, such as “believes in God” or “speaks French,” or they were inanimate in nature, such as “has a round shape” or “made of wood.” Participants were shown the object name and the description and were also told they would need to remember the object names for a later memory task. The memory task consisted of a recognition task where participants saw object names they had previously studied mixed in with new object names, and were asked to decide for each name whether it was new or from the original study list. Results showed significantly better recognition rates for object names that had been paired with animate descriptions compared to object names that had been paired with inanimate descriptions, thus demonstrating that the animacy effect extends to recognition memory tasks. Bonin, Gelin, and Bugaiska (2013) also studied the animacy effect with word lists in a remember/know recognition paradigm, where "remember" judgments are instances of recollection and "know" judgments are instances of familiarity, and found an effect of animacy as well, confirming the that the animacy effect extends to recognition tasks.

While it is hypothesized that animate items are more easily remembered due to their potential to become a threat, a food source, or a potential mate, there are questions surrounding the proximal cause of the animacy effect. Possible causes such as differences in imagery (Gelin, Bugaiska, Meot, Vinter, & Bonin, 2018) and category strength (VanArsdall, Nairne, Pandeirada, & Cogdill, 2017), have been explored, but neither of these have proven to be the driving force behind the animacy effect. However, it is possible that attention might play an important role in how animate and inanimate items are attended to, resulting in the animacy effect in memory.

Prior research has shown that attention plays an integral role during the encoding of memories in many different scenarios outside of the animacy effect (Baddeley, Lewis, Eldridge, & Thomson, 1984; Craik, Govoni, Naveh-Benjamin, & Anderson, 1996; Fisk & Schneider, 1984). Jennings and Jacoby (1993) examined the role of attention in learning by exposing participants to a list of stimuli and asking some participants to simultaneously complete a divided attention task. In the divided attention task, participants heard a list of digits being read during the stimuli presentation and were asked to respond each time three odd digits were presented in a row (e.g. “3,” “7,” “1”). The divided attention task sharply reduced participants’ recognition rates compared to participants who were not asked to do the secondary digit task.

Attention could be the proximal cause of the animacy effect. Based on the animate monitoring hypothesis proposed by New *et al.* (2007), which posits that animate items are prioritized when distributing attention, it would follow that perhaps animate items are better remembered because they still receive the attention necessary for encoding, even when attention is limited by a secondary task. There is a large body of research that demonstrates unique effects of animacy in attentional paradigms, however none have included memory in their design.

Guerrero and Calvillo (2016) examined the effect of animacy on perception in an attentional blink task. Attentional blink tasks involve the rapid presentation of a series of items, two of which will be marked differently, such as with a colored border, and participants will be asked to report the two marked items. However, when the two targets are shown too closely together in the sequence, the first target grabs the viewer’s attention, causing him or her to miss the second target. Guerrero and Calvillo (2016) used an attentional blink task in which the first target item was always inanimate, and the second target was either animate or inanimate. Results showed that when the second target was an animate item, it was noticed significantly more often than when the second target was an inanimate item, even when presented during the typical “blink” period. Animate items were seen when inanimate items were not, suggesting that animate items are processed differently from inanimate items, thus allowing them to be detected even when attentional resources are being used by the first target.

The animacy effect has also been found in inattentional blindness tasks, such that unexpected animate items are noticed more often than unexpected inanimate items (Calvillo & Jackson, 2013), and in change detection tasks, such that changes made to an animate item in a scene are noticed faster and more accurately than changes made to an inanimate item (New, Cosmides, & Tooby, 2007). These attentional effects may play a role in the memory advantage for animacy.

The aim of the current studies was to first replicate the animacy effect in a remember/know recognition paradigm, and then to examine how divided attention during encoding (Jennings & Jacoby, 1993; Sahakyan & Malmberg, 2018) affects the animacy effect in both a remember/know recognition paradigm, and in a free recall paradigm. In a remember/know recognition paradigm, participants study a word list, and are exposed to a second word list at test that includes both new items and old items that were shown during the encoding phase. At test, participants must decide for each item whether it is old or new. If they indicate that the item is old, they must then decide whether they "remember" the item (i.e. they can identify specific details that allow them to recall having seen the item during encoding) or if they "know" the item (i.e. the item feels familiar, but the participant cannot identify specific details from seeing the item during encoding).

Recognition memory is often theorized to be a dual-process, meaning that both recollection and familiarity function differently and reflect different aspects of memory (see Yonelinas, 2002 for a review). Often, recollection judgments in recognition studies are thought to be a process of "recall-to-accept," in which specific details from encoding are used to either accept or reject a stimulus as being old. Familiarity judgments are thought to be an automatic process that reflects the processing fluency for a given item. Compared to familiarity, recollection is highly sensitive to the effects of dividing attention, such that divided attention results in fewer remember judgments than full attention, but has a limited impact on know judgments (Craik *et al*., 1996; Gardiner & Parkin, 1990; Mangels, Picton, & Craik, 2001).

In the study conducted by Bonin *et al.* (2013) examining the animacy effect in a remember/know recognition paradigm, an effect of animacy was found in remember judgments, such that animate items resulted in recollective memories more often than did inanimate items, but no such effect was found in know judgments. A separate study done by Bugaiska, Meot, and Bonin (2016) found the same pattern of results. The results from these two studies suggest that the animacy effect in recognition is driven by the recollection process rather than the familiarity process, meaning that it should be sensitive to manipulations that divide the attention of participants. The results of the present studies will help to determine the role of attention in the animacy effect on memory.

CHAPTER 2

EXPERIMENTS

Experiment 1

The purpose of Experiment 1 was to replicate the work done by Bugaiska *et al*. (2016) by examining the effects of animacy on recognition memory, particularly in the remember judgments, and to test for an animacy effect with the current set of materials. The materials used by Bugaiska and colleagues in 2016 were designed for native French speakers, meaning the animate and inanimate items used were not equated for their English counterparts and a new set of materials had to be created for the present studies.

I predicted that the animacy advantage in recognition would replicate, specifically that participants would have significantly more remember judgments for animate items than for inanimate items. I did not expect to find a significant difference in the frequencies of know judgments between animate and inanimate items.

Method

Participants

Participants were 29 undergraduate students at Florida State University, based on the number of participants collected by Bugaiska *et al.* (2016). All participants were recruited through an online experiment sign-up system, and were granted partial class credit for their participation.

Stimuli

Forty-two words (21 animate and 21 inanimate) were drawn from the materials used by VanArsdall *et al*. (2016), and an additional 38 words (19 animate and 19 inanimate) were drawn from the MRC Psycholinguistic Database version 2, for a total of 80 words (40 animate and 40 inanimate). Animate words included items such as “dog,” “engineer,” and “uncle,” and inanimate words included items such as “branch,” “stove,” and “journal.” Animate and inanimate words were equated on mean number of letters, concreteness ratings, imageability ratings, familiarity ratings, and Kucera-Francis written frequency ratings (see Table 1 for means and standard deviations).

An additional 40 ambiguous words were selected from the MRC Psycholinguistic Database version 2 to serve as filler words, but were not used in the data analysis. All 40 words were rated by four undergraduate researchers and were determined to be ambiguous by all four individuals with one-hundred percent interrater reliability. Words such as “accident,” “message,” and “tough” were included, and the ambiguous word list did not differ in average letter length from the animate list, t = 1.51, *p* = 0.14, nor the inanimate list, t = .83, *p* = .41.

Table 1. Statistical Characteristics of the Control Variables in Experiments 1 and 2 for Animate and Inanimate Stimuli

Word List Control Variables: Experiments 1 and 2

	Animate			Inanimate			*t* Test
Variable	Mean	*SD*	Range	Mean	*SD*	Range	
Concreteness	583.9	30.4	531 - 644	593.1	22.7	539 - 635	*t* = -1.53, n.s.
Familiarity	542.6	41.8	418 - 606	542.0	45.6	468 - 636	*t* < 1
Imageability	588.9	32.7	486 - 636	579.4	33.2	509 - 635	*t* = 1.29, n.s.
KF frequency	46.3	42.2	2 - 242	38.9	36.9	1 - 198	*t* < 1
Letters	5.4	1.6	3 - 9	5.1	1.6	3 - 10	*t* < 1

Design and Procedure

Experiment 1 featured a within subject design with two levels (animate items and inanimate items). Participants were assigned to one of two counterbalanced word lists for the encoding phase, each containing 20 animate words, 20 inanimate words, and 20 ambiguous words (60 words total). Words were presented randomly, with the constraints that the first two items and the last two items in the list were always ambiguous words to serve as a buffer from primacy and recency effects, and that the remaining items were evenly distributed throughout each quarter of the experiment (i.e. of the 60 words presented, each block of 15 words consisted of five of each item type), similar to the method used by Nairne *et al*. (2013). E-prime software was used to present the items to the participant during both the encoding and the recognition phase. Each word was centered on the screen, and each presentation lasted for two seconds with 500ms between each word presentation.

Participants were asked to read and sign the informed consent, and upon doing so, were seated in front of a computer screen and assigned to a counterbalance. Participants were told that they would see a list of words shown one at a time, and would need to read each word out loud and try to remember the items for a later memory test. After the encoding phase, participants were given a filler arithmetic task in which they were asked to complete simple mathematical equations (e.g. 4 + 2), and were told to complete as many of the simple math problems as possible during the two minutes while still maintaining accuracy.

Following the arithmetic task, participants were told that they were going to see a new list of words, and that some of the words might be repeated from the previous list. The word list presented at test contained all 60 items presented during the encoding phase, and an additional 60 words (20 animate, 20 inanimate, and 20 ambiguous) that had not been presented (i.e. the words used during the encoding phase for the alternative counterbalance) for a total of 120 words. For each word, participants were instructed to first indicate whether the word was old or new, and for words they considered old they were asked to decide if their memory of the word was a “Type

A" memory or a "Type B" memory. They were instructed to respond "Type A memory" (typically called a "remember" judgment) if they could recollect some specific aspect of seeing the word on the initial list, and to respond "Type B memory" (typically called a "know" judgment) if they thought they had seen the word before but could not recall any specific details. For each item that a participant deemed a Type A memory, they had to briefly describe the details that made the item a Type A memory to ensure adherence to the instructions. The terms "Type A memory" and "Type B memory" were used by McCabe and Geraci (2009) and were found to reduce confusion over the difference between remember and know judgments. The instructions given to participants to inform them of the definitions of Type A and Type B in the present experiment were the exact instructions used in the second study in McCabe and Geraci (2009) (see Appendix A).

Results and Discussion

Overall corrected recognition was calculated for animate and inanimate items by subtracting the total false alarms from the total correct hits (see Table 2 for all means and standard deviations). A significant difference in overall corrected recognition was found between animate and inanimate items, $F(1, 28) = 8.92$, $p = .006$, MSE = .01, $\eta^2 = .051$, such that animate items were better recognized than inanimate items. Following the findings from Bonin *et al.* (2013) which found that the animacy effect is recognition is in the remember judgments, an ANOVA assessed the interaction between judgment type (remember vs. know) and item type (animate vs. inanimate). The interaction was not significant, $F(1, 28) = 3.12$, $p = .09$, MSE = .008, $\eta^2 = .008$, however Experiment 1 was only intended to replicate the findings of Bonin *et al.* (2013), therefore all other analyses were still conducted.

Corrected remember judgments and corrected know judgments were calculated for both animate items and inanimate items in the same manner as the overall corrected recognition, such that “remember” false alarms were subtracted from the total correct remember judgments for both animate and inanimate items, and the total “know” false alarms were subtracted from the total correct know judgments for both animate and inanimate items. Animacy did have a significant effect on the corrected remember judgments, $F(1, 28) = 15.95$, $p < .001$, $MSE = .004$, $\eta^2 = .042$ such that more remember responses were given for animate items compared to inanimate items. As predicted, animacy did not have a significant effect on the corrected know judgments, $F(1, 28) = .12$, $p = .732$, MSE = .009, $\eta^2 = .001$.

Table 2. Means and Standard Deviations for Corrected Recognition Judgments in Experiment 1

Corrected Recognition Memory: Experiment 1

	Animate		Inanimate	
Recognition Type	Mean	*SD*	Mean	*SD*
Overall Recognition	.55	.14	.48	.19
Remember Judgments	.26	.17	.19	.17
Know Judgments	.30	.14	.29	.18

Bonin *et al.* (2013) and Bugaiska *et al.* (2016) found that animate items produced better overall recognition and more remember judgments in comparison to inanimate items. As predicted, my results follow a similar pattern such that animate items had better overall recognition compared to the inanimate items, and that there was an animacy effect in the remember judgments but not in the know judgments.

Experiment 2

Results from Experiment 1 demonstrate that the animacy effect in recognition does replicate with the current materials, and that animate items produced more remember judgments than did inanimate items. Having replicated the animacy effect, the next step was to examine how dividing attention during encoding would impact the animacy effect. The purpose of Experiment 2 was to examine the effects of divided attention on the animacy effect in a recognition task.

Based on the animate monitoring hypothesis (New *et al.*, 2007), animate items should be better recognized because they are given the attention necessary for proper encoding to take place, even when attention is limited. Therefore, reducing the attention available for studying the word lists through the addition of a divided attention task should result in an attentional prioritization of the animate items. As a result, there should be a minimal impact on the number of correct remember responses for animate items, but a reduction in the number of correct remember responses for inanimate items, thus causing the animacy effect to appear more extreme. I did not expect to find an interaction in the know judgments, as familiarity has been found to be resilient against divided attention manipulations (Craik *et al.*, 1996; Gardiner & Parkin, 1990; Mangels, Picton, & Craik, 2001).

Method

Participants

Participants were 91 undergraduate students at Florida State University. All participants were recruited through an online experiment sign-up system, and granted partial class credit for their participation. Four participants were dropped from the analysis due to failure to follow instructions, leaving a total of 87 participants (23 men and 64 women) aged 18–25 years (*M* =

19.62, *SD* = 1.40) divided between the two conditions (full attention condition n = 45, divided attention condition n = 42). An a priori power analysis conducted using G*Power software had revealed that a sample size of 80 would be required to detect the predicted interaction between word type and attention, based on an effect size of $\eta^2{}_p = .15$ (Bugaiska *et al.*, 2016).

Experiment 3—conducted prior to Experiment 2—failed to find a significant word type by attention interaction. As a result, a Bayesian stopping rule was used in Experiment 2 as an additional stopping measure, such that data collection would stop when the Bayes factor in favor of the null or the hypothesis reached a value greater than ten (Wagenmaker *et al.*, 2015; for detailed explanation see Rouder, 2014), or when more than 80 participants had been collected as determined by the power analysis. The additional Bayesian stopping rule was employed in hopes of streamlining data collection, however the Bayes factor for either the null or the hypothesis never exceeded a value of four, therefore data was collected until the requirements from the power analysis had been satisfied.

Stimuli and Design and Procedure

Experiment 2 featured a two by two mixed design with word type (animate vs inanimate) manipulated within-subjects and attention (full vs. divided) manipulated between subjects. The stimuli and design of Experiment 2 were highly similar to those of Experiment 1 with a few minor adjustments. The encoding phase was counterbalanced and presented participants with the same stimuli used in Experiment 1, however each word was presented for five seconds rather than two seconds to promote proper encoding, as piloted results showed poor recognition with a two second presentation under divided attention conditions. Additionally, half of participants received a divided attention task during encoding, in which participants listened to a recording of a string of digits being read at a rate of one digit every one and a half seconds, and made a response each time they heard two odd digits in a row (e.g. 1, 7). The divided attention task was piloted to ensure that attention was properly divided without causing recognition to reach floor effects (see Sahakyan & Malmberg, 2018). Participants saw the list of studied words once, and then completed a math task identical to that of Experiment 1. At test, participants completed a recognition task identical to that of Experiment 1.

Results and Discussion

Preliminary analyses revealed no significant gender or age effects, thus these factors were not included in future analyses. Pr values were computed to establish a corrected measure of accuracy for each participant and to control for false alarm rates (Snodgrass & Corwin, 1988) (see Table 3 for means and standard deviations for Pr values. See Table 4 for means and standard deviations for hits and false alarms). As in Experiment 1, an ANOVA assessed the interaction between judgment type (remember vs. know) and item type (animate vs. inanimate) within the full attention condition to ascertain that the animacy effect in recognition is driven by the animacy effect in the remember judgments under full attention conditions. The interaction was significant, F(1, 41) = 11.59, p = .001, MSE = .014, η^2 = .018, such that the effect of animacy was greater in the remember judgments than in the know judgements.

Table 3. Means and Standard Deviations for Recognition in Experiment 2 in Terms of Pr Values

Recognition Memory Pr Values: Experiment 2

	Full Attention				Divided Attention			
	Animate		Inanimate		Animate		Inanimate	
Recognition Type	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Overall Recognition	.57	.24	.49	.26	.35	.17	.34	.16
Remember Judgments	.30	.21	.21	.19	.16	.14	.10	.13
Know Judgments	.26	.27	.28	.27	.19	.15	.23	.15

A mixed model ANOVA conducted on the Pr values assessed the main effects and the interaction term for the combined remember and know judgments. A main effect of word type was found, $F(1, 85) = 7.52$, $p = 0.007$, $MSE = 0.013$, $\eta^2 = .01$, such that animate items were better recognized than inanimate items. A main effect of attention was found, $F(1, 85) = 19.03$, $p < 0.001$, $MSE = 0.077$, $\eta^2 = .18$, such that participants in the full attention condition had better recognition than participants in the divided attention condition. The word type by attention interaction term did not reach significance, $F(1, 85) = 3.70$, $p = 0.58$, $MSE = 0.013$, $\eta^2 = .005$, suggesting that attention does not influence the animacy effect.

Table 4. Means and Standard Deviations for Recognition Hits and False Alarms in Experiment 2

Hits and False Alarms: Experiment 2

		Full Attention				Divided Attention			
		Animate		Inanimate		Animate		Inanimate	
Recognition Type		Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Overall Recognition									
	Hits	.72	.16	.68	.17	.51	.16	.54	.21
	FAs	.14	.17	.18	.17	.14	.14	.18	.15
Remember Judgments									
	Hits	.34	.23	.25	.23	.19	.16	.13	.15
	FAs	.02	.03	.03	.06	.02	.05	.02	.04
Know Judgments									
	Hits	.38	.23	.42	.22	.31	.16	.41	.21
	FAs	.12	.16	.15	.15	.12	.12	.16	.14

A mixed model ANOVA was conducted using the Pr values from the remember judgments to assess the main effects and the interaction term. A significant main effect was found for word type, $F(1, 85) = 40.99$, $p < 0.001$, $MSE = 0.006$, $\eta^2 = .043$, such that animate items had more recollection than inanimate items. A significant main effect was found for attention, $F(1, 85) = 13.21$, $p < 0.001$, $MSE = 0.052$, $\eta^2 = .13$, such that participants in the full attention condition experienced more recollection than those in the divided attention condition. The interaction term for word type by attention did not reach significance, $F(1, 85) = 1.89$, $p = 0.17$, $MSE = 0.006$, $\eta^2 = .002$, suggesting that attention is not likely the proximal cause of the animacy effect.

Paired t-tests assessed the effect of animacy within each of the two attention conditions for the remember judgments, and the *p*-values reported here were corrected with a Bonferroni correction. An effect of animacy was found in both the full attention condition, $t(44) = 4.82$, $p < .001$, and the divided attention condition, $t(41) = 4.13$, $p < .001$, such that animate items were remembered better than inanimate items in both conditions.

A final mixed model ANOVA was conducted using Pr values from the know judgments to assess the main effects and the interaction term. No significant main effect was found for word type, $F(1, 85) = 2.99$, $p = 0.087$, $MSE = 0.012$, $\eta^2 = .004$, nor for attention, $F(1, 85) = 1.75$, $p = 0.19$, $MSE = 0.086$, $\eta^2 = .02$. There was no significant word type by attention interaction term, $F(1, 85) = .86$, $p = .357$, $\mathrm{MSE} = .012$, $\eta^2 = .01$. However, following the results from Bonin *et al.* (2013) and Bugaiska *et al.* (2016), I did not expect to find a significant main effect for word type, and following results showing that familiarity is not sensitive to divided attention manipulations (Craik *et al*., 1996; Gardiner & Parkin, 1990; Mangels, Picton, & Craik, 2001), I did not expect to find a significant main effect of attention.

A mixed model Bayesian ANOVA was conducted to further explore the word type by attention interaction term. Bayesian analyses allow for the discovery of evidence in favor of the null hypothesis—something that cannot be otherwise accomplished (Wagenmakers *et al.*, 2017). Know judgments were excluded from this analysis due to prior work showing no animacy effects (Bonin *et al.*, 2013; Bugaiska *et al.*, 2016), meaning that remember judgments were driving any effects. The main effects for both word type and attention were included in the null model leaving only the interaction term in the alternative hypothesis model, thus creating a Bayes term that was specific to the alternative hypothesis that the interaction of word type and attention would be significant above and beyond the main effects of both factors. The Bayes factor favored the null, $B_{01} = 2.04$, meaning that the observed data are 2.04 times more likely to occur under the null hypothesis than under the alternate hypothesis. Although the Bayes Factor does not surpass the critical value of 3 to fully support the null hypothesis (Wetzels *et al*., 2011), it does fail to support the alternative hypothesis, thus failing to support the idea that attention is the proximal cause of the animacy effect.

Table 5. Means and Standard Deviations Br Values in Experiment 2

Recognition Memory Br Values: Experiment 2

	Full Attention				Divided Attention			
	Animate		Inanimate		Animate		Inanimate	
Recognition Type	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
Overall Recognition	.32	.20	.37	.19	.24	.17	.31	.21
Remember Judgments	.07	.07	.08	.12	.06	.07	.05	.07
Know Judgments	.17	.13	.22	.14	.16	.12	.25	.19

Mixed model ANOVAs assessed the effect of item type and attention condition on the Br measure of response bias (see Table 5 for means and standard deviations). The response bias scores did not reach significance for the main effect of attention nor for the interaction term in any of the analyses (see Table 6 for all ANOVA results). There was a main effect of word type in overall recognition, *F*(1, 85) = 10.33, *p* = .002, *MSE* = .013, η^2 = .11, such that participants were more conservative in their recognition judgements for animate items compared to inanimate items. Further analyses revealed no significant main effect for word type in the remember judgements, *F*(1, 85) < 1, η^2 = .004, however a significant main effect of word type was found in the know judgements, *F*(1, 85) = 23.82, *p* < .001, *MSE* = .008, η^2 = .21, such that participants were more conservative in their recognition judgements for animate items compared to inanimate items. In other words, participants required less information to report recognizing inanimate words, resulting in more false alarms, but also resulting in more hits than if they had used a more conservative response criteria for inanimate items.

Table 6. Full Results for the Effect of Word Type, Attention, and the Interaction Term on the Br Values from Experiment 2

Br Values Analyses: Experiment 2

Recognition Type	Variable	*F(1, 85)*	*P*	*MSE*	η^2
Overall Recognition					
	Word Type	10.33	0.002	0.013	0.110
	Attention	2.28	0.14	0.063	0.026
	Interaction	2.12	0.15	0.013	0.022
Remember Judgments					
	Word Type	0.34	0.56	0.002	0.004
	Attention	1.16	0.28	0.013	0.013
	Interaction	1.98	0.16	0.002	0.023
Know Judgments					
	Word Type	23.82	< .001	0.008	0.210
	Attention	0.11	0.74	0.034	0.001
	Interaction	2.48	0.12	0.008	0.022

The results from Experiment 2 failed to find a significant word type by attention interaction term, suggesting that attention might not be the proximal cause of the animacy effect as was predicted. Additionally, a Bayesian analysis found that the present results are 2.04 times more likely if the null hypothesis were true, failing to support the alternative hypothesis that attention interactions with word type. Therefore, Experiment 2 does not support my hypothesis that attention is the cause of the animacy effect in a memory paradigm.

Experiment 3

Experiment 3 aimed to examine the effects of divided attention on the encoding of animate versus inanimate words in a free recall paradigm. Following the animate monitoring hypothesis (New *et al.*, 2007), it is plausible that animate items are better remembered because they are given the attention necessary for proper encoding to take place, even when attention is limited. Therefore, I predicted that although dividing attention reduces the attentional resources available for studying the word lists, animate items should still receive the resources necessary for strong encoding to take place, while the inanimate items should not receive sufficient attentional resources. A lack of attentional resources should reduce the number of correctly recalled inanimate items while having minimal impact on the number of correctly recalled animate items, thus causing the animacy effect to appear more extreme in the divided attention condition and creating a significant interaction between word type and attention.

However, if the null word type by attention interaction term from Experiment 2 is reflective of the true role that attention plays in the animacy effect (i.e. attention is not the proximal cause), then there should also be no significant interaction term in Experiment 3. Instead, divided attention should reduce recall for animate items and inanimate items equally.

Method

Participants

A power analysis conducted using G*Power software revealed that a sample size of 80 would be required to detect the predicted interaction between word type and attention, based on an effect size of $\eta^2{}_p = .15$ (Bugaiska *et al*., 2016). One-hundred and six undergraduate students at Florida State University participated in the study for partial class credit. Six participants were dropped from the analysis due to failure to follow instructions, leaving a total of 100 participants (24 men and 76 women) aged 18–23 years (*M* = 19.53, *SD* = 1.27) divided between the two conditions (full attention condition n=50, divided attention condition n=50).

Stimuli and Design

A two (word type: animate vs. inanimate) by two (attention: divided attention vs. full attention) mixed design was used to examine the interaction between word type and attention, and to identify any main effects. Word type was manipulated within subjects, and attention was manipulated between subjects.

The stimuli used in Experiment 3 were a subset of the animate and inanimate word lists used in Experiments 1 and 2. Ten animate items and ten inanimate items were selected such that they did not differ on any of the dimensions discussed in Experiment 1 (see Table 7 for word list characteristics), and were presented randomly with the constraint that the animate and inanimate words were divided equally across both halves of the presented list. Two ambiguous words were added to both the start of the list and the end of the list to protect against recency and primacy effects and were not included in the analysis.

Table 7. Statistical Characteristics of the Control Variables in Experiment 3 for Animate and Inanimate Stimuli

Word List Control Variables: Experiment 3

	Animate			Inanimate			*t* Test
Variable	Mean	*SD*	Range	Mean	*SD*	Range	
Concreteness	596.2	24.7	564 - 644	603.0	11.0	588 - 617	$t < 1$
Familiarity	530.7	37.2	489 - 597	521.1	37.4	476 - 578	$t < 1$
Imageability	584.7	18.8	557 - 608	585.5	23.6	550 - 617	$t < 1$
KF frequency	34.7	20.9	7 - 62	22.8	16.6	4 - 58	$t = 1.41$, n.s.
Letters	4.6	0.97	3 - 6	4.5	0.53	4 - 5	$t < 1$

Half of the participants in Experiment 3 were asked to simultaneously perform a divided attention task during encoding identical to that of Experiment 2. The filler math task given between encoding and test was identical to that used in Experiments 1 and 2, except the task duration was one minute rather than two minutes.

Procedure

Participants were asked to read and sign the informed consent and were then assigned to either the full attention condition or the divided attention condition. Encoding instructions for both conditions were the same, with participants in the divided attention condition also receiving the instructions for the divided attention task.

During encoding, participants saw all 20 words, plus the ambiguous buffer words, for five seconds each with a 500ms buffer between words. The word list was presented a total of three times, with each list presentation having a random word order. A math task identical to that used in Experiment 1 was conducted for one minute after each presentation. For participants in the divided attention condition, a new digit list recording was played for each word list presentation, and the three recordings were randomly ordered for each participant. Presenting the word list three times was done to avoid floor effects and followed the method used by Nairne *et al.* (2013).

At test, participants were asked to freely recall as many words as possible from the list they had studied. The test was self-paced, and all responses were entered by the experimenter to minimize errors.

Results and Discussion

Preliminary analyses showed no effect for either gender or age, thus these factors were not included in later analyses. A mixed model ANOVA assessed the effects of word type (animate vs. inanimate) and attention (full attention vs. divided attention) on word recall (see Table 8 for means and standard deviations). A significant main effect was found for word type, $F(1, 98) = 43.02$, $p < .001$, $MSE = 1.59$, $\eta^2 = .30$, such that animate items were recalled more frequently than inanimate items. A significant main effect was also found for attention, $F(1, 98) = 108.20$, $p < .001$, $MSE = 5.25$, $\eta^2 = .53$, such that participants in the full attention condition had better recall performance than did participants in the divided attention condition. The interaction term for word type and attention was not significant, $F(1, 98) < 1$, $\eta^2 = .005$.

Table 8. Means and Standard Deviations for Free Recall in Experiment 3.

Free Recall Memory: Experiment 3

	Full Attention		Divided Attention	
Word Type	Mean	*SD*	Mean	*SD*
Animate	.62	.24	.27	.11
Inanimate	.49	.23	.17	.12

Paired t-tests assessed the effect of animacy within each of the two attention conditions, and the *p*-values reported here were corrected with a Bonferroni correction. An effect of animacy was found in both the full attention condition, $t(49) = 4.66$, $p < .001$, and the divided attention condition, $t(49) = 4.71$, $p < .001$, such that animate items were remembered better than inanimate items in both conditions.

A mixed model Bayesian ANOVA was conducted to further explore the word type by attention interaction term. The main effects for both word type and attention were included in the null model leaving only the interaction term in the alternative hypothesis model, thus creating a Bayes term that was specific to the alternative hypothesis that the interaction of word type and attention would be significant above and beyond the main effects of both factors. The Bayes factor favored the null, $B_{01} = 3.45$, meaning that the observed data are 3.45 times more likely to occur under the null hypothesis than under the alternate hypothesis. By surpassing the critical value of 3 (Wetzels *et al.*, 2011), the Bayesian analysis does support the idea that attention is not the proximal cause of the animacy effect.

Following the animate monitoring hypothesis which suggests that the animacy effect stems from a prioritization of animate stimuli when allocating attentional resources (New *et al.*, 2007), the prediction for Experiment 3 was that the animacy effect would widen under divided attention conditions. However, the data from Experiment 3 instead suggest that dividing attention has no impact on the animacy effect as is evident by the lack of a significant word type by attention interaction term. One possible explanation for the lack of a significant interaction term might be that the divided attention measures were either not severe enough to produce the desired effect, or that they were too severe and knocked out any interaction effects. The fact that there was a significant main effect for attention suggests that the attention manipulation was severe enough to produce an effect, and the fact that the animacy effect remained constant under divided attention conditions and that memory did not reach floor suggests that the attention manipulation was not too severe to knock out any interaction effects. As a whole, the data from Experiment 3 support the findings from Experiment 2 and suggest that attention is not likely to be the cause of the animacy effect.

CHAPTER 3

GENERAL DISCUSSION

The present set of experiments set out to establish two main findings—first, that the animacy effect found by Bonin *et al.* (2013) in recognition would replicate with English materials, and second, that attention was the proximal cause of the animacy effect. The results from Experiment 1 demonstrated that the animacy effect was seen with the present set of stimuli, such that animate items had better recollection than inanimate items. The results from Experiments 2 and 3 confirmed these findings, as animate items were more often recollected in both the full attention condition and the divided attention condition in Experiment 2, and were better recalled in both the full attention condition and the divided attention condition in Experiment 3.

Though these three studies firmly support a successful replication of the animacy effect, they do not support attention as the proximal cause of the animacy effect. Experiments 2 and 3 both found main effects for word type and attention, such that animate items were better remembered under both full attention and divided conditions, and that divided attention resulted in worse test performance for animate and inanimate items, but both experiments failed to find a significant interaction between word type and attention. Furthermore, the Bayesian analyses from Experiments 2 and 3 failed to support the alternative hypothesis, showing that the present results were respectively 2.04 and 3.45 times more likely under the null hypothesis than under the alternative hypothesis. The Bayes factor from Experiment 3 can be interpreted as evidence in favor of the null hypothesis as it surpasses the critical value of 3 (Wetzels *et al.*, 2011), meaning that the Bayes factor from Experiment 3 supports the null hypothesis that attention does not interact with the animacy effect.

One possible explanation for a lack of a significant interaction term is that the divided attention manipulation was either not severe enough to influence the results in a meaningful way, or that the divided attention manipulation was too severe and wiped out any sensitive effects that could have been found with a less severe manipulation. However, in light of the present results either of these explanations is unlikely. The divided attention task used in these studies was carefully piloted to find a task and a digit presentation speed that did not overly tax participants, but still affected their memories, and results support that the divided attention task did exactly that. Both Experiments 2 and 3 found a significant effect for attention, meaning that attention was divided enough to successfully hinder participant's memories for the studied materials. The results from Experiments 2 and 3 also found a significant effect of word type within each of the attention conditions, meaning that even with divided attention participants still exhibited a significant effect of animacy where animate items were better recalled and better recollected than inanimate items. Taken together, the data from Experiments 2 and 3 do not support the notion that a floor or ceiling effect of the divided attention task is to blame for the lack of a significant interaction.

Though I hypothesized that modulating attention should lead to a larger animacy effect because the animate items should be prioritized over the inanimate items during encoding, meaning that the animate items should still receive sufficient attention for encoding to take place when attention is limited, one could argue that the opposite would be true due to the animacy effect being the result of a controlled process. Findings from Boot, Brockmole, and Simons (2005) and from Matsukura, Brockmole, Boot, and Henderson (2011) demonstrated that increasing cognitive load with an auditory divided attention task modulated oculomotor capture for controlled processes, which led to the elimination of effects that were being driven by controlled processes, such as the typical attention capture produced by a sudden onset. Effects found in recollection, thought to be the result of controlled processes, could be wiped out by divided attention as well. Findings from Experiment 2 support the idea that the animacy effect in recognition is driven by differences in the remember judgments, which are a measure of recollection. Logically, it follows that the animacy effect, the result of a controlled process, could be modulated by an auditory divided attention task as was used in the present studies, thus leading to a reduced animacy effect rather than an increased animacy effect. However, this was not the case, and instead the present studies show that dividing attention had no effect on the size of the animacy effect.

Attention has not proven to be the proximal cause of the animacy effect, leaving the true proximal cause as a continuing mystery. In creating the present set of word stimuli, care was taken to ensure that word frequency was equated between animate and inanimate word lists such that none of the word lists differed significantly on that characteristic. However, context variability, or the measure of different contexts in which a given word arises, was not considered. Given that the effect of context variability on memory does differ from the effects of word frequency (i.e. low context variability words are better recalled than high context variability words, but high frequency words are better remembered than low frequency words) (Hicks, Marsh, & Cook, 2005, Marsh *et al.*, 2006), it is possible that a difference in context variability stands behind the animacy effect.

To investigate the possible role of context variability in the animacy effect in these experiments post hoc, context variability scores for each word were taken from the Touchstone Applied Science Associates (TASA) corpus, which contains 10,710,325 words and 37,652 text samples. Averages were computed for the animate word set and the inanimate word sets used in both the recognition task in Experiments 1 and 2, and the free recall task in Experiment 3, and t-test comparisons assessed the differences in context variability between each of the animate-inanimate list sets (see Table 9 for means and standard deviations). There was no significant difference in context variability between the animate word list and the inanimate word lists from the recognition task in Experiments 1 and 2 for the first counterbalance, $t(34.93) < 1$, or the second counterbalance, $t(35.88) = 1.45$, $p = 0.16$, nor was there a difference between the animate and inanimate lists used in the free recall task in Experiment 3, $t(17.82) < 1$. The lack of an underlying difference in context variability among the word list sets suggests that context variability was not likely the driving the animacy effect, as it was not a confound in the present set of experiments.

Table 9. Means and Standard Deviations for Context Variability in All Word Sets

Context Variability: Experiments 1, 2 and 3

	Animate		Inanimate	
Word List Set	Mean	*SD*	Mean	*SD*
Experiments 1 and 2 First Counterbalance	325.10	259.24	358.00	351.93
Experiments 1 and 2 Second Counterbalance	535.25	488.92	331.32	387.36
Experiment 3 Free Recall	349.90	255.60	274.80	283.10

Interestingly Experiment 3 found that participants were more conservative with their criteria for recognition of animate items, and more liberal with their criteria for recognition of inanimate items, specifically within the know judgements. That is, participants required more certainty to say that an animate item felt familiar, and they required less certainty to say that an inanimate item felt familiar. In a change detection paradigm involving animate and inanimate stimuli, Altman, Khislavsky, Coverdale, and Gilger (2016) found an opposite pattern, such that participants were more liberal (i.e. required less certainty) to say an animate item in a scene had changed, and were more conservative (i.e. required more certainty) to say an inanimate item in a scene had changed. Altman *et al*. frame their results in terms of the Error Management Theory (Haselton & Buss, 2000), which suggests that all decision-making scenarios have a chance for error, and evolutionary factors have resulted in humans adopting decision-making strategies that are biased towards making the least costly errors. For example, within the context of animate stimuli, failing to notice a hostile predator is more costly than being ready to defend oneself against a predator that is not actually there, as failing to see a predator might result in death.

Though my findings stand in contrast to the findings from Altman *et al.* (2016), it is possible that differences in distinctiveness between animate and inanimate items might be driving the differences in response bias. While it is thought that remember judgements reflect the participant's ability to use a "recall-to-accept" strategy (i.e. participants can say they studied an item because they can recall specific details of doing so), it is also possible that participants are able to use a "recall-to-reject" strategy that would allow them to imagine the thoughts they might have had if they had in fact studied the item before. (i.e. participants can say they did not study an item because if they had, they would have thought about a specific detail). However, if inanimate items are less distinctive participants may not be able to accurately discriminate between items, causing inanimate items to feel more vaguely familiar, resulting in a liberal response bias. A future study may wish to examine differences in distinctiveness between animate and inanimate items, as these differences may tell us more about the proximal cause of the animacy effect.

Taken together, the results from the present experiments do not support the idea that attention is the driving force behind the animacy effect as theorized based on the animate monitoring hypothesis (New *et al.*, 2007). Instead, given the Bayesian analysis in Experiment 3 these studies provide evidence favoring the null hypothesis that attention does not play a significant role in the animacy effect. Understanding the animacy effect is important in furthering the understanding of how humanity’s evolutionary past influences our present lives, so future studies may wish to investigate other potential causes of the animacy effect, or investigate the role of attention via an alternative form of manipulation.

APPENDIX A

IRB APPROVAL

Office of the Vice President for Research

Human Subjects Committee

Tallahassee, Florida 32306-2742

(850) 644-8673 · FAX (850) 644-4392

APPROVAL MEMORANDUM

Date: 07/13/2019

To: Heather Rawlinson

Address: 4301

Dept.: PSYCHOLOGY DEPARTMENT

From: Thomas L. Jacobson, Chair

Re: Use of Human Subjects in Research

The Effect of Animacy on Memory

The application that you submitted to this office in regard to the use of human subjects in the proposal referenced above have been reviewed by the Secretary, the Chair, and two members of the Human Subjects Committee. Your project is determined to be Expedited per 45 CFR § 46.110(7) and has been approved by an expedited review process.

The Human Subjects Committee has not evaluated your proposal for scientific merit, except to weigh the risk to the human participants and the aspects of the proposal related to potential risk and benefit. This approval does not replace any departmental or other approvals, which may be required.

If you submitted a proposed consent form with your application, the approved stamped consent form is attached to this approval notice. Only the stamped version of the consent form may be used in recruiting research subjects.

If the project has not been completed by 09/11/2019 you must request a renewal of approval for continuation of the project. As a courtesy, a renewal notice will be sent to you prior to your expiration date; however, it is your responsibility as the Principal Investigator to timely request renewal of your approval from the Committee.

You are advised that any change in protocol for this project must be reviewed and approved by the Committee prior to implementation of the proposed change in the protocol. A protocol change/amendment form is required to be submitted for approval by the Committee. In addition, federal regulations require that the Principal Investigator promptly report, in writing any unanticipated problems or adverse events involving risks to research subjects or others.

By copy of this memorandum, the chairman of your department and/or your major professor is reminded that he/she is responsible for being informed concerning research projects involving human subjects in the department, and should review protocols as often as needed to insure that the project is being conducted in compliance with our institution and with DHHS regulations.

This institution has an Assurance on file with the Office for Human Research Protection. The Assurance Number is IRB00000446.

Cc: Colleen Kelley, Advisor

HSC No. 2018.25672

APPENDIX B

INFORMED CONSENT FORM

You are invited to be in a research study to understand how different factors influence memory. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

The study is being conducted by Heather Rawlinson, a graduate student in the Department of Psychology, and Dr. Colleen Kelley of the Department of Psychology at Florida State University.

Background Information:

The purpose of this study is to understand how different items contribute to memory.

Procedures:

If you decide to be in the study, you will view a set of words on the computer and will be asked to memorize them. At the same time, you will be asked to perform a simple task of monitoring a set of digits for a certain pattern. You will be asked later if you remember the words you saw. The experiment will take about 35 to 45 minutes to complete.

Risks and benefits of being in the Study:

The study has few risks beyond those of normal everyday life using computers, paying attention, and memorizing. There is a possibility that you may experience some mild frustration if you are unable to perform a task as well as you want. Please simply complete the tasks to the best of your ability.

There are no direct benefits to you by participating in this study. However, your participation will serve to enhance our understanding of the mechanisms of learning and memory.

Confidentiality:

The records of this study will be kept private and confidential to the extent permitted by law. Your responses will be given an ID number so that your name will not be linked to your responses. In any sort of report we might publish, we will not include any information that will make it possible to identify a participant. Research records will be stored securely and only researchers will have access to the records. All records of your participation will remain in locked file cabinets within this lab, and there will be no link between your name and your data.

Compensation:

Research Participation Credit: Upon completion of the study, you will be awarded credit at the rate of ½ credit for an experiment under 35 minutes, and one credit for an experiment that lasts from 35 minutes to 60 minutes. This will be credit for your research participation requirement for Introduction to Psychology class or extra-credit for your advanced psychology class. If you are uncomfortable performing any of the tasks and decide to withdraw from the study, you will not be penalized. If you decide to withdraw from the study, you will be compensated for the time of your participation in increments of ½ credit for 30 minutes of participation.

Voluntary Nature of the Study:

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Florida State University. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:

The researchers conducting this study are Heather Rawlinson and Dr. Colleen Kelley. You may ask any questions of the experimenter you have now. If you have a question later, you are encouraged to contact Heather Rawlinson at ***-***-***, or *********@***.***.***.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, you are encouraged to contact the FSU IRB at 2010 Levy Street, Research Building B, Suite 276, Tallahassee, FL 32306-2742, or 8506448633, or by email to humansubjects@fsu.edu. You will be given a copy of this information to keep for your records.

Statement of Consent:

I have read the above information. I have asked questions and have received answers. I consent to participate in the study. By participating, I attest to being 18 years of age or older.

______________________________________ ________________

Signature Date

____

Print Name

FSU Human Subjects Committee approved on 09/12/2018, void after 09/11/2019. HSC #2018.25672

APPENDIX C

INSTRUCTIONS FOR THE REMEMBER-KNOW PARADIGM

Type A response—When you see a word on the test, it may bring to mind the exact thought you had from when you first studied the word at the start of the experiment. If you can recall the exact thought you had from when you studied the word earlier, it is a Type A response. Often when people give a Type A response it is because they can recall a personal association that came to mind when they first saw the word, or some other details about when they studied the word. For example, imagine you had studied the word BOOK earlier in the experiment. Imagine also that when you studied the word BOOK that you thought of the title of a book you have recently been reading. If you then saw the word BOOK on the test, and you recalled that when you were studying it you had thought about the title of the book you have been reading, then you would give a Type A response for the word BOOK. There are other details you may recall about studying a word that would lead you to give a Type A response, such as a feeling you had when you saw the word, or a mental image that came to mind while you were studying the word. You may also be able to recall that you associated the word with another word that you studied, or you may recall what the word looked like on the screen. If you can be sure you studied the word because you can recollect specific details about when you studied it, say it is a Type A response. If you decide it is a Type A response, you must give the details of your memory.

Type B response—If you see a word on the test and you believe it was presented but you cannot recall any specific association that you made when you studied it, say it is a Type B response. In other words, a Type B response means you ‘‘just know” you studied the word, even though you cannot recall any details from when you studied it.

REFERENCES

Altman, M. N., Khislavsky, A. L., Coverdale, M. E., & Gilger, J. W. (2016). Adaptive attention: How preference for animacy impacts change detection. *Evolution and Human Behavior,37*(4), 303-314. doi:10.1016/j.evolhumbehav.2016.01.006

Baddeley, A., Lewis, V., Eldridge, M., & Thomson, N. (1984). Attention and retrieval from long-term memory. *Journal of Experimental Psychology: General,113*(4), 518-540. doi:10.1037/0096-3445.113.4.518

Bonin, P., Gelin, M., & Bugaiska, A. (2013). Animates are better remembered than inanimates: Further evidence from word and picture stimuli. *Memory & Cognition,42*(3), 370-382. doi:10.3758/s13421-013-0368-8

Boot, W. R., Brockmole, J. R., & Simons, D. J. (2005). Attention capture is modulated in dual task situations. *Psychonomic Bulletin & Review,12*(4), 662-668. doi:10.3758/bf03196755

Bugaiska, A., Méot, A., & Bonin, P. (2016). Do Healthy Elders, Like Young Adults, Remember Animates Better Than Inanimates? An Adaptive View. *Experimental Aging Research,42*(5), 447-459. doi:10.1080/0361073x.2016.1224631

Calvillo, D. P., & Jackson, R. E. (2013). Animacy, perceptual load, and inattentional blindness. *Psychonomic Bulletin & Review,21*(3), 670-675. doi:10.3758/s13423-013-0543-8

Chapman, H. A., Johannes, K., Poppenk, J. L., Moscovitch, M., & Anderson, A. K. (2013). Evidence for the differential salience of disgust and fear in episodic memory. *Journal of Experimental Psychology: General,142*(4), 1100-1112. doi:10.1037/a0030503

Charash, M., & Mckay, D. (2002). Attention bias for disgust. *Journal of Anxiety Disorders,16*(5), 529-541. doi:10.1016/s0887-6185(02)00171-8

Craik, F. I., Govoni, R., Naveh-Benjamin, M., & Anderson, N. D. (1996). The effects of divided attention on encoding and retrieval processes in human memory. *Journal of Experimental Psychology: General,125*(2), 159-80. doi:10.1037//0096-3445.125.2.159

Craik, F. I., & Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology: General, 104*(3), 268-294. doi:10.1037//0096-3445.104.3.268

Croucher, C. J., Calder, A. J., Ramponi, C., Barnard, P. J., & Murphy, F. C. (2011). Disgust Enhances the Recollection of Negative Emotional Images. *PLoS ONE,6*(11). doi:10.1371/journal.pone.0026571

Fernandes, N. L., Pandeirada, J. N., Soares, S. C., & Nairne, J. S. (2017). Adaptive memory: The mnemonic value of contamination. Evolution and Human Behavior, 38(4), 451-460. doi:10.1016/j.evolhumbehav.2017.04.003

Fisk, A. D., & Schneider, W. (1984). Memory as a function of attention, level of processing, and automatization. *Journal of Experimental Psychology: Learning, Memory, and Cognition,10*(2), 181-197. doi:10.1037/0278-7393.10.2.181

Gardiner, J. M., & Parkin, A. J. (1990). Attention and recollective experience in recognition memory. *Memory & Cognition,18*(6), 579-583. doi:10.3758/bf03197100

Gelin, M., Bugaiska, A., Méot, A., Vinter, A., & Bonin, P. (2018). Animacy effects in episodic memory: Do imagery processes really play a role? *Memory,*1-15. doi:10.1080/09658211.2018.1498108

Godden, D. R., & Baddeley, A. D. (1975). Context-Dependent Memory In Two Natural Environments: On Land And Underwater. *British Journal of Psychology,66*(3), 325-331. doi:10.1111/j.2044-8295.1975.tb01468.x

Guerrero, G., & Calvillo, D. P. (2016). Animacy increases second target reporting in a rapid serial visual presentation task. *Psychonomic Bulletin & Review,23*(6), 1832-1838. doi:10.3758/s13423-016-1040-7

Haselton, M. G., & Buss, D. M. (2000). Error management theory: A new perspective on biases in cross-sex mind reading. *Journal of Personality and Social Psychology,78*(1), 81-91. doi:10.1037//0022-3514.78.1.81

Hicks, J. L., Marsh, R. L., & Cook, G. I. (2005). An observation on the role of context variability in free recall. Journal of Experimental Psychology: Learning, Memory, and Cognition, 31(5), 1160.

Jacoby, L. L., Shimizu, Y., Daniels, K. A., & Rhodes, M. G. (2005). Modes of cognitive control in recognition and source memory: Depth of retrieval. *Psychonomic Bulletin & Review,12*(5), 852-857. doi:10.3758/bf03196776

Jennings, J. M., & Jacoby, L. L. (1993). Automatic versus intentional uses of memory: Aging, attention, and control. *Psychology and Aging,8*(2), 283-293. doi:10.1037/0882-7974.8.2.283

Kensinger, E. A. (2007). Negative Emotion Enhances Memory Accuracy. *Current Directions in Psychological Science, 16*(4), 213-218. doi:10.1111/j.1467-8721.2007.00506.x

Mangels, J. A., Picton, T. W., & Craik, F. I. (2001). Attention and successful episodic encoding: An event-related potential study. *Cognitive Brain Research,11*(1), 77-95. doi:10.1016/s0926-6410(00)00066-5

Marsh, R. L., Meeks, J. T., Hicks, J. L., Cook, G. I., & Clark-Foos, A. (2006). Concreteness and item-to-list context associations in the free recall of items differing in context variability. Journal of Experimental Psychology: Learning, Memory, and Cognition, 32(6), 1424.

Matsukura, M., Brockmole, J. R., Boot, W. R., & Henderson, J. M. (2011). Oculomotor capture during real-world scene viewing depends on cognitive load. *Vision Research,51*(6), 546-552. doi:10.1016/j.visres.2011.01.014

Mccabe, D. P., & Geraci, L. D. (2009). The influence of instructions and terminology on the accuracy of remember–know judgments. *Consciousness and Cognition,18*(2), 401-413. doi:10.1016/j.concog.2009.02.010

Nairne, J. S., Thompson, S. R., & Pandeirada, J. N. (2007). Adaptive memory: Survival processing enhances retention. *Journal of Experimental Psychology: Learning, Memory, and Cognition,33*(2), 263-273. doi:10.1037/0278-7393.33.2.263

Nairne, J. S., & Pandeirada, J. N. (2008). Adaptive Memory: Is Survival Processing Special? PsycEXTRA Dataset, 59, 377-385. doi:10.1037/e527342012-271

Nairne, J. S., Pandeirada, J. N., Gregory, K. J., & Arsdall, J. E. (2009). Adaptive Memory Fitness relevance and the hunter-gatherer mind. *Psychological Science,20*(6), 740-746. doi:10.1111/j.1467-9280.2009.02356.x

Nairne, J. S., Vanarsdall, J. E., Pandeirada, J. N., Cogdill, M., & Lebreton, J. M. (2013). Adaptive Memory. *Psychological Science,24*(10), 2099-2105. doi:10.1177/0956797613480803

New, J., Cosmides, L., & Tooby, J. (2007). Category-specific attention for animals reflects ancestral priorities, not expertise. *Proceedings of the National Academy of Sciences,104*(42), 16598-16603. doi:10.1073/pnas.0703913104

New, J., Krasnow, M. M., Truxaw, D., & Gaulin, S. J. (2007). Spatial adaptations for plant foraging: Women excel and calories count. *Proceedings of the Royal Society B: Biological Sciences,274*(1626), 2679-2684. doi:10.1098/rspb.2007.0826

Pandeirada, J. N. S., Fernandes, N. L., Nairne, J., Marinho, P., & Vasconcelos, M. (2015, November). Better recognition memory for faces when looking for a long-term partner. Poster presented at the 56th Annual Meeting of the Psychonomic Society Chicago Illinois, USA.

Rouder, J. N. (2014). Optional stopping: No problem for Bayesians. *Psychonomic Bulletin & Review,21*(2), 301-308. doi:10.3758/s13423-014-0595-4

Sahakyan, L., & Malmberg, K. J. (2018). Divided attention during encoding causes separate memory traces to be encoded for repeated events. *Journal of Memory and Language,101*, 153-161. doi:10.1016/j.jml.2018.04.004

Sandry, J., Trafimow, D., Marks, M. J., & Rice, S. (2013). Adaptive Memory: Evaluating Alternative Forms of Fitness-Relevant Processing in the Survival Processing Paradigm. *PLoS ONE,8*(4), 1-12. doi:10.1371/journal.pone.0060868

Snodgrass, J. G., & Corwin, J. (1988). Pragmatics of measuring recognition memory: Applications to dementia and amnesia. *Journal of Experimental Psychology: General,117*(1), 34-50. doi:10.1037//0096-3445.117.1.34

Vanarsdall, J. E., Nairne, J. S., Pandeirada, J. N., & Cogdill, M. (2014). Adaptive memory: Animacy effects persist in paired-associate learning. *Memory,23*(5), 657-663. doi:10.1080/09658211.2014.916304

Vanarsdall, J. E., Nairne, J. S., Pandeirada, J. N., & Cogdill, M. (2017). A categorical recall strategy does not explain animacy effects in episodic memory. *Quarterly Journal of Experimental Psychology,70*(4), 761-771. doi:10.1080/17470218.2016.1159707

Wagenmakers, E., Beek, T. F., Rotteveel, M., Gierholz, A., Matzke, D., Steingroever, H., . . . Pinto, Y. (2015). Turning the hands of time again: A purely confirmatory replication study and a Bayesian analysis. *Frontiers in Psychology,6*. doi:10.3389/fpsyg.2015.00494

Wagenmakers, E., Marsman, M., Jamil, T., Ly, A., Verhagen, J., Love, J., . . . Morey, R. D. (2017). Bayesian inference for psychology. Part I: Theoretical advantages and practical ramifications. *Psychonomic Bulletin & Review,25*(1), 35-57. doi:10.3758/s13423-017-1343-3

Weinstein, Y., Bugg, J. M., & Roediger, H. L. (2008). Can the survival recall advantage be explained by basic memory processes? *Memory & Cognition,36*(5), 913-919. doi:10.3758/mc.36.5.913

Wetzels, R., Matzke, D., Lee, M. D., Rouder, J. N., Iverson, G. J., & Wagenmakers, E. (2011). Statistical Evidence in Experimental Psychology. *Perspectives on Psychological Science,6*(3), 291-298. doi:10.1177/1745691611406923

Yonelinas, A. P. (2002). The Nature of Recollection and Familiarity: A Review of 30 Years of Research. *Journal of Memory and Language,46*(3), 441-517. doi:10.1006/jmla.2002.2864

BIOGRAPHICAL SKETCH

HEATHER RAWLINSON

EDUCATION

Florida State University **In Progress**
Doctor of Philosophy (Ph.D.), Cognitive Psychology
Major Professor: Colleen M. Kelley, Ph.D.

Florida State University **Aug 2017 – July 2019**
Master of Science (M.S.), Cognitive Psychology
Major Professor: Colleen M. Kelley, Ph.D.

Heidelberg University **Aug 2014- May 2017**
Bachelor of Science (B.S.), *summa cum laude*, Honors Program
Psychology major with a Spanish minor
GPA: 3.97
Advisor: Neil Sass, M.S.

AWARDS AND MEMBERSHIPS

AWARDS

Psi Chi Outstanding Senior Award	**2017**
Russell and Eugenia Morcom Excellence Award	**2019**

MEMBERSHIPS

Psi Chi International Honors Society in Psychology	**2016-Present**

RESEARCH EXPERIENCE

Graduate Researcher **Aug 2017-Present**
Department of Psychology, Florida State University
Advisor: Colleen M. Kelley, Ph.D.

- Manage data collection and participant signups.
- Develop methods to test the effects that reminding can have on learning.
- Use programs such as E-Prime, Excel, SPSS, and R to execute experiments and analyze data.

TEACHING EXPERIENCE

Department of Psychology, Florida State University

Instructor, Cognitive Psychology Laboratory (EXP3604C) (50 students) **Aug 2018-Aug 2019**

- Used interactive online tools to promote understanding of difficult class topics.
- Prepared lectures and class activities for 20-25 sophomore, junior, and senior level undergraduates.
- Graded weekly assignments to assess learning progress.

LEADERSHIP

Graduate Student Supervisor, Kelley lab **Aug 2017-Present**

- Coordinate and run meetings with students.
- Train students to run experiments and code data using Excel and SPSS programs.
- Help mentor students to ensure their engagement and professional development.

Lab Coordinator, Kelley lab **Jan 2019-Present**

- Interview students for lab assistants and make enrollment decisions.
- Coordinate student schedules and manage lab space.

PRESENTATIONS

Rawlinson, H.C. & Gregg, V. (presented April 2017). *The Relationship Between Sexual Education and Sexual Activity in Adolescents and Young Adults*. Poster Presentation at the Midwestern Psychological Association's 89th conference, Chicago, IL.

Rawlinson, H.C. & Kelley, C.M. (presented April 2019). *Haven't I Heard This Before? The Effect of Spontaneous Reminding on Recall of Sound and Picture Pairs*. Poster Presentation at Graduate Research Day, Florida State University.