

## **Survival Processing: Its potential role as a learning strategy**

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### **Abstract**

Evolutionary psychologists have proposed that our memory is an adaptable product of natural selection which has evolved to strengthen our needs to reproduce and survive. Our memory systems can be especially prone to survival and reproductive relevant encoding, hence we retain information better when it is encoded under survival conditions. This notion was explored in two experiments which compared the efficiency of four different encoding strategies for vocabulary-based learning using paired associate recall. 295 participants who were undergraduate students at Florida International University were examined. I was interested in a method known as survival processing- a process in which the learner recollects words relevant to an imaginary scenario of personal survival. I compared this new method to conventional encoding techniques. Participants were shown a list of particular words of English-Swahili translations on a PowerPoint view board and were instructed to rate the relevance of each word-pair pertaining to a specific retention strategy. After a retention interval, the participants were given a recall test for each word-pair they previously rated. The results indicated that survival processing was the most effective strategy to use for survival-relevant vocabulary; however, the visual imagery technique was advantageous for overall paired associate recall. Consequently, the research proposes revised teaching and learning strategies for vocabulary based word recall, specifically in foreign language courses in which vocabulary retention is constantly tested.

**Keywords: Evolution, Memory, Survival**

### **1. Introduction**

Recent memory research supports the notion that improved recall occurs when the learning is relevant to survival in ancestral environments. This evolutionary perspective known as "survival processing" derives from the research of James Nairne and colleagues<sup>1</sup>. Nairne suggested that our memory is a function of processing that was shaped by evolution; therefore processing that matches ancestral processing will allow for a good memory. For example, an early *Homo Sapien* being chased by a wolf would find great fitness value in remembering the location of a cave. Survival processing examines this theory by the participant imagining they are in a survival scenario while learning new information. I am extending Nairne's concept of adaptive memory by measuring survival processing strictly with retaining content that is relevant to survival. In addition to natural survival scenarios, this study will investigate survival processing under contemporary survival environments, such as being abandoned in a destroyed city. Survival processing will be compared to other well known encoding techniques and will collect data which demonstrates an advantageous encoding strategy for paired associate vocabulary.

Nairne, Pandeirada, and Thompson<sup>2</sup> tested 300 students on survival processing. The participants were given a list of words to learn. Nairne et al. later gave them a free recall test. The results indicated a substantial proportion of 57% correct recall in survival processing compared to the other 6 encoding categories, all of which were below 50%. A follow-up experiment had a similar outcome. Nairne et al. concluded that the study showed the significance of a survival scenario produced substantial retention compared to non-survival-relevant control. Similarly, my experiment will concentrate on analyzing survival processing to vocabulary retention, but specially for participant-specified survival relevant words. The purpose of my current study is to understand how our memory processes are affected by words with survival related contexts. So far, it is not clear how survival processing may work in accordance to survival relevant words while being compared to other words which favor stimulation enhancement for self referencing and keyword techniques. I will hypothesize that because of the

evolutionary implications of survival processing as a product of adaptive memory<sup>3</sup>, the experiments will show improved participant recall scores under survival processing with survival relevant word-pairs related to other conditions. In confirming so, this research may allow us to revise better recall teaching strategies for teachers and learning techniques for students, specifically in foreign language courses in which vocabulary retention is constantly required.

## 2. Experiment 1

### 2.1. participants and design

A total of 138 students participated in the first experiment. All participants signed informed consent. The source of the participants was students in general Psychology classes who were given extra credit for volunteering in the study. The participants were at least 18 years old and consisted of both men and women of various ethnicity. Common variations in demographics were irrelevant, but two requirements to participate in the study were the participant's ability to speak English fluently, and their lack of knowledge of the Swahili language vocabulary. The study was approved by the FIU IRB.

A total of 20 Swahili words paired with their English translation were shown on PowerPoint slides from a screen in the middle of a class auditorium. The auditorium environment was chosen to test more participants simultaneously. It also had a large PowerPoint screen; thus, all subjects had no problems viewing the words and instructions displayed. The Swahili words used for the experiments were chosen on their similar frequencies in percentage of recall difficulty, noun structure, and word likeness rating<sup>4</sup>. In addition, Swahili is not a language typically studied in Western culture.

### 2.2. procedure

After arriving in the auditorium and signing consent, participants each given a five-page package consisting of a demographics form (page 1), word relevance instructions (page 2), a word rating sheet (page 3), a retention interval test consisting of simple math problems (page 4), and a recall test (page 5). There were three different conditions of instructions randomly given to each subject depending on the experimental condition<sup>5</sup>:

#### 2.2.1. *word pleasantness*

"I am going to show you a list of word pairs on a PowerPoint slide show. Each slide will display a single word in Swahili on the left side, and its English translation on the right side, for 5 seconds. Your task is to rate the pleasantness of each word (on a scale of 1 to 5; 1 being very unpleasant and 5 being very pleasant) Some of the words on these slides may sound or look pleasant to you while some words may not- it is up to you to decide."

#### 2.2.2. *survival grassland setting*

"Imagine as best as possible that you are stranded in foreign grassland, such as the plains of Africa. You are the only one in this environment and you have no survival materials. Over the course of a few months, you will need to find steady supplies of food and water and protect yourself from predators. We are going to show you a list of word pairs on a PowerPoint slide show. Each slide will display a single word in Swahili on the left side, and its English translation on the right side, for 5 seconds. Your task is to rate how relevant each of these words would be for you in this survival situation (on a scale from 1 to 5; 1 being barely relevant and 5 being highly relevant). Some of the words on these slides may be relevant and some may not- it is up to you to decide."

#### 2.2.3 *Survival city setting.*

"Imagine as best as possible that you are stranded in a foreign city. You are the only one in this environment and you have no survival materials. Over the course of a few months, you will need to find steady supplies of food and water and protect yourself from attackers. We are going to show you a list of word pairs on a PowerPoint slide show. Each slide will display a single word in Swahili on the left side, and its English translation on the right side, for 5 seconds. Your task is to rate how relevant each of these words would be for you in this survival situation (on a

scale of 1 to 5; 1 being barely relevant and 5 being highly relevant). Some of the words on these slides may be relevant and some may not- it is up to you to decide."

Among these three conditions, the pleasantness condition represented the control group because this self referencing technique is commonly associated with effective retention rates in general vocabulary based learning strategies<sup>6</sup>. The grassland scenario was used to test the effectiveness of ancestral survival processing. The city condition was chosen to measure survival processing in a contemporary context.

After reading their specific instructions, subjects were shown a list of 20 Swahili words paired with the English translation. Each word-pair was shown on an individual PowerPoint slide for 5 seconds. During this time, the subjects were instructed to rate each word-pair's relevance (according to their particular condition) on a Likert scale with values from 1-5. Next, the word-pair slides were shown again in the same order for 3 seconds for the purpose of increased word familiarization. Once the word ratings were complete, the participants were given a retention interval test consisting of arithmetic problems for 5 minutes. This was for the purpose of discarding any short-term memory influence of the participant's retention other than what the instructions of their condition presented them. Afterwards, the participants were given a surprise recall test. They were shown a slide with a Swahili word without its English translation for 15 seconds. They were instructed to write the English word translating the particular Swahili word being shown on the slide. The word-pair order shown during the recall test was different than the words shown during the rating tasks in order to avoid any possible primacy and recency effects occurring upon subject retention. Finally, the participants were debriefed and thanked for their participation.

## 2.3 rating results

The purpose of the word ratings was to determine which word-pairs were relevant to each participant's condition. In other words, it was necessary to see which words in the pleasantness condition sounded or appeared more pleasant than others, and in the two survival conditions it was needed to see which words were rated more relevant for survival than others. This data would be used to include only relevant words in the recall results ANOVA.

### 2.3.1. *word pleasantness condition*

The combined mean rating of all 20 word-pairs was 3.1, indicating an above average pleasantness rating on the Likert scale (see figure 1A). [The highest rated word mean was 3.7 (Ziwa: lake) and the lowest rated word mean was 2.3. (Mfupa: bone).] If the mean rating of the particular word was  $\leq 3.0$ , then the word was considered relevant to pleasantness. This procedure was done for all 20 word-pairs. A total of 13 words were deemed "pleasant" by averaging each participant's rating for one word-pair (see figure 1B).

### 2.3.2. *survival grassland condition*

The combined mean rating of all 20 word-pairs was 2.86, indicating an average survival relevance rating on the Likert scale (see figure 1A). [The highest rated word-pair mean was 4.8 (Chakula: food) and the lowest rated word-pair mean was 1.5 (Yatima: orphan) representing the longest range of word-pair relevance when compared to the other conditions.] If the mean rating of the particular word was  $\leq 3.0$ , then the word was considered relevant to survival in the grasslands. A total of 9 words were deemed survival relevant for a grassland environment by averaging each participant's rating for one word-pair (see figure 1B).

### 2.3.3. *survival city condition*

The combined mean rating of all 20 word-pairs was 2.84, indicating a below-average survival relevance rating on the Likert scale (see figure 1A). [The highest rated word-pair mean was 4.6 (Chakula: food) and the lowest rated word-pair mean was 1.7 (Mfupa: bone) representing a longer range of word-pair relevance when compared to the pleasantness condition.] If the mean rating of the particular word was  $\leq 3.0$ , then the word was deemed relevant to city survival. A total of only 8 out of 20 words were deemed survival relevant for a city environment by averaging each participant's rating for one word-pair (see figure 1B).

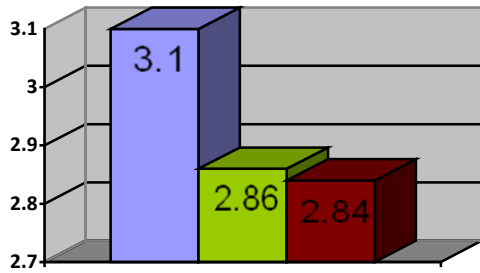


Figure 1A. Ex.1 mean rating values for all 20 words

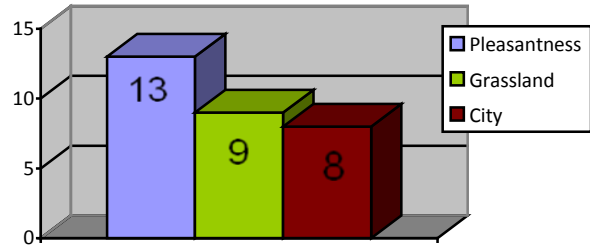


Figure 1B. Ex.1 amount of words rated ≤ 3.0

## 2.4. recall results

I conducted a one way ANOVA test on words rated above average within each condition using ≤ 3.0 recall as the dependent measure. The Conditions affected the likelihood of recall,  $F(2,135) = 4.9, P < .05$ . (see figure 2A and 2B)

	Number of Participants	Mean Recall Correct	Std. Deviation	Std. Error	95% Mean Confidence Interval		Min.	Max
					Lower Bound	Upper Bound		
Pleasantness	46	.2575	.16396	.02417	.2008	.3062	.00	.62
Grassland	46	.2799	.20947	.03088	.2177	.3421	.00	.88
City	46	.1691	.15842	.02336	.1220	.2161	.00	.56
Total	138	.2355	.18382	.01565	.2046	.2664	.00	.88

Figure 2A. Experiment 1 Descriptives

	Sum of Squares	Degrees of Freedom	Mean Square	F	Sig.
Between Groups	.234	2	.117	3.727	.026
Within Groups	4.843	154	.031		
Total	5.078	156			

Figure 2B. Experiment 1 Analysis of Variance

### 2.4.1. word pleasantness

The combined percentage mean of words recalled correctly out of all 20 word-pairs was 21% (see figure 3A). [The highest word-pair mean percentage recalled correctly was 67% (Mbwa: dog; Lulu: pearl) and the lowest mean recalled correctly was 4% (Ladha: flavor; Pafu: lung; Pamba: cotton).] According to the rating buffer of ≤ 3.0 relevance (in which word-pairs rating below a 3 on the Likert scale in this condition were discarded), there were 13 words deemed relevant to pleasantness. The combined percentage mean of these words recalled correctly was 26% (see figure 3B).

### 2.4.2. survival grassland condition

The combined percentage mean of words recalled correctly out of all 20 word pairs was 21% (see figure 3A). [The highest word-pair mean recalled correctly was 59% (Yai: egg) and the lowest mean recalled correctly was 2% (Handaki: trench; Pafu: lung).] There were only 8 words measured relevant for survival in this condition according to the rating buffer of 3.0 relevance (in which word-pairs rating below a 3 on the Likert scale in this condition were discarded). The combined mean of these 8 words recalled correctly was 28% (see figure 3B).

### 2.4.3. survival city condition

The combined percentage mean of words recalled correctly out of all 20 word-pairs was 17% (see figure 3A). [The highest word-pair mean recalled correctly was 47% (Mbwa: dog) and the lowest mean recalled correctly was 2% (Ladha: flavor).] By using a rating buffer of ≤ 3.0 relevance (in which word-pairs rating below a 3 on the Likert scale in this condition were discarded), there were only 7 word-pairs out of 20 which were deemed relevant for city survival. The combined percentage mean of these 7 words recalled correctly was only 16% (see figure 3B).

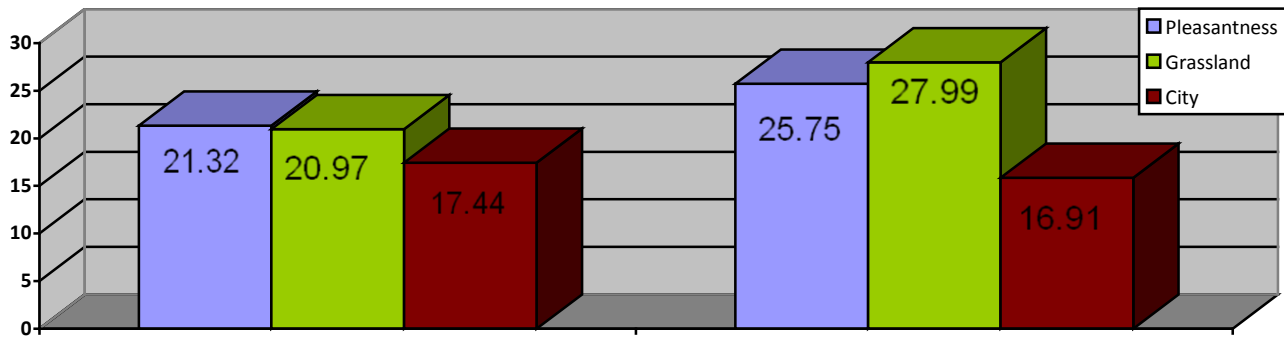


Figure 3A. Ex. 1 mean recall % for all 20 words

Figure 3B. Ex. 1 mean recall % for words rated  $\leq 3.0$  only

## 2.5 discussion

A 21% correct recall percentage of the pleasantness condition showed to have the best recall advantage within the test's entirety. The survival condition in a grassland scenario followed narrowly behind (21%) and the contemporary survival condition of the city scenario finished last (17%). In this case, self-referencing (pleasantness) has the highest general recall advantage when considering all 20 words. However, when only considering the recall of word-pairs that were rated with the highest relevance for the particular condition, the survival advantage of the grassland scenario was clear. It had the highest correct recall rate of 28%. Pleasantness, in this case, followed second (26%) and the city scenario finished last once more with a 16% correct recall score.

The data supports the hypothesis that survival processing is advantageous but self-referencing works just as good for recalling general vocabulary lists, which also include words of little conditional relevance. Even though grassland survival processing finished first in recall for relevant words, the difference in recall scoring between grassland survival processing and the self-referencing technique of pleasantness was insignificant. Alternatively, the statistical significance in recall percentage differences was clear with the city condition under pleasantness and grassland survival. The survival advantage falls short when applied to the city scenario- it finished last in both recall scoring sums. Why is this?

The data supports the evolutionary perspective that our memory is a product of evolution.<sup>3</sup> It also supports the notion that our memory processes have been shaped for survival, and evolution has shaped the ability to retain certain content.<sup>3</sup> Then again, it is not certain whether these results can imply that survival processing is always ineffective when applied to all other survival conditions which are not of the natural wild. Yet, according to the results, survival processing is only responsive in an ancestral context. The experimental outcome therefore provides evidence that survival processing in vocabulary based paired associate recall, although advantageous, is only effective when it is applied to processing using ancestral environments.<sup>7</sup>

## 3. Experiment 2

### 3.1 participants and design

A total of 157 students participated in the second experiment. The source and the demographic characteristics of the participants are equivalent to the participants in Experiment 1. The same materials, word-pair stimuli, and design from Experiment 1 were used in the same format and order.

### 3.2 procedure

The same procedure from Experiment 1 was used, except the city survival condition was replaced by the visual imagery condition. The visual imagery instructions that 1/3 of the participants received read as follows<sup>2</sup>:

#### 3.2.1. visual imagery

"I am going to show you a list of word pairs on a PowerPoint slide show. Each slide will display a single word in Swahili on the left side, and its English translation on the right side, for 5 seconds. Your task is to rate each word-pair as to the ease or difficulty with which they arouse mental images. Words differ in their capacity to arouse

mental images of things or events. Some words arouse a sensory experience, such as a mental picture or sound, very quickly and easily, whereas others may do so only with difficulty (i.e., after a long delay) or not at all. Any word which, in your estimation, arouses a mental image (i.e., a mental picture, sound, or other sensory experience) very quickly and easily should be given a high imagery rating. A word that arouses a mental image with difficulty or not at all should be given a low imagery rating."

The purpose of this condition change was to compare survival processing and self referencing retention strategies with that of the proven and common visual imagery strategy. Visual Imagery is one of the oldest and most effective retention techniques for vocabulary based recall.<sup>8</sup>

### 3.3. rating results

#### 3.3.1. word pleasantness

The mean rating value of all 20 word-pairs was 3.12, indicating an above average pleasantness rating on the Likert scale (see figure 4A). There was only .02 deviation of rating value compared to the pleasantness condition in Experiment 1, which represents a very strong rating consistency. [The highest rated word mean was 3.73 (Ziwa: lake) and the lowest rated word mean was 2. (Mfupa: bone).] If the mean rating of the particular word was  $\leq 3.0$ , then the word was considered relevant to pleasantness. A total of 11 words were deemed "pleasant" by averaging each participant's rating for each word-pair (see figure 4B).

#### 3.3.2. grassland condition

The combined mean rating of all 20 word-pairs was 2.95, showing an average survival relevance rating on the Likert scale (see figure 4A). [The highest rated word mean was 4.8 (Chakula: food) and the lowest rated word-pair mean was 1.59 (Yatima: orphan) representing the longest range of word-pair relevance when compared to the other conditions.] If the mean rating of the particular word was  $\leq 3.0$ , then the word was considered relevant to survival in the grasslands. Only 7 words were deemed survival relevant for a grassland environment by averaging each participant's rating for one word-pair (see figure 4B).

#### 3.3.3. visual imagery

The mean rating of all 20 word-pairs was 3.03 (see figure 4A). [The highest rated word mean was 3.59 (Farasi: horse) and the lowest rated word mean was 2.18 (Handaki: trench).] If the mean rating of the particular word was  $\leq 3.0$ , then the word was considered relevant to arouse visual images. 11 words were considered to create strong visual stimulations by averaging each participant's rating for each word-pair (see figure 4B).

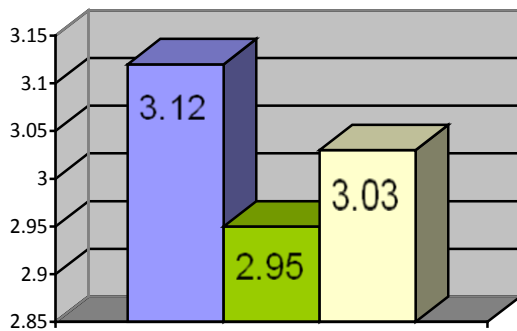


Figure 4A. Ex.1 mean rating values for all 20 words

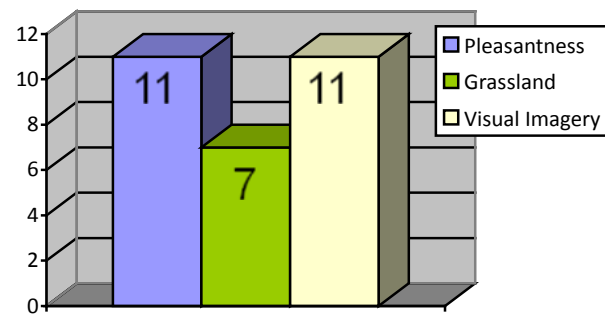


Figure 4B. Ex.1 amount of words rated  $\leq 3.0$

### 3.4. recall results

Another one way Analysis of Variance (ANOVA) test was conducted on words which were rated as  $\leq 3.0$  in order to compare correct recall percentage across conditions. The ratings were based on the averages from all participant rating scores combined within each condition. I found there were differences among conditions:  $F(2, 154) = 3.7, P < .05$ . (see figure 5A and 5B).

	Number of Participants	Mean Recall Correct	Std. Deviation	Std. Error	95% Mean Confidence Interval		Min.	Max
					Lower Bound	Upper Bound		
Pleasantness	56	.2386	.11829	.01581	.2070	.2703	.00	.45
Grassland	52	.3269	.22023	.03054	.2656	.3882	.00	.88
Imagery	49	.3080	.18259	.02608	.2555	.3604	.00	.73
Total	157	.2895	.18042	.01440	.2611	.3180	.00	.88

Figure 5A. Experiment 2 Descriptives

	Sum of Squares	Degrees of Freedom	Mean Square	F	Sig.
Between Groups	.316	2	.158	4.943	.008
Within Groups	4.314	135	.032		
Total	4.629	137			

Figure 5B. Experiment 2 Analysis of Variance

### 3.4.1. word pleasantness

The combined mean of all 20 word-pairs recalled correctly was 19% (see figure 6A). [The highest word-pair mean recalled correctly was 48% (Lulu: pearl) and the lowest mean recalled correctly was 2% (Handaki: trench).] By using a rating buffer of 3.0 relevance (in which the 9 word-pairs rating below a 3 on the Likert scale were discarded), the combined mean of words recalled correctly was 24% (see figure 6B).

### 3.4.2. grassland condition

The combined mean of all 20 word-pairs recalled correctly was 24% (see figure 6A). [The highest word-pair mean recalled correctly was 87% (Yai: egg) and the lowest mean recalled correctly was 2% (Ladha: flavor; Pafu: lung).] the combined mean of the 7 averaged survival relevant words recalled correctly was 33% (see figure 6B).

### 3.4.3. visual imagery

The combined mean of all 20 word-pairs recalled correctly was 27% (see figure 6A). [The highest word-pair mean recalled correctly was 73% (Yai: egg) and the lowest mean recalled correctly was 6% (Handaki: trench).] The combined mean of the 11 word-pairs recalled correctly which rated high in imagery arousal was 31% (figure 6B).

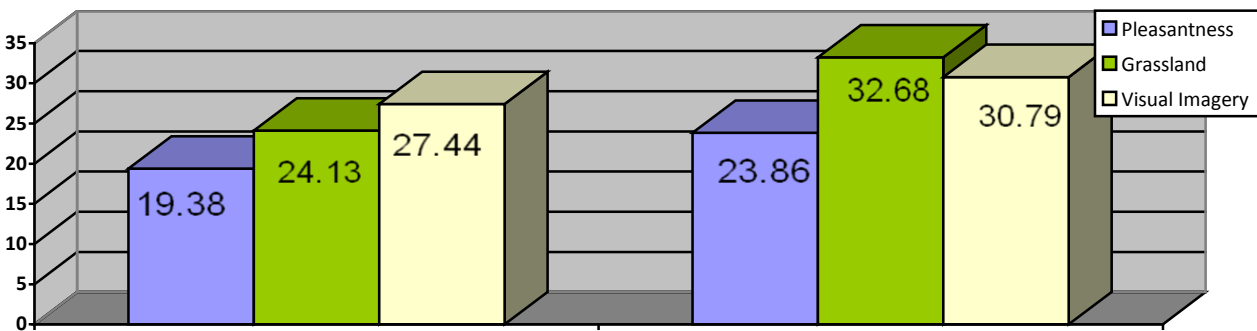


Figure 6A. Ex.2 mean recall % for all 20 words

Figure 6B. Ex. 2 mean recall % for words rated ≤ 3.0 only

## 3.5 discussion

The strategy of visual imagery applied to paired associate recall held up to its reliable reputation, with a correct recall score percentage of 27% when all 20 word-pairs were included. The order results were as follows: the grassland condition fell to second overall (24%) and the pleasantness setting was surprisingly third (19%). In this particular experiment, the grassland scenario finished above the pleasantness condition by 5%, whereas in Experiment 1, the pleasantness condition finished first by only a small difference of under 1%.

Afresh, the focus of the current experiment was to see how well the recall scores were for word-pairs with a high relevance rating. In this case, the grassland survival scenario was first again, with a 33% correct recall score. The grassland scenario demonstrated to be the best recall strategy to use in this experiment for words relevant to its condition. On the other hand, the difference between the grassland condition and the visual imagery condition in relevant word-pair recall scores was not statistically significant.

Both of these experiments provided evidence for the superior success of ancestral survival processing within word-pair recollection. The results indicate that survival processing strategies (within an ancestral context) can be more beneficial for vocabulary based word-pairing retention than the visual imagery approach, but only when words that are being encoded have survival relevance to the particular survival condition. Therefore, due to the effective but limited advantage of survival processing, the study indicates that visual imagery techniques generally can work best under cued paired associate recall with words of no particular conditional relevance.

The results provide evidence for an alternative conclusion which is distinct to the conclusions of Nairne, et al.<sup>1</sup> I found that survival processing is actually most effective when only encoding survival relevant words which naturally and substantially pertain to the specified survival condition. I did not find that encoding generalized word stimuli overall benefited on survival processing; in other words, a subject will most likely remember the word *water* when using survival processing because the word *water* is, for most people, relevant for survival in a natural ancestral surrounding. However, if a subject encodes the word *book*, for example, while using survival processing then the subject will generally not encode this word better (because it is transformed into survival relevance via critical thinking) rather than a naturally strong, survival relevant word.

The results from these experiments oppose the skeptical analysis of memory evolution from Weinstein et al.<sup>7</sup> and support the notion of Nairne and Pandeirada<sup>9</sup> that our memory bear traces of their evolving to help us survive in the wild thousands of years ago. The data from the city scenario compared to the grassland scenario, etc. mostly contributed to this rationale. In addition, it suggests that our ability to remember certain words specific to our living and reproductive needs may be a consequence of natural selection.<sup>3</sup> If we were to apply this information representatively, survival processing can be beneficial for many situations, such as learning survival relevant words while abroad or traveling in other countries. Furthermore, students who are required to take foreign language courses in grade school or in college, etc., may benefit their retention skills for foreign vocabulary with the use of this survival approach more than others.

## 5. References

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<sup>2</sup> James S. Nairne, Josefa N. S. Pandeirada, and Sarah R. Thompson, "Adaptive Memory: The Comparative Value of Survival Processing," *Psychological Science*, 19, no. 2 (2008): 176–180.

<sup>3</sup> John Tooby and Leda Cosmides, *Conceptual Foundations of Evolutionary Psychology*, In David M. Buss (Ed.) *The Handbook of Evolutionary Psychology* (Hoboken, NJ: Wiley & Sons, Inc., 2005)

<sup>4</sup> Thomas O. Nelson and John Dunlosky, "Norms of Paired-Associate Recall During Multitrial Learning of Swahili-English Translation Equivalents." *Memory*, 2, no. 3 (1994): 325-335.

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<sup>6</sup> James S. Nairne and Josefa N. S. Pandeirada, "Adaptive Memory: Remembering With a Stone-Age Brain," *Current Directions in Psychological Science*, 17, no. 4 (2008): 239–243.

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<sup>9</sup> James S. Nairne and Josefa N. S. Pandeirada, "Ancestral Priorities and the Mnemonic Value of Survival Processing," *Cognitive Psychology*, 61 (2010): 1-22.