An Ecologically Valid Test of the Survival Processing and Animacy Effects

By

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Abstract

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Many of our abilities and physical features have been shaped by evolution with the ultimate goal that these changes will help increase our survival and enhance fitness. One such evolutionary adaptation is memory. Countless studies have suggested that our memory systems are particularly tuned to information that is relevant to our survival (e.g., Nairne, Thompson, & Pandeirada, 2007). This finding has become known as the survival processing advantage. Another less studied processing method, which has become known as the animacy effect, states that animate objects are better recalled than inanimate objects (e.g., VanArsdall, Nairne, Pandeirada, & Blunt, 2013). The present study examined the effect that both of these processing effects would have on recall by comparing memory for animate and inanimate objects in a survival related condition and a non-survival related condition. However, this study differed from other studies in the way that it contained more ecological validity. All of the previous studies on survival and animacy either presented words or images on a screen that people had to remember later on. This study was composed of a more life-like situation, induced by a realistic video of a person walking through grasslands, which contained animate and inanimate objects appearing on the screen. Based on previous findings related to both the survival and animacy processing advantages, it would be logical to expect animate objects to be recalled at higher rates than inanimates and for recall to be better in the survival group. The results showed that no survival effect appeared to be present, but the animacy effect was seen in both conditions and was stronger in the survival condition than in the hunting condition. The results are discussed in the context of previous findings.

Introduction

Many of our abilities and physical features have been shaped by evolution with the ultimate goal that these changes will help increase our survival and enhance fitness. One such evolutionary adaptation is memory. Since the earliest humans, memory has evolved with a purpose. It is likely that memory has developed based on specific selection pressures that human ancestors faced (Otgaar, Smeets, & Van Bergen, 2010). From an ancestral perspective, episodic memory, memory for specific events in our past, allowed us to avoid dangerous conditions by enabling us to recall situations more clearly and to plan for the future by remembering past findings such as food and prey. From an adaptive perspective, it makes sense that we would remember information better when it had been processed to help with our fitness, such as where food had been located or stored, or where potential predators and prey were likely to be found (Nairne, VanArsdall, Blunt, & Pandeirada, 2012). Based on this, it would not be surprising if modern memory systems are sensitive to certain tasks or situations that are similar to what our ancestors had to endure and be aware of during their time (Nairne et al., 2012).

Survival Advantage

Over the past decade, there has been increased interest in how human memory has evolved. In particular, considerable research has focused on survival processing and its effect on the human episodic memory system and the remembrance of information. The outcomes of much of this research have demonstrated the advantage of survival processing. The survival advantage refers to the finding that when stimuli are thought of in ways that pertain to survival or fitness value, they will be remembered at higher rates than when they are thought of in other non-survival ways (Nairne, Thompson, & Pandeirada, 2007). This makes sense from an evolutionary perspective.

The survival advantage was first tested in a study by Nairne et al. (2007), where the purpose was to examine if thinking about items or stimuli as they related to survival would increase people's ability to remember them. They had predicted that retention would be impacted by the fitness content of the information. This prediction was tested in four incidental learning experiments where the participants were told to rate how relevant certain words were to a survival situation, which was followed by a surprise retention task for the words that had been shown. Performance here was compared to numerous other control tasks. Because my study tests the survival processing advantage using similar procedures to Nairne et al. (2007) I describe their experiments in detail here.

Upon arrival to the laboratory, participants were split up into three different conditions, determining the scenario they would be given: survival, moving, or pleasantness. Participants in the survival condition were told to imagine that they were stranded in the grasslands of a foreign land without any materials and they had to rate the relevance of words in the list as they pertained to their survival in the grasslands. Participants in the moving group were told to imagine that they were planning to move to a new house in a foreign city. They had to locate and buy a house then move all of their belongings. They were told to rate how relevant each of the words in the list would be in helping them accomplish this task. In the pleasantness condition, the participants simply had to rate how pleasant each word seemed to them. After the words had been displayed, there was a digit-recall distractor task, which was followed by a free-recall task, where subjects were asked to recall all of the items they had previously rated.

First and foremost, the authors found a significant effect of condition where the survival-based processing group had the best retention, performing significantly better than the other two groups. The researchers then looked at the relevancy ratings. It was important for the researchers

to look at these ratings due to the fact that it was possible that the survival advantage could be partially due to the congruency effect. Other research has shown that people remember stimuli given "yes" responses to questions better than stimuli that were given "no" responses (e.g., Craik & Tulving, 1975; Moscovitch & Craik, 1976). Hence, the congruency effect refers to the finding that if items are rated higher or receive a "yes" rather than "no" response, they will be remembered better. The researchers found that average ratings were highest for the pleasantness scenario and there was no difference between the survival and moving groups. This meant that at least for this experiment, the survival advantage was not due to encodings with more congruency.

A second experiment in this study compared the survival situation to self-reference, which is considered to be one of the most effective encoding techniques. The self-reference effect is the finding that retention is enhanced when people relate material or information to themselves (Nairne et al., 2007). For example, rating adjectives for how well they describe oneself enhances retention for the adjectives relative to rating them on other semantic dimensions. In this study, the two conditions were survival and self-reference. Despite the fact that self-reference is an extremely effective encoding mechanism, there was a significant effect of condition, more specifically, there was a significant survival advantage. This occurred despite the fact that average relevance ratings were higher for the self-reference condition than for the survival condition. Overall, the results reported by Nairne et al. (2007) demonstrated the existence of the survival processing effect and suggested that it might be due to pressures faced by our ancestors.

Varying Survival Conditions

Initial studies on the survival advantage introduced the idea of "ancestral priorities" that may have been faced by our ancestors. The ancestral priorities view is based on the concept that our memory systems should be more keyed into problems faced by our ancestors under those

conditions in which they adapted to the problems. This idea, which has become known as the ancestral environment hypothesis, predicts that information will be remembered better when it is learned in the same environmental context that was experienced by our ancestors at the time our memory systems evolved to remember survival relevant information (Weinstein, Bugg, & Roediger, 2008). Soderstrom & McCabe (2011) examined this idea by comparing an ancestral-consistent situation to a modern survival situation. They compared an ancestral situation containing threats that were encountered by our ancestors (predators) to either unrealistic threats (zombies) or realistic, but more modern threats (attackers). Participants read one of four survival situations where the environment and the threat were either consistent or inconsistent with problems faced by our ancestors. Similar to other studies, participants then rated the words based on how relevant they were to survival or, in the control group, how pleasant they were. The rating task was followed by a quick distractor task, and eventually, a 10-minute recall period. The data they collected did not support the ancestral environment hypothesis. There was a main effect of threat type, where situations with zombies led to higher recall than situations with predators or attackers. While a main effect of environment was not found, all of the survival scenarios led to higher recall than the pleasantness control condition.

Due to the fact that these results were somewhat unexpected, the researchers further investigated why zombie scenarios had such a strong impact on memory and were able to rule out some possible explanations. They found that the zombie situations did not have higher relevance ratings than the other situations, which allowed the congruency effect explanation to be eliminated. The researchers were also able to check for possible between-condition time differences by comparing rating response times across the different situations. They found that people in the grasslands situations took longer to rate words than people in the city situations, but the zombie

conditions did not take longer, meaning the advantage for the zombie conditions was not simply due to the fact that more time was spent rating the words. Lastly, each participant in all of the conditions rated the same words, which allowed for the elimination of possible stimulus effects. The researchers landed on the fact that it might be possible that the zombie situations led to the activation of "death and disgust systems", which might have made the zombie threat more salient and led to more specific imagery than the other threats, which might be more effective in inducing survival-related processing. Overall, these results do not necessarily mean that the survival advantage is unrelated to some evolutionary adaptation, it is just that this adaptation does not work better in an ancestral environment than it does in a modern environment. Overall, this study suggests that maybe the ancestral environment is not as important as it has been thought to be.

Varying Control Conditions

In the original Nairne et al. (2007) study, the moving condition was included to induce schema activation and meaningful processing (which would be expected in the survival situation) but it may have been somewhat boring, less arousing, and less novel than the survival situation. This brought up the possibility that the memorial advantage for the survival scenario was only due to the fact that one condition was more exciting than the other. Keeping this in mind, Kang, McDermott, & Cohen (2008) came up with a burglary scenario, instead of the traditional moving scenario, to compare with pleasantness and survival, where participants had to plan a bank heist and rate words based on how relevant they were to the burglary situation. This was done with the intention of making the control scenario seem as exciting, arousing, and novel as the survival situation. However, they still found recall in the survival condition to be significantly better than the other two conditions even with the implementation of the burglary scenario.

Nairne, Pandeirada, & Thompson (2008) also compared the survival scenario to a control group that was something other than a moving condition. This time, however, instead of matching the control condition to the survival condition based on levels of novelty and excitement, the researchers wanted to test the strength of survival-based processing by setting it against other excellent encoding procedures that are known to be very effective memory enhancers. In addition to survival processing, there have been other encoding procedures that consistently seem to lead to high levels of recall, such as assessing the pleasantness or forming a visual image of an item, and generating an item.

In their first experiment, the researchers wanted to see how retention of items in the survival scenario would compare to retention of items after using other successful encoding strategies. In order to do this, people were randomly assigned to one of the following conditions: survival (rating how relevant the items would be in a survival situation), pleasantness (rating the pleasantness of each word), imagery (rating the words based on difficulty which they arouse mental images), self-reference (rating how easily the word brings to mind an important personal experience), generation (rating the words after you switch the order of the letters when necessary), and intentional learning (told to remember words for a memory test in the future). Each of these encoding strategies was designed and created to induce deep or semantic processing. The researchers found a significant effect of condition where survival processing stood out and out-performed the other groups that used different encoding techniques. There were no significant differences among the non-survival processing conditions. The survival advantage was still the best even when compared to the "best of the best" deep processing techniques.

The second experiment in this study was similar to that performed by Kang et al. (2008). Nairne et al. (2008) wanted to directly compare survival processing with another contextually rich,

but not survival related, encoding situation. In this study, participants rated words for their relevance to a survival situation or a vacation situation. Once again, survival processing clearly produced a significant recall advantage and produced significantly higher average ratings than the vacation situation. These findings attest to the generality of the survival advantage and lead us to believe that survival seems to be better than many other control conditions that have already been known to improve memory.

Varying Stimuli

The majority of studies regarding the survival advantage have used word lists as the to-be-remembered stimuli in experiments. An unexplored issue was whether or not the survival recall advantage would occur for other classes of stimuli such as pictures. It is known that information is more likely to be recalled when it is presented in a picture format rather than as words, which is known as the picture superiority effect (e.g., Rajaram, 1996). Otgaar, Smeets, & Van Bergen (2010) conducted a study to look at whether the survival recall advantage could be seen using pictorial stimuli rather than words. In their first experiment, people were randomly assigned to the survival, moving, or pleasantness condition, similar to previous studies. However; instead of showing the participants lists of words, they were presented with pictures of objects that they rated for their relevance to the scenarios. They hypothesized that pictures would be more likely to be remembered in the survival scenario than in others. They found a significant effect of condition where people recalled significantly more pictures in the survival condition than in the moving or pleasantness condition.

Nairne, VanArsdall, Blunt, & Pandeirada (2012), conducted another study that used pictures as the primary stimuli. Their experiments tested location memory when an item's initial position was directly relevant to the rating decision. From an adaptive perspective, the researchers

figured that remembering where food has been located or stored, or where potential predators are likely to be found would have increased chances of survival and would therefore, be recalled at higher rates than less relevant information. Instead of presenting words to people, pictures of food (experiment 1) or pictures of animals (experiment 2) were shown one at a time in different locations on the screen relative to the central fixation point that represented the person's location. Some items were closer to the fixation point and others were further away. People were then asked to use a five-point scale to rate how easily the food or animal could be captured. It was thought that that location or distance of the item from the fixation point would be a central feature of the rating decision. After the rating task and distractor, people had to recall the specific locations of each of the pictures. Both of the experiments confirmed that item location was relevant during the rating task due to finding a main effect of position, where people rated items further from the center as harder to collect. There was also a main effect of group, where people in the survival condition showed the best memory location.

Savine, Scullin, & Roediger III (2011) took this idea of pictorial stimuli one step further when they decided to use human faces as the stimuli in their study. Up until this point, a lot of work had been done with words as stimuli and some had been done with pictures, but nothing had been done with faces. The main goal of this study was to look at whether the survival processing effect would also work for face stimuli. It was predicted that processing faces based on their usefulness for survival would lead to better recognition of the same faces when compared to control conditions. This prediction was tested in five experiments, each with slight variations. Experiment 1 tried to replicate the survival processing advantage with faces by following Kang et al.'s (2008) design. They compared effects of survival processing to processing faces based on how relevant they would be in a bank robbery situation. It was predicted that processing faces in

the survival situation would lead to increased recognition when compared to the bank robbery situation. They used a within-subjects design where an equal number of faces were rated in each of the two conditions. All of the faces used were computer generated in order to lower the chances of the influence of non-facial qualities and to exclude all unusual faces. In each of the conditions, participants were told to rate the faces from 1 (very unhelpful) to 5 (very helpful) based on how useful they would be in each of the two conditions (aiding survival or accomplishing robbery goals). After rating the same number of faces in both of the conditions, everyone completed the Tetris distractor task for 10 minutes before they completed the recognition test. For this test, the participants were told that they were going to be shown another set of faces and they had to decide if they had seen the faces earlier by hitting keys labeled as "old" and "new".

The results the researchers found did not support their initial hypothesis. The results of the recognition test showed that there was no rating condition effect for hits. Overall, these results point to the fact that survival processing might not help later recognition of faces, which as mentioned earlier, was the opposite of the initial hypothesis and was not consistent with results that had been seen with words used as stimuli. The next four experiments were modified versions of Experiment 1, all of which had the goal of finding results that would support the initial hypothesis. Therefore, it appears that survival processing may not improve memory for all forms of stimuli.

It was not until the fifth and final experiment where the researchers found results that were somewhat in the realm of what they were hoping to find. Experiment 5 tested whether or not presenting faces along with statements from categories identified by Nairne & Pandeirada (2008) as evolutionarily relevant (survival, social, kin, navigation, and reproduction) would result in a survival processing benefit. They also included neutral statements for comparison. Participants

were randomly assigned to either the survival or moving situation. After people read all six statements for a face, participants rated the face (1 to 5) based on the instructions from their assigned condition (survival or moving). After the rating task, each participant completed the Tetris distractor task for five minutes before completing the same face recognition test that had been done in the previous experiments. After the recognition test, each participant had to recall as many of the statements from earlier as possible in a five- minute time frame. Once again, the results of the recognition test showed that survival processing did not affect face recognition hits or false alarms when compared to the moving situation. However; they did find some evidence for survival processing effects while examining recall of statements. They found that survival processing benefitted both the survival relevant and neutral statements. While the researchers did not see their predicted results of any survival processing effect found for face recognition after conducting five experiments, they did end up with some results that provide evidence for survival processing benefits.

Animacy Effect

Survival processing is one way in which memory adaptations have been studied. Another way is by studying memory advantages associated with animacy (or living things). The animacy effect is the finding that animate objects are better remembered than inanimate objects (VanArsdall, Nairne, Pandeirada, & Blunt, 2013). From a developmental standpoint, humans learn the difference between living (animate) and non-living (inanimate) things from a very young age. The concept that human memory systems might be more prepared to store information about animates makes sense from an adaptive or evolutionary perspective. Having this ability to detect and remember animates in the natural world is imperative for survival and was quite possibly a factor that helped increase our ancestor's fitness.

The animacy effect was initially tested in a study by VanArsdall et al. (2013), where the focus was on people's ability to recognize and recall animate objects, which as mentioned earlier, is critical to survival. They had predicted that processing nonwords as animates would lead to better memory compared to the inanimate condition. This prediction was tested in two experiments where participants had to process and memorize the exact same stimuli, pronounceable nonwords, but the researchers manipulated whether the nonwords were being processed as animate (living) or inanimate (non-living) objects. In order to do this, each nonword was paired with a characteristic that was suited for something that was either living or non-living. Experiment 1 tested recognition memory of the nonwords and Experiment 2 tested recall of the nonwords.

In the first experiment, each participant rated the same list of nonwords, half of which had been paired with a property that was characteristic of animates and half paired with properties characteristic of inanimates. The participants were told to choose how likely each nonword was either a living thing or an object by using a 6-point scale where a rating of 1 meant "very likely to be an object" and 6 meant "very likely to be a living thing". Participants were also told to try to remember the property that was associated with each nonword they saw. The rating task was followed by a brief distractor task. Following the distractor task, each participant completed the same recognition test. Here, people were told that they would be shown the same nonwords as earlier along with some new ones. They had to judge whether they had seen the nonword during the first part of the experiment by using a 6-point scale again, where 1 meant "definitely did not see the nonword" and 6 meant "definitely did see the nonword". Following the recognition task, some of the participants completed an imagery-rating task to see if there was a difference in the level of ease of forming a mental image between the animate and inanimate properties that had been assigned to the nonwords.

Most importantly, the animacy effect was found, where recognition hit rates for nonwords paired with animate properties were higher than for nonwords with inanimate properties. Hit rates were defined as the proportion of old nonwords that had been given a "yes" response in a given condition during the recognition task. The researchers also found that people rated the nonwords that had been paired with living properties significantly higher (and more like living things) than those nonwords paired with nonliving properties. Additionally, it was found that animacy also impacted reaction times during the rating task. People rated nonwords paired with animate properties faster than the nonwords paired with inanimate properties. This finding is important because it means that the animacy effect was not due to more processing, which would require more time to encode the nonwords with the animate properties. It is also important to note that the two property types did not differ in the imagery dimension, which lowers the chances that imageability caused any differences in retention. This simply means that these findings are not due to the notion that it might be easier to form a mental image of an animate property, which might increase retention of the paired nonword. It is also important to note that everybody processed and recognized the same nonwords, which means it is impossible to attribute the animacy effect to an item selection artifact or any previous bias towards certain real words.

The second experiment was designed to replicate the memory advantage for animate processing but used recall rather than recognition. While performance levels were relatively low overall, there was still a very significant recall advantage for the nonwords that had been paired with living properties, which once again supports the idea that animacy improves memory. Again, the nonwords that had been paired with living characteristics were rated significantly higher than the nonwords that had been paired with nonliving properties. Similar to Experiment 1, people also rated the nonwords with living properties significantly faster than the nonwords paired with

nonliving characteristics. Overall, the results provided by VanArsdall et al. (2013) do indeed support the idea that animacy is another powerful encoding technique that most likely played an important role in the survival and fitness of our human ancestors.

It has been suggested in other studies that memory systems are designed in such a way that gives precedence to animate items, which means that the animacy effect should appear even if people are asked to process items in multiple ways that have been known to impact a person's ability to remember them. Leding (2018) conducted a study to test this that looked at both the animacy effect and the survival advantage. Her experiment on the animacy effect is what I will discuss here. In this experiment, people processed animate and inanimate items at either a shallow or deep level. She predicted that that manipulations would have their typical impacts on memory, where items processed in the deep condition would be remembered the best and that animate words would be better remembered than inanimate words regardless of processing condition. In the shallow condition, people were asked to respond whether the word they were shown had a letter "e" by pressing keys for either "yes" or "no". In the deep condition, people had to think about the meaning of the words and rate them based on how pleasant they were.

She found a significant effect of animacy, where animate words were recalled significantly more than inanimate words in both processing conditions. Due to the fact that the animacy effect was present in both processing conditions, it is clear that the manipulation of processing did not have an impact on the animate and inanimate words differently, which adds evidence that people might be more likely to remember animate words regardless of context. She also found a significant effect of processing, where deeply processed words were recalled at a higher rate than words processed shallowly, which is an effect that has been shown countless times.

Animacy Effect and Survival Advantage

As previously mentioned, being able to detect animate objects such as prey, mates, or predators must have been imperative for the survival of our ancestors, which makes studies that combine the animacy effect and the survival effect valuable. Both the survival advantage and the animacy effect have received considerable attention on their own, but few researchers have looked at the effects on memory when both of these powerful encoding techniques are used. The following studies are important to discuss because they pertain directly to my own study, which looks at both the survival advantage and the animacy effect.

As mentioned earlier, Leding (2018) conducted a study in which she looked at the effects of both animacy and survival combined on memory. The purpose of her second experiment was to see if there would be an effect on the recall of animate and inanimate words when they were processed based on the grassland survival or moving situations. In order to do this, people were asked to imagine that they were either in the survival grassland situation or a moving situation and they had to rate how relevant each of the words would be to their assigned condition. The descriptions of each of the situations were the same ones used in the original Nairne et al. (2007) study. Leding found a significant main effect of processing, where words that were processed in the grassland situation were recalled at higher rates than words in the moving situation. However, the animacy effect was also significant in the moving condition, which meant that the animacy effect was there regardless of the condition. This meant that the manipulation of processing did not differentially impact animate and inanimate words, which provides more evidence for the animacy effect, but does not make the survival effect any bigger. Overall, these experiments showed that the animacy advantage does not seem to be due to deeper processing of items or by survival processing and that it is a strong effect that is independent of context.

One of the only other studies that combined both the survival processing advantage and the animacy effect was conducted by Gelin, Bugaiska, Méot, & Bonin (2017), and contained four different experiments that looked at whether animacy effects in memory would vary across different sets of encoding instructions. The different encoding conditions consisted of survival situations, non-survival situations, and incidental memory tasks where no schema were activated. As has been the case in previous survival processing studies, people were told to imagine that they were stranded in a grassland where they would have to survive, part of which would include defending themselves from predators. These predators might be dangerous animals or possibly other people, both of which are animate objects. Therefore; the researchers predicted that in the grassland situation, animates should be given a processing advantage over inanimates and would therefore be remembered better.

Their first experiment used the classic grassland and moving conditions for the survival and non-survival situations used in previous studies. Once each participant was assigned to their condition, they were shown a total of 28 nouns, 14 of which were animate objects and 14 were inanimate objects. The participants were told to rate how relevant each presented word would be toward the goals of their assigned condition on a five-point scale where 1 was “totally irrelevant” and 5 was “extremely relevant”. After the rating phase, there was a five-minute delay period where two interference tasks were performed before the five-minute recall task. While there was no significant main effect of encoding condition on correct recall rates, animate words were better remembered than inanimate words. There was no reliable difference on recall rates between animate and inanimate words in the moving condition, but a significant difference in the survival group was found, where more animates were being recalled than inanimates. The three experiments that followed were based on this initial experiment but had slight modifications. Each

of the experiments ended up with the same results as Experiment 1, where animates were better recalled than inanimates and people in the survival condition recalled more words than people in the other, non-survival condition(s).

My study is based on the same foundation as the last two studies discussed above. I had two conditions, survival and non-survival, as had been done in previous studies. However, this study differed from these other studies in the way that it contained more ecological validity. All of the previous studies on survival and animacy either presented words or images on a screen that people had to remember later on. My study was composed of a more life-like situation, induced by a realistic video of a person walking through grasslands, which contained animate and inanimate objects appearing on the screen. I was interested in whether or not I could replicate the survival processing and animacy effect findings in a study where there was a greater degree of ecological validity. The video more closely mimics how our ancestors used their memories. It might also allow us to manipulate variables that are not easily manipulated with word lists (e.g., perceptual qualities of the objects, circumstances under which the objects are located, how close the objects are to the person, etc.). Based on previous findings related to both the survival and animacy processing advantages, it would be logical to expect animate objects to be recalled at higher rates than inanimates and for recall to be better in the survival group.

Method

Participants

Fifty-six Union College undergraduates participated in this study in exchange for partial class credit for psychology courses or a small payment. Each participant was tested individually in a session lasting approximately 30 minutes. There were 28 participants per condition.

Materials and Design

The video shown to each of the participants was originally created from “Rust” the video game. The clip, which can be seen in Figure 1, was from the point of view of a person as he or she walked through a grassland environment. The total duration of the video was 9 min, 11 s. The video started off with 5 s of “walking”, which consisted of the video moving through the grasslands. After these 5 s, the screen froze and either one or two objects appeared. When the pictures were presented alone, they were centered on the screen and when the pictures were presented together, they were vertically centered, but spaced roughly equidistant from the edges. If an object appeared by itself, it stayed on the screen for 6 s and if a pair of objects appeared, they stayed up for 12 s. A total of 56 objects appeared in the video, 28 were animate and 28 were inanimate, which were taken from Bonin, Gelin, & Bugaiska (2013). The sets of items were matched on several dimensions such as, surface variables of the number of letters, lexical variables including the frequency that the words appeared in books and subtitles, and semantic variables including familiarity, imageability, and emotional valence. After the allotted presentation time, another 5 s of walking occurred before the video froze again and the next item(s) appeared. This continued through the whole video The videos ended the same way they began, with 5 s of walking without any freezes or objects appearing.

In order to control for possible sequencing and ordering effects, I had to counterbalance which objects appeared alone or with another object and the order in which animate and inanimate objects appeared. This resulted in the animate and inanimate objects being presented equally often in each ordinal position within the videos. All of the objects were also shown alone or simultaneously an equal number of times. Once all of this was done, there were two versions of the video, each of which had two orders, for a total of four videos.

Figure 1.

Procedure

Upon arrival to the laboratory, each participant signed a consent form. Participants were then randomly assigned to one of the two experimental conditions, which were survival and hunting contest. The instructions and rating scale for each of the conditions were as follows:

Survival. "As you watch the video, please imagine that you are living long ago in the grasslands of a foreign land. As part of a small group, you are in charge of contributing meat to feed your tribe. You will need to hunt big game, trap small animals, or even fish in a nearby lake or river. Hunters often have to travel great distances, pursue animals through unfamiliar terrain, and successfully return home. Whatever the conditions, you must hunt successfully to feed your tribe. I am going to show you a video where you will be traveling through the terrain and will come across various objects. I would like you to rate on a 1-5 scale (1 being extremely irrelevant and 5 being extremely relevant) how relevant each of these objects would be in your attempt to hunt successfully. Some of the objects may be relevant and other may not—it's up to you to decide".

Hunting Contest. "As you watch the video, please imagine that you have been invited to participate in a hunting contest. As part of a team, you are in charge of contributing captured game to the team effort. You will need to hunt big game, trap small animals, or even fish in a nearby

lake or river. Members of the team often have to travel great distances, pursue animals through unfamiliar terrain, and successfully return to the contest center. Whatever the conditions, you must hunt successfully to help your team win the contest. I am going to show you a video where you will be traveling through the terrain and will come across various objects. I would like you to rate on a 1-5 scale (1 being extremely irrelevant and 5 being extremely relevant) how relevant each of these objects would be in your attempt to hunt successfully. Some of the objects may be relevant and others may not—it's up to you to decide".

Each of the participants then viewed the short video containing the images. As the video progressed and the pictures were displayed, the participants rated the images on their rating sheet using the rating scale previously mentioned. When two items were presented, participants rated the left-hand item first, followed by the right-hand item. Immediately after the rating task, the participants were instructed to complete a distractor task where they were asked to write out the names of as many states as possible in 2 min. After the distractor task, each participant was given 7 min to complete a free recall test for the images they had seen on the screen while the video was playing. They were also asked to draw a line under the last item recalled after each minute of the recall period so that the number of items recalled each minute could be analyzed. After the recall period, participants were debriefed.

Results

The mean ratings of items for each of the two conditions, hunting (M = 2.34) and survival (M = 2.36), were nearly the same. A t-test was conducted to show that there was no significant difference between the ratings for each of the conditions, F (1,54) = 3.34, p = .132, suggesting that the items were equally relevant to the two groups. Figure 2 shows the mean number of words recalled for the hunting and survival conditions as a function of animacy for items in the single

presentation condition. These same results are shown in Figure 3 but for the items in the multiple presentation condition.

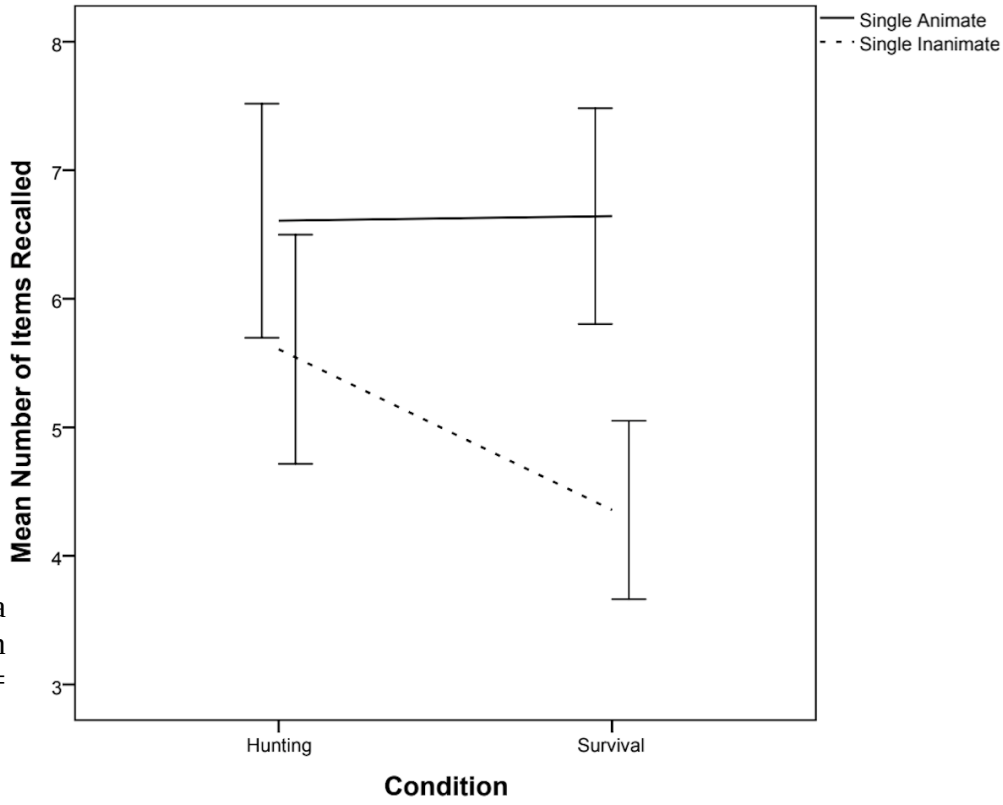

Figure 2. Mean number of words as a function of condition and animacy in single presentation condition. Error Bars = 95% confidence intervals

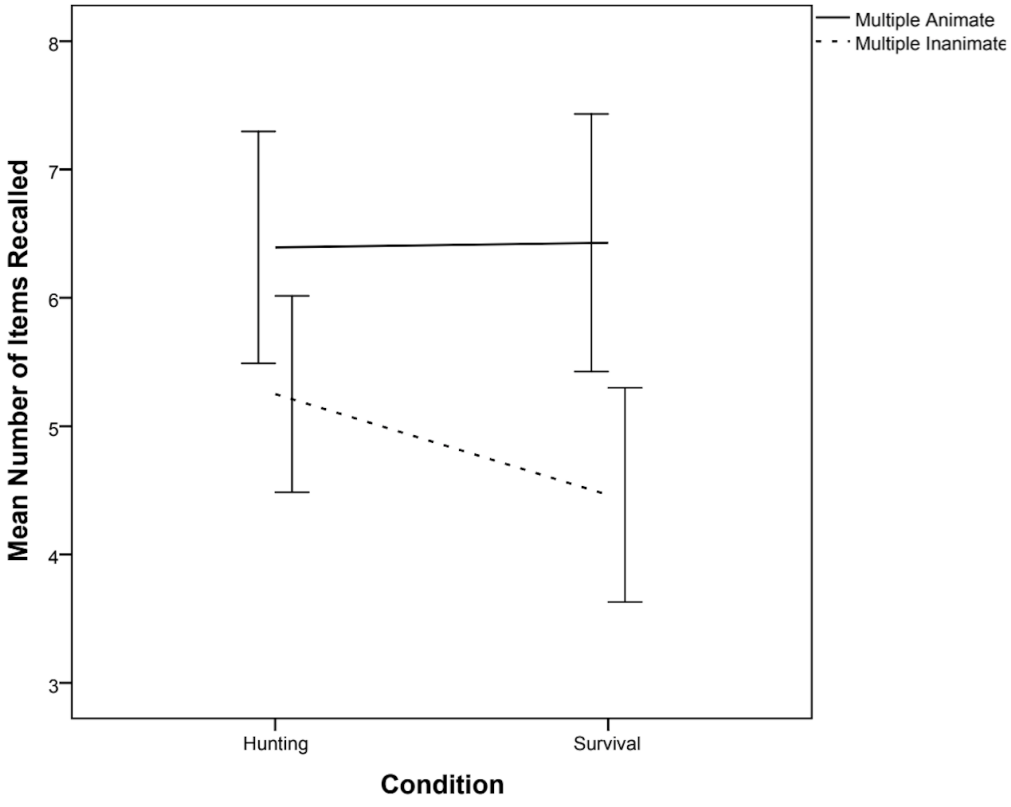

Figure 3. Mean number of words as a function of condition and animacy in multiple presentation condition. Error Bars = 95% confidence intervals

As seen in the figures, there was a large animacy effect in both conditions, but it appeared to be stronger in the survival condition. There was no evidence of the survival processing effect and it even appeared that survival did slightly worse than hunting. This same pattern was seen for both the single and multiple presentation conditions. I conducted a 2 (Scenario: Hunting or survival) x 2 (Animacy: Animate or inanimate) x 2 (Presentation style: Single or multiple) mixed factor ANOVA on the recall scores. There was a significant main effect of animacy F (1,54) = 34.23, p = .000. The animacy by scenario interaction was nearly significant F (1,54) = 3.72, p = .059. None of the other effects approached significance (smallest p = .218). To explore the cause of this near significant interaction, I collapsed across presentation style and conducted a dependent groups t-test to compare animate and inanimate objects in both the survival and hunting conditions. Both t-tests were significant (hunting: t (1,27) = 2.48, p = .020, survival: t (1,27) = 6.36, p = .000). Hence, the animacy effect was seen in both conditions but was stronger in the survival condition than in the hunting condition.

Discussion

The most surprising result from the present study was the lack of a survival processing effect. In fact, the opposite was seen, where recall rates were numerically higher for those in the hunting condition than the survival condition. While there is no way to know for certain why this is the case, I do have some ideas about what may have led to the minimization of the survival processing effect. Prior to beginning the experiment, I decided that I needed a minimum of 64 participants per condition in order to have sufficient statistical power to be confident that I could detect an effect if it were present in the population. I ran a power analysis on the ability to detect a medium sized effect 80% of the time and it suggested that I would need 128 total participants. Once the study had been conducted, I only ended up with 56 total participants, which meant only

28 per condition rather than the desired 64. Due to this, there is a possibility that I did not obtain the survival processing effect because there was not enough statistical power. However; since my results are going in the opposite direction than those in previous studies, it is less likely that this was actually the main reason behind these unexpected results.

Leading up to the study, I thought that the video would enhance the survival processing effect by providing a greater degree of ecological validity; thereby making the survival scenario more life-like. Based on the results, this might not be the case. As previously mentioned, rather than enhancing the survival processing effect, the video seemed to eliminate, or even reverse, any benefits of it. While once again, I do not necessarily know why this occurred, I do have some ideas that might have contributed to these unexpected results. First, the use of the video provides participants with more imagery and a more realistic scenario. This may have forced people in both conditions to relate the items more toward themselves, which is known to be another strong encoding technique. This would eliminate or diminish any survival processing benefit. It is also possible that because people in both conditions all watched the same video, the use of the video made the tasks more similar and the difference in the verbal instructions was not strong enough to really differentiate the survival condition from the hunting condition.

While most prior studies that looked at survival processing were able to find evidence of the survival processing effect as it pertained to evolution and our ancestors, a study mentioned earlier, by Soderstrom & McCabe (2011), found results similar to those of the present study. In their study, they were unable to find a main effect of environment, but found that all of the survival situations led to higher recall than the control condition, unlike the present study. They also found that less ancestrally related situations led to greater recall rates than those similar to scenarios in which our ancestors faced. As previously mentioned, this goes against the ancestral environmental

hypothesis. In the present study, I was also unable to come up with results that support the ancestral environmental hypothesis, since I found that recall was better for the non-survival related condition.

The present study was able to replicate the robust animacy effect, seen in Leding (2018) and VanArsdall et al. (2013), in both the survival and hunting conditions. Leding (2018) found a significant effect of animacy, where animate words were recalled significantly more than inanimate words. She also found that the manipulation of processing (deep or shallow) did not have an impact on the animate and inanimate words, which added evidence that people might be more likely to remember animate words over inanimate words regardless of context. This is not consistent with the findings in the present study, which showed an interaction between animacy and condition, where there was a stronger animacy effect in the survival condition than the hunting condition even though it was present in both. VanArsdall et al. (2013) found a significant animacy effect in both experiments, where nonwords that had been paired with animate properties were recalled at higher rates than nonwords paired with inanimate properties. It is also important to note that each participant saw and processed the same objects, which meant that it was impossible to attribute the animacy effect to an item selection artifact.

In addition to seeing an overall animacy effect, I also saw an interaction between animacy and condition. More specifically, it appeared that the animacy effect was stronger in the survival condition than the hunting condition. This result makes sense from both ancestral and evolutionary perspectives. While our ancestors were trying to survive, it would make more sense for them to be able to remember where their predators and prey reside rather than where there is a cluster of rocks or a clearing in the forest. Since prey and predators are animate objects and the rocks and clearing are inanimate, it would make sense for the animates to be given processing priority and be recalled

at higher rates compared to the inanimates. However; in non-survival scenarios, such as cooking and tool making, it may not be helpful for animate items to be remembered better.

As mentioned earlier, few studies have yet to look at the impact that both survival processing and the animacy effect have on recall. Leding (2018) and Gelin et al. (2017) conducted studies similar to the present study and the comparison of their results to the current results are rather interesting. Leding's (2018) second experiment found that the animacy effect was numerically greater in the survival condition than the moving condition. It was stated that there was no significant interaction, but the results were the opposite of that in the present study. Gelin et al.'s (2017) first experiment found that the animacy effect was greater in the survival condition than the moving condition. The next experiment showed that numerically, the animacy effect was greater in the survival condition than the moving condition. Gelin et al.'s (2017) last experiment found that the animacy effect was statistically equivalent in each of the three conditions (survival, tour guide, and explicit learning condition). Although the interaction was not significant, there was a third condition in that experiment (unlike the present study) that may have made detection of the interaction more difficult. So we do not know if there would have been an interaction between the survival and non-survival (tour guide) scenarios. In summary, I was able to replicate Experiments 1 and 2 in the Gelin et al. (2017) study but was unable to replicate the results from Experiment 2 in the Leding (2008) study and Experiment 3 in Gelin et al.'s (2017) study. Overall, the data further support the notion that animacy is bigger under survival than non-survival conditions.

In future research, it would be imperative to have a larger sample size, closer to what I had originally hoped for, in order to try to reach a more acceptable level of statistical power. If more participants are recruited and it turns out that greater statistical power does not lead to the presence of the survival processing effect, I would be more certain that the results I obtained were real and

not simply due to too little statistical power. If, on the other hand, further studies that also implement this video are able to find the survival processing advantage, it could be beneficial to make the study even more realistic by using virtual reality (VR) technology. With the use of VR technology, participants will really feel as though they are removed from the lab and dropped in the middle of the wilderness. This increased reality will hopefully create a greater degree of ecological validity, which could potentially enhance the survival processing advantage even more.

While the use of the video seemed to be an exciting and novel idea initially, there seems to be a few possible problems that need to be dealt with in future research. As mentioned previously, the use of the video might make the two tasks more similar than when a list of words was used. It would be beneficial to make the scenarios different enough so that it is clear one condition instills thought of survival whereas the other does not. This could be done by changing the verbal instructions that the participants hear. The instructions for the two conditions in the present study might not have differed from each other enough, making the survival cues less powerful and obvious when we are using the video.

If research ultimately shows that there is no true effect with this video, then this might tell us something about what is going on with the survival processing effect. The video is clearly changing something. Figuring out what that something is might reveal something interesting about the survival processing advantage, which is why further research is important.

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