



The Effect of the Distinctiveness of Stimulation on the Survival Processing Superiority

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Abstract: According to the theory of survival processing superiority, under the condition of survival processing, people's memory retention rate is significantly improved, which is the result of the evolution of memory system and the proximity mechanism. It may be due to the extensive adaptive mechanism formed in the process of human evolution, rather than being sensitive to a single and individual survival processing. However, in the past the uniqueness of the house-moving scene used in the experiment of the processing superiority of survival memory is not high enough. Therefore, this study used the illusory scene with high uniqueness to explore the influence of the uniqueness of survival stimulus on the processing superiority of survival memory. The memory test scores of the subjects in different scenes (ancient survival / modern survival / illusory survival) were investigated by using the inter subject design. The results showed that the unique performance of stimulation affected memory. Therefore, the superiority effect of survival processing can be partly attributed to the distinctiveness of stimulation, not all because of the ancestral priorities.

Keywords: survival processing, survival-fitness, distinctiveness, survival scenario, adaptive memory

1. INTRODUCTION

Evolutionary psychology holds that our psychological mechanisms have evolved as the product of the hunter-gathering society of our ancestors' (Tooby & Cosmides, 1990, 1995). It originates from Darwin's theory (1859) of natural selection. This evolutionary perspective has recently been applied to psychology. The assumption (Nicholson, 1997) of the evolutionary psychology is that, we are not only physically adapted, but also mentally adapted. Humans are evolved to be mentally adaptive to their ancestor's hunter-gathering society (Tooby & Cosmides, 1990). Our brain can be regarded as an adaptive organ like other physical adaptations (e.g. immune system protects human from disease). The role of evolutionary psychology is to identify these specific modulations of human mind (Barkow, Cosmides, & Tooby, 1992; Li, 2018). One simple example of adapted modulation is the fear of snakes and spiders. Serious studies showed (Mineka & Öhman, 2002; Öhman & Mineka, 2003; Rakison & Derringer, 2008) that human and other primates fear snakes and spiders more intensely than most other objects, even like cars and guns, which is more dangerous in the modern society. Evolutionary psychology explains that this fear helps human to avoid danger swiftly in the wild world (Mineka & Öhman, 2002). The adaptation of human also comes along with by-products and noise (Barkow et al., 1992; Confer et al., 2010). For instance, the fear of harmless snakes and spiders is by-product of adaptation. Noise, however, is the random characteristics that are result from casual environment or genetic mutations.

From an evolutionary perspective, human cognitive abilities have been shaped by natural selection. Functions of our brain are the result of natural adaptation, and that the "stone-age" brain is still with us (Cosmides & Tooby, 1994). Following this reasoning, evolutionary psychologists (Buss, 1995) suggest that our cognitive performance should have evolved to better face survival-related problems. Nairne, Thompson, and Pandeirada (2007) first proposed the concept of adaptive memory. Adaptive memory refers to the idea that our brain is tuned to better remember information relevant to survival.

Location of food and image of the predator, for example, might be more important for our ancestor's survival, and therefore those who remember survival-related information better were more likely to survive and reproduce. Gradually, memory system of human being has evolved to remember fitness-relevant stimuli better.

In the first study on adaptive memory by Nairne et al. (2007), participants were first asked to read a scenario where they imagine themselves facing survival problems in an ancestral environment or non-ancestral scenarios like moving to a foreign land. Then words were presented one by one and participants were asked to rate the words in terms of their relevance to the scenario or to pleasantness (control). After being distracted by a numerical task, they were given a surprise recall test, which they were not informed before. In the task they need to write down the words they had rated. The results indicated that more words were retained if they had rated the relevance to ancestral survival scenario comparing to other scenarios or other type of rating. These findings supported their hypothesis that survival processing can enhance memory performance. The research also showed Source memory is associated with adaptive decisions in a Prisoner's Dilemma game (Marie Luisa Schaper, Laura Mieth, Raoul Bell, 2019).

The advantage of survival processing might be explained by the proximate explanation. The current study aims to study the advantage of survival processing and examine whether it is possible to employ the proximate explanation to explain adaptive memory. Specifically, distinctiveness of the scenario will be manipulated. According to (Howe & Otgaar, 2013); Kroneisen and Erdfelder (2011), the richness or distinctiveness in of the ancestral scenario may lead the participants to make more elaboration and therefore easier to be retrieved in the future. They suggested that, with the rating task, participants are implicitly prompted to think distinct argument to support the claim that a certain object is relevant in a context with survival problems. Therefore, it generates potential memory cues for the later retrieval. Moreover, it was suggested (LaBar & Cabeza, 2006) that people may be more emotional aroused by the distinctive scenario and therefore remember the words better after rating the relevance to the scenario. To study whether this distinctiveness of coding would confound with the effect of survival processing, a fictitious scenario that is designed to be equally distinctive with the ancient scenario is employed in the current study.

Specifically, three scenarios used in this study were matched on four factors as in the study by Weinstein et al. (2008): the subject matter to which the scenarios referred to; the grammatical structure and vocabulary of the scenario descriptions; the emotional arousal associated with the scenarios and participants' first-hand experience with each scenario. To study distinctiveness, the level of novelty was manipulated as previous study. The ancient scenario and the modern scenario were identical to the one in Nairne and Pandeirada (2010a), and the fictitious scenario was designed to match the ancient scenario in terms of level of novelty. The level of novelty was rated and matched by four different students. The modern scenario is a control condition here as previous studies show consistent results that rating relevance to ancient scenario can enhance memory comparing to modern scenario (Nairne & Pandeirada, 2010a). If the advantage of survival processing is truly due to human's sensitivity to ancestral information but not due to the distinctiveness in the ancestral environment, the ancient scenario should enhance memory better than both the ancient and the modern scenarios. Although it was suggested (Nairne et al., 2007) that the advantage of survival processing is not due to distinctiveness by showing that, comparing to a moving scenario where participants were asked to image that they are moving to a foreign land, ancestral scenario prompt participants to recall more words, an alternative is that the moving scenario is not distinctive enough comparing to the moving scenario. The rational of the current study is that if the human brain is tune to the process ancestral-related information better, recall performance of the ancient should be better than other groups. It was hypothesised that distinctive scenario can improve recall as much as ancestral scenario do, that is, the fictitious scenario can enhance memory like the ancestral scenario do.

2. METHOD

2.1. Participants and Materials

Participants were 30 students from Lancaster University who have not been in similar experiment about adaptive memory before. There are 16 female students and 14 male students ($M_{age} = 20.37$, $SD_{age} = 1.81$) with normal vision. Thirty-six unrelated concrete nouns from the study of Nairne and

Panderrada's (2010) (see the Appendix) were employed. Words presentation in the experiment was via PowerPoint on a PC.

Participants were informed that their responds would be treated confidentially and they could withdraw from the experiment at any time for any reason. In the debriefing, the purpose of the experience was also given.

2.2. Design

A between-subject design was employed, with rating scenario (ancient/modern/ fictitious) as independent variable. According to the independent variable, participants were randomly divided into three groups, and each had the same number of participants (N=10). Not knowing that they will be asked to recall the words, participants were presented with words and were asked to rate its relevance to the scenario. The proportion correct recall was defined as dependent variable.

2.3. Procedure

There were three phases in the experience: rating task, numerical task and recall task.

In the rating phase, one of the thirty-six words appeared in the centre of the screen for 5s, and after 1s, another word appeared. Participants were required to rate (see Appendix) the relevance of the nouns to the survival scenario (ancient/modern/fictitious). Rating was on a five-point scale, where 1 = totally irrelevant and 5 = extremely relevant, and the rating scale was printed out in a respond sheet, where people rated the words by circling the value of their choice. There was a practise session for the participants to familiarize with the rating procedure. Words from the practise session were not counted in the result, and there was no mention of the later retention test during the practise sessions.

The list of 36 words and their order were kept the same for each participant. The only difference between each group was the following scenario used in the rating task, which followed the wording in (Nairne & Panderrada, 2010a):

2.3.1. Ancestral

In this task, please imagine that you are stranded in the grasslands of a foreign land, without any basic survival materials. You have recently received word that a dangerous predator has been seen in the area. You will need to avoid and/or escape from the predator to ensure your survival. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be in your attempt to avoid the predator.

2.3.2. Modern

In this task, please imagine that you are stranded in the city of a foreign land, without any basic survival materials. You have recently received word that a dangerous criminal in your area. You will need to avoid and/or escape from the dangerous criminal. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be in your attempt to avoid the criminal.

2.3.3. Fictitious

In this task, please imagine that you are stranded in the city of a foreign land, without any basic survival materials. You have recently received word that a zombie outbreak has been reported in your area. You will need to avoid and/or escape from the zombies to ensure your survival. We are going to show you a list of words, and we would like you to rate how relevant each of these words would be in your attempt to avoid the zombies.

Then in the second phase, a digit recall task was employed to distract the participants in order to avoid the effect of short-term memory or working memory of the words. Subjects were asked to remember a sequence of number and recall it. Specifically, two sets of numbers were showed to the participants sequentially. In each set, there were 8 one-digit or two-digit numbers. Every number was presented for 4 seconds whereas participants were asked for calculations (mentally subtract 3 from the presenting number). The result of calculation was recorded by the participants after each set of presentation.

In the recall task, participants were required to write down as many rated words as they could in 6 minutes. The proportion of correct recall was recorded as dependent variable.

3. RESULTS

The descriptive statistics are presented in Table. 1.

Table1: Descriptive for all conditions in the picture recognition task

Scenario	N	M	SD	Range of scores
Ancient	10	0.50	0.49	.44 – .59
Modern	10	0.35	0.75	.22 – .44
Fictitious	10	0.48	0.14	.22 – .72

All effects are reported as significant at $p < .05$. 1. Number of words correctly recalled was transformed into proportion correct recall. For the proportion correct recall, the variances were significantly differ across three groups, $F(2, 27) = 5.29, p < 0.05$, which means that the statistics are normally distributed and it is safe to proceed the analysis. Means of proportion correct recall in each group are presented in Figure. 1. A one-way ANOVA was used to test recall performance across the different scenarios (ancient/modern/fictitious). Performance across three conditions differed significantly, $F(2, 27) = 6.89, p < 0.05, \eta_p^2 = 0.34$. Turkey post-hoc comparisons of the three groups indicated that participants rating modern scenario ($M = 0.35$) retained significantly less words than those rating ancient scenario ($M = 0.50, p < 0.05, \eta_p^2 = 0.61$) and those rating fictitious scenario ($M=0.48, p < 0.05, \eta_p^2 = 0.25$). Comparison between ancient scenario ($M = 0.35$) and fictitious scenario ($M = 0.48$) however, were not statistically significant ($p = .83$).

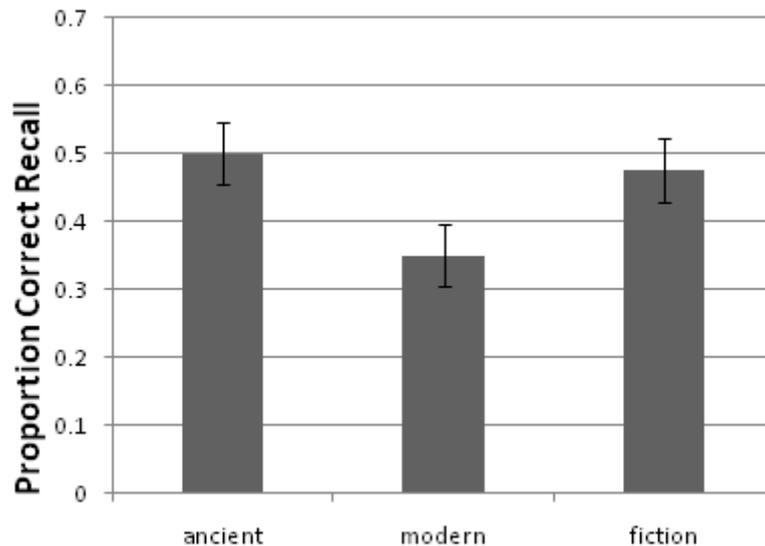


Figure1: Proportion of correct recall performance in each of the conditions. Error bars represent standard error of the means.

4. DISCUSSION

4.1. Distinctiveness as a Key Factor to Influence Memory

This current study sought to investigate whether the finding of Nairne and Pandeirada’s (2010a) can truly be explained by the theory of evolutionary psychology but not the proximate mechanism. The comparison of the ancient and the modern condition replicated those in Nairne and Pandeirada’s (2010a) study: recall was significantly better in ancient scenario than in the modern scenario. With the fictitious group, however, revealed that adaptive processing seems not to be the only reason that improves recall: recall after rating the relevance to the fictitious scenario was significantly better than those of the modern scenario, and there was no significant recall difference between the fictitious group and the ancient group. These results are consistent with our hypothesis and indicate that richness of the stimuli can explain the rule behind the survival processing.

Both the ancient scenario and the fictitious scenario differ very much from the modern world we live in today, and processing of these scenarios can both improve recall of the rated words. Basing on these results, the adaptive explanations of the improved memory in previous studies are challenged. One possible explanation is that the scenarios like bank heist scenario and moving scenario employed in the previous studies (Kang et al., 2008; Nairne et al., 2008) are not distinctive enough.

The richness of encoding hypothesis (Kroneisen & Erdfelder, 2011) could be used to explain our result. Richness of encoding hypothesis suggested that when processing stimulus, people create more association with rich/distinctive stimulus than simple stimulus, therefore rich/distinctive stimulus should be better retain. In this case, it can be considered that retention performance between these two groups did not differ significantly because both the ancient scenario and the fictitious scenario served as rich/distinctive stimuli. Indeed, experiment conducted by Kroneisen and Erdfelder (2011) also suggested that the richness of encoding could explain those retention difference in Nairne and Panderada's (2010a) study.

In fact, in another study, it was suggested that both mortality salience and the ancestral cue share the same proximate mechanism, and that they both improve memory (Erdfelder et al., 2013). Previous study (Hart & Burns, 2012) showed that the thought of death can improve memory and was referred to *dying to remember* effect. Erdfelder et al. (2013) suggested that the proximate mechanism might underpin both the effect of survival processing and the dying to remember effect. Their results showed that dying and survival scenarios produced equally high recall rate and implied that there underlies overlapping mechanisms.

4.2. Extraneous Variable

Our results also suggested that previous scenarios employed as control might not match the ancestral scenario in terms of richness. For example, the moving scenario (Nairne et al., 2007) where participants were asked to image that they are moving to a foreign, is not that distinctive in today's modern world. The bank heist scenario where (Kang et al., 2008) might also not be distinctive enough as it is not impossible in the society and such scenario is often depicted on the mass media.

Another possible explanation of the proximate explanation is that the emotional arousal of scenario produces the advantage of recall (Weinstein et al., 2008). It was suggested that emotional arousal can result in better retention. The ancestral and the fictitious scenarios employed in the current study might arouse stronger emotional feeling than the modern one, and therefore lead to better recall. This explanation on the other hand, may still be an adaptive one as evolutionary point of view postulates that human's ability to remember stimuli that is more emotionally arousing is adaptive because they can act swiftly and properly in face of this kind of event in the future.

4.3. An Alternative Evolutionary View

It should be noted what we proposed is not against the evolutionary point of view. Instead, it is suggested our ability to remember certain stimuli better might not because of survival processing, but a more general mechanism that has been shaped by the environment and allows us to function well in various situations. As mentioned in the introduction, human being faces all kinds of survival and reproductive challenges like selecting mate, detecting cheaters and so on. It is hard to prove that a certain kind of processing is the underlying mechanism as we have little knowledge about the detail and the nature of the survival problems that our ancestors faced. Moreover, if human are indeed sensitive to certain stimuli that are related to survival, it can be inferred that various stimuli that is related to our survival and reproduction (e.g. mate selection, cheater detection, kinship) should be special too. However, Sandry, Trafimow, Marks, and Rice (2013) did not find any mnemonic benefit for alternative fitness-relevant processing scenarios (e.g. incest avoidance and mate selection scenarios). These evidences raise the concern over the generality of the evolutionary account of remembering.

5. CONCLUSION

In conclusion, the finding suggested that survival processing cannot fully explain the retention advantages in ancient scenario, and richness/distinctiveness of the stimulus of the proximate explanation should be employed to explain adaptive memory and a more general evolutionary point of view should be employed.

Indeed, there are some alternative accounts for our results. One of them is the difference of methodology. Both Weinstein et al. (2008) and Nairne and Panderada's (2010a) studies employed a within-subject design while a single between-subject design was used in the current experiment. In addition, with a pure between-subject design, the effect of richness/distinctiveness was also robust in Soderstrom and McCabe's (2011) experiment. It might be explained that richness/distinctiveness in

the scenario was more salient when being compared. Further investigation is needed before a definite conclusion.

Furthermore, it should be noted that there was only a small effect size between the modern and fictitious group while there was a medium effect size between modern and ancient group. The richness of encoding hypothesis might not explain all the difference between the ancestral condition and modern condition. Nevertheless, it can be suggested that the richness of encoding hypothesis does not necessarily conflict with the survival-processing paradigm. It is possible that they share similar mechanisms and the richness/distinctiveness in ancient scenario facilitates the richness encoding. Future experiments are needed to analysis the mechanism.

Nairne et al. (2007) suggested with the same set of stimuli, the processing of the stimuli can be studied. However, it is also very difficult to match scenarios in terms of richness/distinctiveness, emotional arousal, self-referencing processing and so on. Future research should pay more attention on the description of the scenarios and better control these variables.

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