What do Participants Think when Judging Items in the Survival-Processing Paradigm? An Exploratory Study Using the Type-Aloud Method

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Abstract

The aim of this study is to investigate the survival-processing advantage using a type-aloud protocol. It was hypothesised that engagement within a survival scenario, whilst rating objects in terms of their fitness-relevance, would prompt participants to generate a larger number of uses for the objects. The increased number of functions would in turn function as retrieval cues to enhance subsequent recall for the objects rated within the survival scenario, making up the survival-processing advantage. To test this hypothesis, participants were instructed to write down their thoughts on the imagined scenario and while rating objects in terms of their relevance in a survival scenario and in a moving scenario. In the end, participants were presented with a surprise-free recall test in which they had to remember as many objects as possible from the scenarios. Results show that participants come up with significantly more functions for objects within the survival scenario. Also, the number of functions thought of for each object, positively predicts recall. The study found a difference in mean recall between the survival and moving scenario, however, the difference did not reach significance. The findings support a richness-of-encoding account for the survival-processing advantage, according to which the distinctiveness and elaboration during encoding is responsible for the increased ability for recall. In addition, it is shown that the type-aloud protocol can be used to study the survival-processing advantage and give direct insights into what people think within the paradigm.

Keywords: survival-processing paradigm, survival-processing advantage, declarative memory, the richness-of-encoding hypothesis, evolutionary theory

What do Participants Think when Judging Items in the Survival-Processing Paradigm? An Exploratory Study Using the Type-Aloud Method

Nairne et al. (2007) reported that judging whether items would be of relevance in a survival scenario improves subsequent memory for the items. Since then, this advantageous mnemonic effect has been replicated and potential proximate mechanisms underlying the effect have been explored (Nairne & Pandeirada, 2016). However, studies have largely focused on modifications of the paradigm without shedding light on the direct thinking processes that lead to better recollection in a survival scenario. The aim of this study is therefore, to elucidate the thought content in participants when presented with the task of rating items according to a survival-scenario or a control moving-scenario, and how the content of their thinking is related to the subsequent recall memory for the items. Secondly, the study aims to investigate if having people write down their thoughts during the judgement tasks can be used as a method to study thought processes directly in the survival processing paradigm.

The Survival Processing Paradigm

The survival-processing paradigm was introduced to test whether declarative memory has evolved as an adaptation to enhance fitness over the course of our ancestral past. If so, declarative memory should be optimally tuned towards fitness relevant information, that has been part of the challenges that faced our ancestors (Nairne et al., 2007). In the classic paradigm by Nairne et al., participants are placed within one of three conditions: a survival condition, a moving condition, or a pleasantness-rating control condition. In the moving condition, participants are asked to imagine themselves as having to move to a foreign country, having to locate and purchase a new home and transport their belongings to it. Subsequently, the participants are asked to rate words in regard to their relevance for the

three aforementioned tasks (locating a home, purchasing a home and transporting items). In the pleasantness-rating participants are asked to rate words in terms of their pleasantness on a five point scale. In the survival condition, participants are instructed to imagine themselves stranded in the grasslands and are subsequently asked to rate words in terms of their relevance for finding food, water, and securing themselves from predators. After finishing the rating tasks, participants are presented with a surprise free-recall test for the rated words. It is assumed that the moving condition controls for depth of processing and self-relevance, whilst being fitness irrelevant. The pleasantness-rating on the other hand is used to control for depth of processing by tapping into semantic analysis of the item. Using these methods, Nairne et al. found compelling evidence for a survival processing advantage, such that items processed as part of the survival scenario led to an increased recall ability compared with the moving and the pleasantness conditions. These results were replicated using both between-subjects and within-subjects designs, and the survival-processing advantage was found for recognition and when tested against a self-reference condition. Taken together, these results suggested that the survival-processing advantage garnered from evaluating items in an imagined survival situation is a powerful mnemonic effect over and above other known mnemonic techniques.

The survival-processing effect is interpreted as an evolved adaptation in declarative memory, which has led to a fine-tuning of processing fitness-relevant information (Nairne & Pandeirada, 2016). It is argued that the survival-processing advantage is a front-end adaptation that co-opts other mnemonics to elicit better memory for information that could be of relevance to survival. Importantly, however, this interpretation concerns itself with the ultimate explanation for why the effect occurs but it offers no explanation as to the concrete mechanisms involved in bringing it about.

The depth-of-processing framework

One account of the proximal mechanism underlying the survival-processing advantage might be found within the depth-of-processing theory proposed by Craik and Lockhart (1972). The general idea behind this theory is that memory traces are by-products of a perceptual analysis taking place at various levels of processing, ranging from shallow sensory input and physical feature recognition to deep associative semantic operations. In this view, memory depends on the depth of analysis during perceptual processing.

Craik and Tulving (1975) set out to explore the hypothesis that recall ability varies with depth of processing at encoding by having participants answer a yes or no question about a set of words. The questions were designed to stimulate various depths of processing. Specifically, the question could probe the visual characteristics of the word (e.g. is the word in capital letters?), inquire into phonemic characteristics (e.g. does the word rhyme with "cap"), or prompt a semantic analysis (e.g. "Is the word an object" or "does the word fit into the sentence: He ate the ____"). Each type of question was assumed to stimulate a progressively deeper level of processing. It was hypothesised that deeper processing during encoding of a word would lead to stronger memory traces and therefore better performance on a surprise recall test. The results were mostly consistent with this hypothesis, as recall was significantly better for words processed in terms of their semantic content (i.e. at a deeper level of processing) than for words processed in terms of their phonemes or visual appearance. Furthermore, at deeper levels of processing (phonetic and semantic), it was found that words congruent with the questions were recollected at a higher rate than words that were incongruent. From this, Craik and Tulving argued that it is the richness of elaborations during encoding, enabled when word and task are able to form an integrated unit, rather than the depth of processing per se, that leads to better memory.

In line with the depth-of-processing theory, it is possible that the richness and distinctiveness of elaboration during encoding drives increased ability for recall in the survival-processing advantage (Kroneisen & Erdfelder, 2011). This hypothesis was tested by comparing a shortened version of the survival-scenario that included rating items in relation to only one survival goal (finding water) instead of three as in the study by Nairne et al. (2007; finding food, water and protection from predators). It was assumed that restricting the goals would restrict the amount of elaboration and ideas generated to serve as memory retrieval cues later on. This should in turn diminish the effect of the survival processing advantage. The results were in line with this hypothesis, revealing that the survival processing advantage diminishes significantly when individuals only have to rate the relevance of items according to a single goal. Moreover, Kroneisen and Erdfelder found that the shortened version of the survival-scenario did not differ significantly from the moving condition in terms of recall. In another experiment, Kroneisen and Erdfelder asked participants to provide either one or four arguments for an item's relevance within the original version of the survival-scenario (containing three goals) or in a control moving-scenario. In line with the richness-of-encoding theory, it was assumed that directly manipulating the number of arguments would allow for more or less ideas to be generated, thereby affecting the subsequent recall. The study's outcome was consistent with the hypothesis, replicating the survival advantage in the four-argument condition but not in the one-argument condition. Taken together, these findings suggest that restricting encoding in such a way that it promotes less elaboration leads to substantially decreased recall rates, potentially eliminating the survival-processing advantage.

Kroneisen et al. 2021 elaborated on these results by introducing a novel procedure to manipulate the depth of processing within the survival processing paradigm. Participants had to rate items with different degrees of functional fixedness. An item with high functional-

fixedness would have few perceived possible functions (e.g. radio), whereas an item with low functional-fixedness would have many perceived possible functions (e.g. stick). It was expected that items with low functional fixedness would prompt more elaborations to be made than items high in functional fixedness. This would in turn lead to substantially better recall for items with many possible uses. In line with this hypothesis, results showed that items low in functional fixedness were recalled at a significantly higher rate than items high in functional fixedness. Furthermore, functional fixedness interacted with the scenario to bring about a strong survival advantage only for items low in functional fixedness. Consistent with these findings, Röer et al. (2013) found that a survival scenario stimulates the generation of more ideas about the use of an object, and that the number of ideas was positively correlated with the probability of recall. This suggests that more elaboration is prompted, in a survival scenario, for items that allow for the generation of many uses to bring about the strongest survival processing advantage.

To further elucidate the topic, Bell et al. (2015) explored how the focus during elaboration in an imagined survival situation affects recall. It was hypothesised that thinking about *functions* (e.g. rate the word ox according to its possible uses) when rating an item would predict recall better than thinking about *threat* (e.g. rate the word ox according to its potential danger). Results revealed that a focus on functions at the time of encoding predicted recall significantly better than focusing on a threat. In fact, a focus on threat within the survival scenario did not significantly differ from a moving-control condition. Additionally, results showed that for concrete words a functional focus enhances the survival advantage effect beyond that of a control pleasantness-rating and the survival condition using a relevance-rating task. This suggests that it is the novel uses derived when processing items in the survival paradigm that enhance recall during elaboration.

Taken together, the findings mentioned above suggest that the depth-of-processing theory, in terms of richness of elaborations during encoding, is central to the understanding of the survival processing advantage on recall. Manipulating the survival scenario to have more or fewer goals (e.g. one or three), restricting the range of arguments allowed whilst judging items relevance (one or four), or manipulating potential elaboration via functional fixedness (high or low) moderate the amount of elaboration possible and therefore subsequent recall rates (Kroneisen & Erdfelder, 2011; Kroneisen et al., 2021). Röer et al. (2013) reproduced the survival advantage and showed that being in a survival processing state increased the amount of functions people would think of. Furthermore, it was shown that the amount of elaboration alone does not lead to a significant survival processing advantage, rather the focus during elaboration matters (Bell et al., 2015). In particular, thinking about potential functions seems to be the principal factor behind the survival advantage. This prompts our main hypothesis that the *richness of elaboration* in terms of *functions and novel uses* is central to the survival processing advantage.

The Current Study

In order to directly study how the previously mentioned findings apply to thinking within the survival processing paradigm, we used a modified version of the verbal think-aloud protocol (Baron, 2008). The think-aloud protocol is a simple method that directly traces the process of thinking by asking subjects what they are thinking when completing a task or briefly after. Muñoz et al. (2006) assessed whether typing one´s thoughts is comparable to producing them verbally. Results showed that typing responses to a task did not crucially alter strategy or comprehension in terms of a reading strategy task, and that typing might be preferred as it allows for additional time to access and express thoughts in terms of comprehension rather than paraphrasing. We therefore decided to use a modified think-aloud

procedure, asking subjects to write down their thoughts while evaluating an item in terms of its relevance within a survival scenario and a moving scenario.

To enable the use of this method, we first ran a pilot study with three participants to construct a coding scheme that would be able to encompass qualitative elements within the thinking of the participants. We developed categories that matched the responses of participants in the write-aloud task based on the theoretical search-inference framework of thinking by Baron (2008). The search-inference framework specifies that thinking consists of a search for objects and inferences about them towards a given goal. The objects are conceptualised within the three categories of possibilities, goals and evidence. *Possibilities* are defined as possible solutions offered by an object towards some end. *Goals* are the standards by which possibilities are evaluated. *Evidence* consists of all beliefs that help determine to what extent given possibilities achieve a given goal. These three concepts became an integral part of the coding scheme we used to quantify participant responses, where the search-inference framework allowed for integration of the aforementioned findings within the survival processing paradigm (e.g., Nairne et al., 2007; Kroneisen & Erdfelder, 2011; Kroneisen et al., 2021; Bell et al., 2015). That is, goals are an inherent part of the survival processing paradigm conditions where they specify the standards that items are evaluated against. Individuals search for possibilities (i.e. functions) in a given item in light of a goal and then make an inference about how relevant it is to overcoming the challenges of the scenario. In this view, experimentally manipulating goals, arguments for inference, or the functional fixedness of items, moderate the amount of searches and inferences made during encoding.

Research Question(s)

This study focuses on two overarching research questions. Firstly, we investigated the efficacy of our coding scheme and the write-aloud method as reliable instruments to explore

the survival processing advantage. Secondly, we examined the thought content of participants as they judged items in terms of relevance to the survival and moving scenario. In line with the richness-of-encoding hypothesis and the search-inference framework we had the following main hypotheses:

Hypothesis 1. The survival scenario will lead to higher recall than the moving scenario.

Hypothesis 2. The relevance-rating of an item will positively predict recall regardless of scenario.

Hypothesis 3. The survival scenario will elicit more thoughts about the possible functions of the item than the moving scenario.

Hypothesis 4. The number of functions thought of when thinking about the relevance an item will positively predict recall.

Moreover, we had two complimentary hypothesis in:

Hypothesis 5. Self-referencing will positively predict recall

Hypothesis 6. Response time for an item will positively predict recall

Methods

Participants

The sample included 12 participants recruited through Prolific (prolific.co). Ethical approval was granted by the Ethics Committee of the Faculty of Behavioural and Social Sciences at the University of Groningen. The final participant pool included 5 males and 7 females. Eligibility criteria for the study included age between 18 and 35, being an English native speaker, and having student status. Participants were paid £8 per hour completing the experiment.

Materials

The experiment was created using Open Sesame (Mathôt et al., 2012) and was conducted online, such that participants completed the task on a laptop or desktop computer. The stimuli consisted of 24 words that were selected from a dataset obtained in a study by Yildirim (2020). From this dataset, we selected words that yielded low, high, or ambiguous relevance ratings for the moving and survival scenarios. The low-relevance items ratings were skewed towards 1 on a 5-point scale, meaning that they were the least relevant to the presented scenario. The high relevance items' ratings were skewed towards 5, and the ambiguous items had a flat distribution of ratings, indicating inconsistent relevance ratings across the participants in the study by Yildirim. For our study, we picked four items from each of these three relevance categories for both scenarios – using 12 words for the survival scenario, and 12 words for the moving scenario. We sought to ensure that the items used in the three relevance categories, over the two scenarios, were distributed equally across different categories of items (e.g. foods and tools). A list of the words used in the study can be seen below (see Table 1).

Table 1

Word list of objects with the corresponding relevance category

Survival Condition		Moving Condition	
Object	Relevance category	Object	Relevance category
Kite	Low	Pumpkin	Low
Window	Low	Harp	Low
Ruler	Low	Bird	Low
Roller skate	Low	Whistle	Low
Hammer	High	Refrigerator	High
Well	High	Suitcase	High
Corn	High	Drawer	High
Tree	High	Screwdriver	High
Cake	Ambiguous	Mitten	Ambiguous
Car	Ambiguous	Pitcher	Ambiguous
Fork	Ambiguous	Sledge	Ambiguous
Hat	Ambiguous	Wagon	Ambiguous

Note. Items and relevance categories are retrieved from the Yildirim (2020).

Design

A within-subject design was used; each participant rated 12 words within the survival scenario and 12 words within the moving scenario. Rating conditions were counterbalanced, so half of the participants rated words for the survival scenario before the moving scenario and vice versa.

Procedure

Before the start of the experiment, participants provided informed consent to participate. Then the experiment was initiated and participants were instructed to read the description of one of the following scenarios adapted from the study by Nairne et al. (2007):

Survival: *"We would like you to imagine that you are stranded in the grasslands of a foreign land, without any basic survival materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from predators. Please take your time to imagine that you are in this situation. After you have done this, you can continue by pressing 'Spacebar'."*

Moving: *"We would like you to imagine that you are planning to move to a new home in a foreign land. Over the next few months, you'll need to locate and purchase a new home, and transport your belongings. Please take your time to imagine that you are in this situation. After you have done this, you can continue by pressing 'Spacebar'."*

After reading this description, participants were asked to report any thoughts while imagining the scenario. They were specifically reminded to type in any associations or thoughts they came up with and not just the conclusions of their thinking process. Having reported their thoughts, the answer was submitted by pressing 'Enter.'

After imagining the scenario, participants did the rating task for the first scenario. For each presented word they had to think about how relevant it would be for them in a given scenario. In the instructions, we asked them to report their thoughts as they tried to judge the

relevance of the word. Again, they were reminded to type in anything that came to their mind during that process: "We are interested in how people arrive at their judgement, not just their conclusion. It is fine if you change your mind during this process. Just type in what you are thinking!" Instructions also included a reminder that some of the words may be relevant and others may not, so it was up to them to decide. After these instructions for the rating task, they pressed 'Spacebar' and were presented with the object word in a combination with a blank page where they could type in their thoughts. Specifically, they received the following instructions: "Describe your thoughts as you think about whether this word would be of relevance to you in the scenario." Subsequently, participants were asked to rate the object in terms of relevance to the scenario on the scale from 1 (completely irrelevant) to five (extremely relevant). They indicated their rating from 1 to 5 by pressing the corresponding key. This task was performed for two words, serving as practice trials. Participants were notified about the end of the practice trial and reminded about the scenario they should imagine themselves. To continue with a rating task of an actual experiment, they had to press 'Spacebar.' After completing the rating task of all 12 objects of the first scenario, participants performed the same procedure for the second scenario. Rating task was followed by a surprise free-recall test. Here participants were asked to type in as many words as they could remember from the rating tasks. Finally, the participants were debriefed about the experiment and its purposes.

Type-aloud Scoring Procedure

To construct a coding scheme for the analysis of our data we ran a pilot study collecting data from three participants. All three participants fit the eligibility criteria, namely they were English native speakers and students with age ranging from 18-35. Initially, we constructed a coding scheme adapted from the theory of Baron (2008). This included distinct categories of Goals, Relevant Functions, Other Functions (see Table 2). After familiarisation

with the responses that participants gave, it was evident that some essential information present in responses was not captured by the existing coding scheme. Therefore, we adapted our coding scheme by including additional categories: Self-references and arguments for the irrelevance of an object to the scenario (i.e. Arguments Irrelevance). Self-reference was added as it became apparent that many answers included reference to the self. Furthermore, the Arguments Irrelevance category was added in order to capture participants' critiques, evidence, or argumentation against an object.

Intraclass correlation coefficient (ICC) was used as a reliability index for interrater reliability as prescribed by Koo & Li (2016). It was decided to use a two-way mixed-effects model with 3 raters of which the mean of the three raters was selected. ICC values are indicative of reliability with scores below 0.5 being poor, 0.5-0.75 being moderate, 0.75-0.9 being good, and above 0.9 being excellent (Koo & Lee, 2016). ICC estimates were calculated using SPSS based on mean-ratings (k=3), based on consistency agreement between raters, in a 2-way mixed-effects model. In our pilot study, ICC for Other Functions (.893) and Relevant Functions (.849) was good (Koo & Lee, 2016). All raters also had a good agreement for the Self-reference category (.838) and Argument Irrelevance (.853). Goals had a low inter-rater reliability (.217), so we changed the scoring to include a more liberal definition of what constitutes a goal. A new definition of a goal constituted any kind of goal that was implicitly or explicitly stated (see Table 2).

Table 2

Scoring Rules for Write-Aloud Protocol

Criterion	Definition	Example
Goals	Count all goals implicitly or explicitly present in the answer.	"source of water", "A suitcase is essential for travelling", "creating shelter"
Relevant Function	Count functions that are relevant to the three goals of the scenario.	"you could hunt with it" "create fire and cook meals"
Other Function	Count functions that are not relevant to the three goals of the scenario.	"shelter from the rain", "protect against the sunshine", "signal passing planes", "relevant for shelter".
Self-reference	Statements indicating personal affective response, personal trait, or anecdote related to the object.	"When my siblings and I were younger", "takes me back to being at my grandmother's house", "I always found whistles annoying"
Argument Irrelevance	Arguments for why the object is not relevant, not relating to goals or functions of the scenario.	"Pitcher wouldn't be relevant as I wouldn't want to drink that much beer", "I do not play the harp, so it would be pretty useless to have."

Note. Examples are all drawn from the responses in our pilot-data.

Results

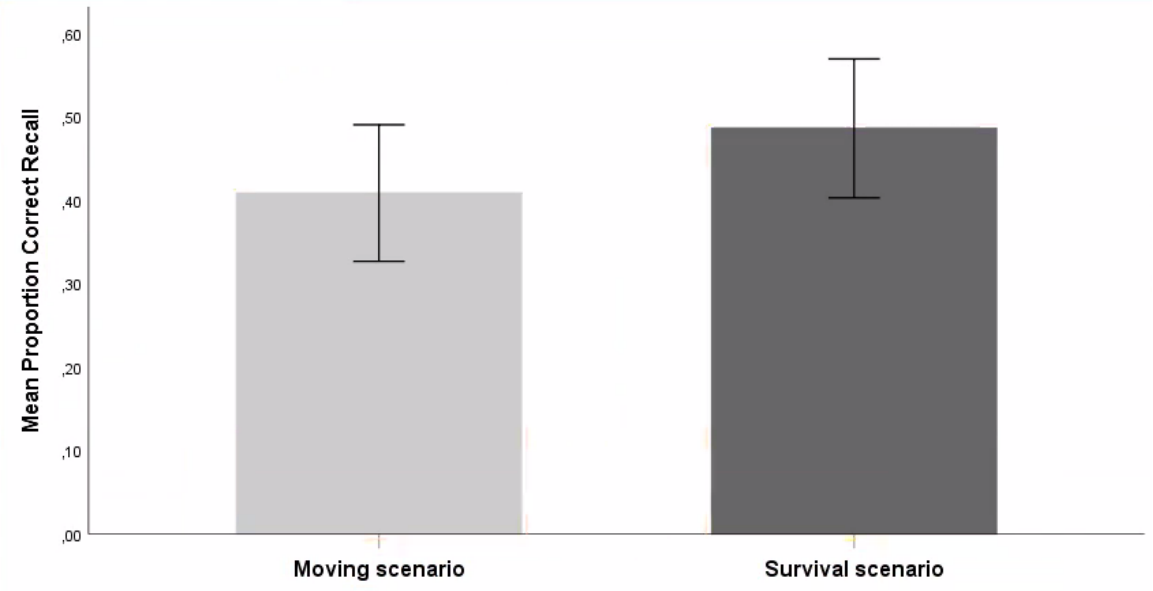
For the 12 participants, 98.61% of object ratings were provided. Overall, 4 object ratings were excluded out of a total 288. All statistical tests were run using a significance level of α =.05. Generalised Estimating Equations were used to analyse the data and to run significance tests. A probit model was used to model the dichotomous outcome variable of recall accuracy for each word and a linear model was used to model continuous outcome variables (functions generated, self-reference and arguments of irrelevance of items). Note that the category for goals was left out of the analysis. This was decided as goals appeared to be implicitly contained within the category for functions and therefore added no further information to the analysis.

The Survival-Processing Advantage

We expected that objects rated in terms of their relevance within a survival scenario would be recalled at a higher rate than objects rated in a moving scenario (Hypothesis 1). To test this hypothesis, we compared the mean proportion of correct recall within the two conditions (survival and moving) and ran a GEE main effects analysis with recall as the dependent variable and the scenario as the independent variable (survival or moving). We found that items rated in terms of their relevance in the survival condition were recalled at a higher rate ($M_{Survival}$ = .485) than items in the moving condition (M_{Moving} = .408).

Figure 1

Mean Proportion of Correct Recall across Scenario. Error bars denote 95%-CI.

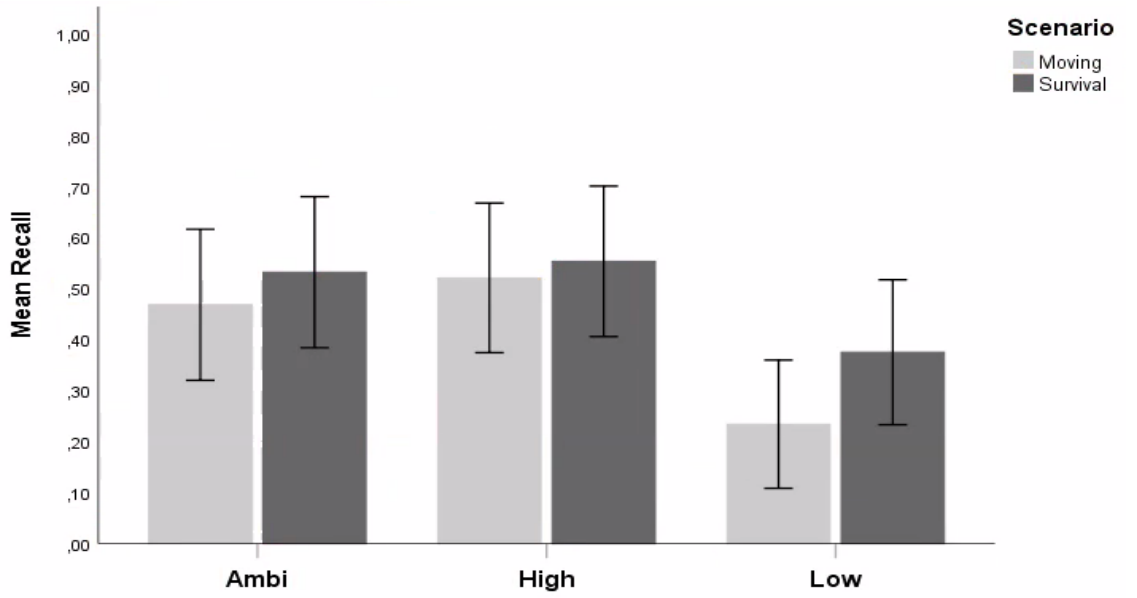


However, the main effect of the scenario on recall was not significant $X^2(1, N = 12) = 6.50$, $p = .31$. The mean proportion of correct free recall in the moving and survival scenario is shown in Figure 1.

Next, we used the GEE procedure to analyse whether the survival processing advantage would be present for objects within the different relevance categories (relevance: high, ambiguous, low). A GEE analysis for recall as a function of scenario (survival or moving) and relevance-category (relevance: high, ambiguous, low) was run. Relevance-category had a significant main effect on subsequent recall $X^2(2, N = 12) = 11.73$, $p = .003$. However, there was no interaction between scenario and relevance category $X^2(2, N = 12) = 1.36$, $p = .507$ indicating that the survival-processing advantage did not depend on the different relevance-categories, with all categories revealing no survival advantage. The differences between mean recall in the two scenarios, for objects in different relevance categories, can be found in Figure 2.

Figure 2

Mean Recall for Objects in Relevance Categories for the Two Scenarios. Error bars denote 95%-CI.



Follow-up analysis of the differences between high, ambiguous and low relevance items revealed that ambiguous and high relevance items were recalled at a significantly higher rate than low relevance items, $X^2(1, N = 12) = 10.59$, $p < .001$ and $X^2(1, N = 12) = 5.53$, $p = .019$ respectively.

In total, we did not find sufficient evidence to support the survival processing advantage per se (hypothesis 1). However, we suspect that this is due to a lack in statistical power, and the difference in mean recall between the two scenarios therefore warrants further investigation.

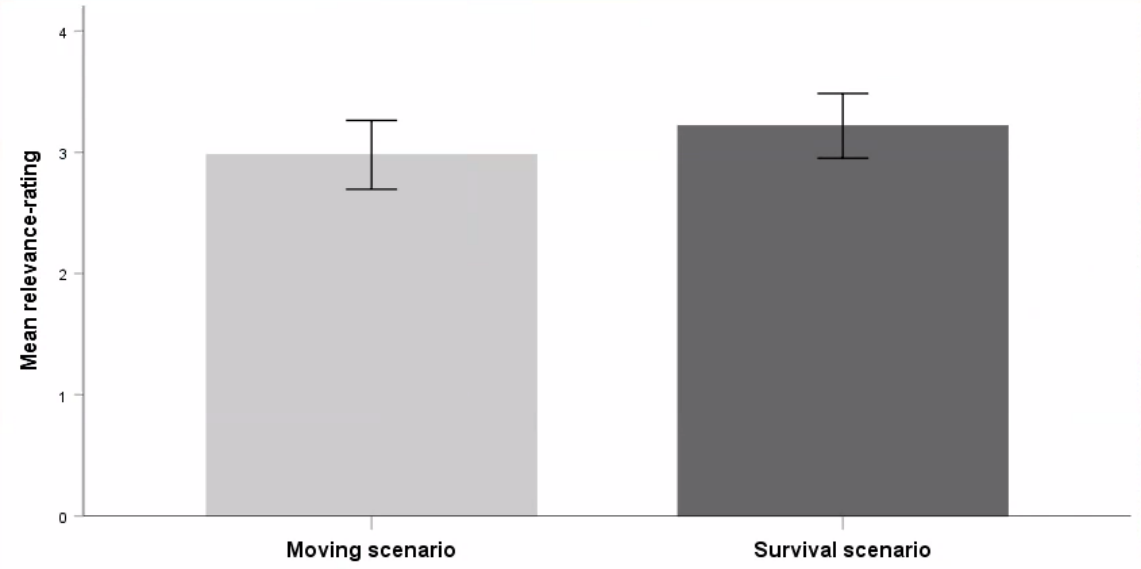
Congruency effect

We expected that words rated as more relevant would be recalled at a higher rate than words rated as less relevant or irrelevant (Hypothesis 2). We initially ran a GEE main effects analysis with mean relevance-rating as the dependent variable and the scenario as the independent variable. Scenario had no significant main effect on mean relevance-rating,

$M_{MovingRating}$ = 2.98 and $M_{SurvivalRating}$ = 3.22, $X^2(1, N = 12) = 1.68$, $p = .194$. The mean relevance rating for the moving and survival condition is shown in Figure. 3.

Figure 3

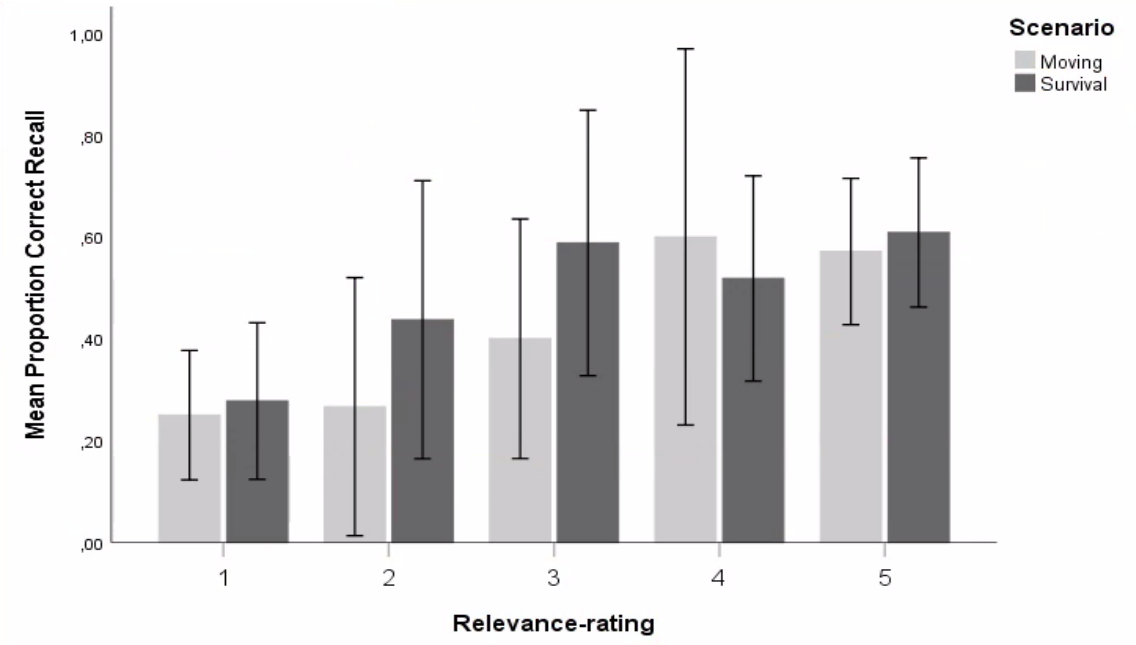
Mean Relevance-rating in terms of Scenario. Error bars denote 95%-CI.



Secondly, we ran a GEE factor analysis with recall as the dependent variable and relevance-rating and scenario as independent variables. In line with our hypothesis, relevance-ratings had a significant main effect on subsequent recall, $X^2(1, N = 12) = 6.50$, $p = .011$, whilst there was no interaction between scenario and relevance-ratings to predict recall $X^2(1, N = 12) = .07$, $p = .799$. This indicates a congruency effect where the relevance of an object independently affects memory independent of the scenario. A depiction of the relationship can be seen below in Figure 4.

Figure 4

Mean Proportion of Correct Recall as a Function of Relevance-rating. Error bars denote 95%-CI.



As a whole we found evidence in support of a congruency effect (Hypothesis 2, with significantly better recall for items rated as more relevant, rather than less relevant.

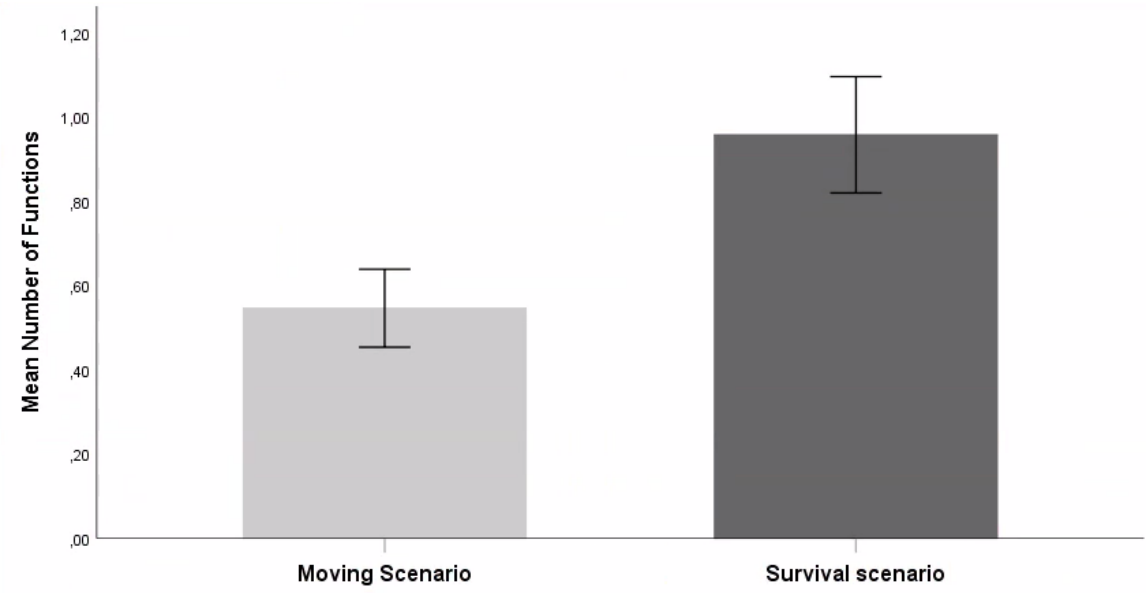
Functions

In line with the richness-of-encoding hypothesis, we hypothesised that being in the survival condition would stimulate a larger number of functions to be generated when rating items (Hypothesis 3). and we hypothesised that the number of functions generated would predict recall (Hypothesis 4). To test Hypothesis 3, we ran a GEE main effect analysis with the number of functions as the dependent variable and scenario as independent variable. A significant main effect of the scenario was found on the mean number of functions generated for an item, $X^2(1, N = 12) = 20.01$, $p < .001$; with the functions generated per object ranging between zero and four. Specifically, 63.8% of the functions generated within the study were in the survival scenario. This indicates that the survival condition prompts individuals to

engage in more elaboration. The average number of functions generated for items in the two scenarios is shown in Figure 5.

Figure 5

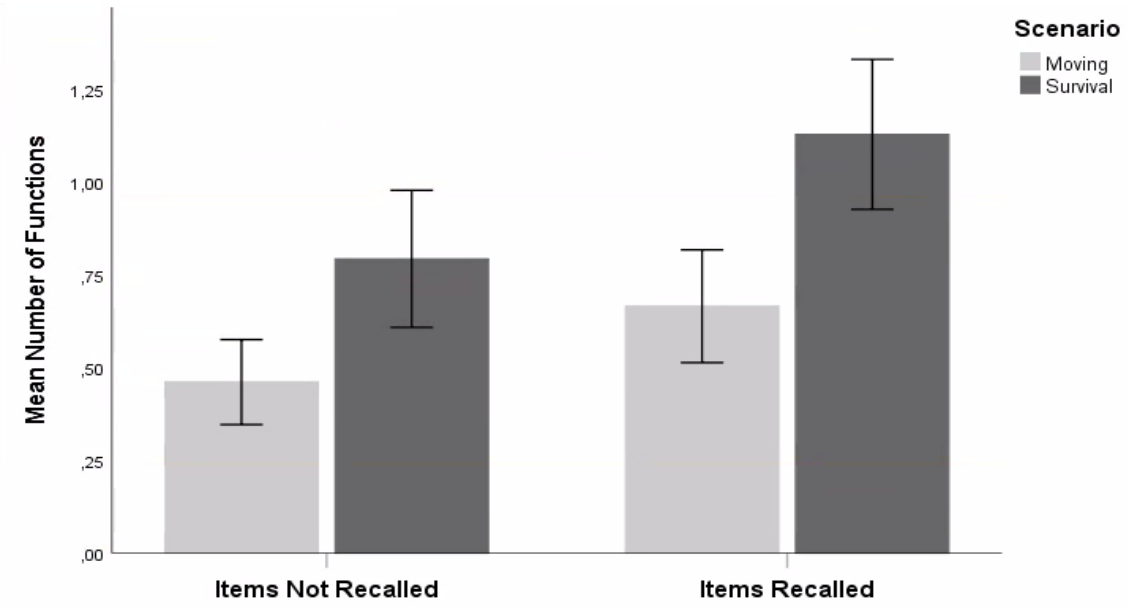
Mean Number of Functions Generated in the Moving and Survival Scenario. Error bars denote 95%-CI.



According to Hypothesis 4, the number of functions mentioned during rating would predict subsequent recall for an item. To test this hypothesis, we ran a GEE analysis with recall as the dependent variable and the number of functions and the scenario as the independent variables. The test revealed a positive main effect of functions on recall $X^2(1, N = 12) = 5.71$, $p = .017$, but no interaction between number of functions and scenario $X^2(1, N = 12) = .39$, $p = .532$. This indicates that the number of functions predicts recall regardless of scenario. The main effect of the number functions on recall can be seen in Figure 6.

Figure 6

Mean number of functions for recalled and forgotten objects across scenario. Error bars denote 95%-CI.



To further elaborate on this finding we investigated the differences between relevant functions (related to goals that were specified as part of the scenario) and other functions (related to other goals invented by the participants themselves). The differences in means for relevant functions and other functions within the two scenarios can be found in table 3 and 4.

Table 3

Mean Number of Relevant Functions for Items in the Survival and Moving Scenario

Survival	Mean	N	Std. Deviation
0	.17	141	.34
1	.40	142	.54
Total	.29	283	.47

Table 4

Mean Number of Other Functions for Items in the Survival and Moving Scenario

Survival	Mean	N	Std. Deviation
0	.37	142	.50
1	.56	142	.68
Total	.46	283	.61

Using a main effects GEE analysis with the number of relevant functions as the dependent variable and the scenario as the independent variable we found a significant effect of the scenario for the mean number of Relevant Functions $X^2(1, N = 12) = 23.58$, $p < .001$. The same procedure was repeated for the scenario effect on the mean number of other functions generated, which also produced a significant effect $X^2(1, N = 12) = 5.23$, $p = .022$. This further strengthens the evidence that being in a survival scenario stimulates elaboration and the generation of ideas in terms of object functions (Hypothesis 3).

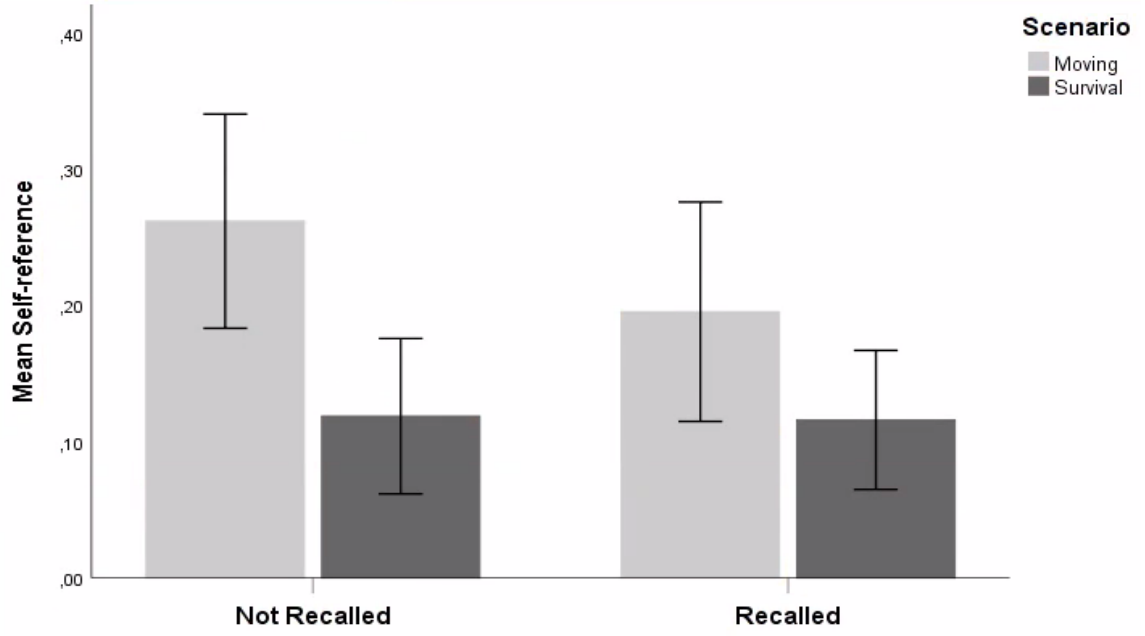
In addition, we entered relevant functions, other functions and scenario into a GEE factorial analysis as independent variables and added recall as the dependent variable. Relevant functions came close to having a significant main effect on recall $X^2(1, N = 12) = 3.57$, $p = .059$. Other functions had a significant main effect on recall $X^2(1, N = 12) = 7.99$, $p = .005$. Finally, relevant functions and other functions interacted to predict recall $X^2(1, N = 12) = 3.96$, $p = .047$. Taken together, the findings indicate that thinking about functions, whether relevant to specified goals within the scenario or in relation to self-made goals, enhances recall – supporting Hypothesis 4. In addition, more functions are thought of in a survival scenario – supporting Hypothesis 3.

Self-reference

We expected that self-referencing would positively predict recall (Hypothesis 5). We found that whilst being in the moving condition, individuals engaged in significantly more self-referencing than in the survival condition $X^2(1, N = 12) = 12.93$, $p < .001$. However, self-reference did not significantly predict subsequent recall for items, $X^2(1, N = 12) = 1.10$, $p = .294$.The mean number of self-references made for items subsequently recalled and forgotten, for the two scenarios, can be found below in figure 7.

Figure 7

Mean Self-reference for Items Recalled and Forgotten across Scenario. Error bars denote 95%-CI.



Length and reaction time

We expected that participants would use more time and think more extensively within the survival condition. In turn, the additional time taken to think about an object whilst rating it would lead to better recall (Hypothesis 6). A GEE main effects analysis was run with the length of responses as the dependent variable and scenario as the independent variable. The test revealed that participants' self-reports were significantly longer in the survival scenario

$X^2(1, N = 12) = 7.12$, $p = .008$. Secondly, recall was added as the dependent variable in a GEE factorial analysis, with length of response and scenario as the independent variables. However, length of response was not significantly related to recall $X^2(1, N = 12) = 1.63$, $p = .200$.

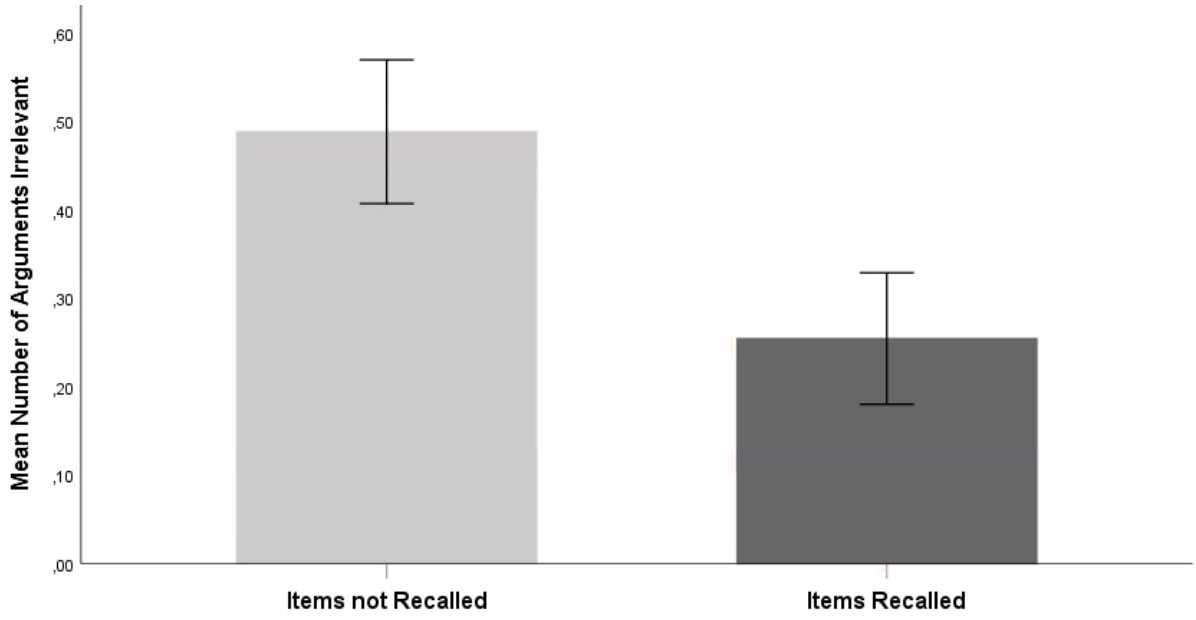
A further GEE main effects analysis, with response time entered as the dependent variable and scenario as the independent variable, did not show any significant effect $X^2(1, N = 12) = .56$, $p = .453$. In addition, a GEE analysis with recall as the dependent variable, and response time and scenario as the independent variables also found no significant effects $X^2(1, N = 12) = 0.65$, $p = .421$.

Arguments for Irrelevance

Finally, using the GEE analysis, we tested whether the number of arguments in terms of the irrelevance of an item differed significantly between the two scenarios and, subsequently, if it had an effect on recall. Scenario did not have a significant effect on the number of arguments made in terms of irrelevance $X^2(1, N = 12) = 0.06$, $p = .808$. However, the number of such arguments made had a significant main effect on recall $X^2(1, N = 12) = 5.84$, $p = .016$, such that more arguments of irrelevance led to poorer performance in recall. The mean difference in the number of arguments made against the relevance of an item across in relation to subsequent recall can be found in figure 8.

Figure 8

Mean Number of Arguments of Item irrelevance for Items Subsequently Recalled and Forgotten. Error bars denote 95%-CI.



Qualitative Analysis

The responses that participants provided when asked to write down their thoughts in response to the scenarios were evaluated in a qualitative manner. We observed several patterns within these responses.

An initial observation was that some participants elaborate more in general, regardless of the scenario encountered. Some participants wrote in the range of 20-40 words for each scenario, whereas others operated within a 150-250 range. For this reason, conclusions on the differences in degree of elaboration between participants should be drawn carefully.

For the moving condition participants tended to emphasise four different areas of concern (or goals): locating a new home, purchasing a new home, transporting belongings and finding friends. For example one participant mentioned “research[ing] of potential moving locations online, considering many places that I had travelled abroad to before” (see

Appendix A) and another participant mentioned "(…)transporting my belongings to that home."

For the survival condition participants also concerned themselves largely with four main tasks (or goals): making shelter, protecting themselves from predators, finding water and procuring food. However, these descriptions were often more detailed than those in the moving scenario. For example one participant imagined in the moving scenario that "(…)I start looking for houses, I choose one, I buy it and I start to move my things to the new house, while I start exploring the surroundings" and in the survival scenario the same participant imagined that

> (…)start to think what I'm going to do next, because I need to find supplies to feed myself, to protect myself and start evolving the situation. I'd maybe start by food, see if I can find some fruit trees or animals nearby. Then I try to find some shelter and something to cover me if its cold. Finally, I try to find something for defense like a sharp glass or something that I can use against predators.

The participant's response in the survival scenario exhibits a greater level of detail than in the moving condition. Specific objects are referenced and their potential functions within the scenario are explored. This example reflects a greater trend within this portion of the results, revealing a pattern in which the survival scenario seems to elicit exploration of concrete and novel functions, in contrast to the moving scenario in which the considerations are more general and commonplace.

Discussion

The overarching purpose of this study was to gain a better understanding of the proximate mechanisms behind the survival processing advantage in memory. The study examined the relationship between how participants assessed objects and subsequent recall within two distinct scenarios. In line with the richness-of-encoding hypothesis, we expected that engagement with a survival scenario would prompt participants to elaborate in greater detail on the potential uses for an object and that this in turn would lead to a greater recall, exemplifying the survival processing advantage.

In order to explore this relationship directly, we used a process-tracing procedure, in which individuals wrote down their immediate thoughts as they participated in the experiment. Examining the efficacy of utilising this type-aloud procedure to study thought processes within the survival-processing paradigm was a secondary aim of the study.

Perspectives on the Survival-processing Advantage

Nairne et al. (2007) found a strong mnemonic effect for words processed within a survival scenario, arguing that this indicates that the declarative memory system has evolved to be especially tuned towards fitness-relevant information. These findings set the stage for further investigation into the mechanisms that constitute the described effect. To that end, Kroneisen and Erdfelder (2011) found that keeping the scenario survival relevant, but restricting the amount of elaboration possible within it, diminishes and perhaps completely removes the survival processing advantage. In addition, Röer et al. (2013) showed that the number of ideas generated about an object within a survival scenario is significantly larger than in control conditions and, subsequently, that the proportion of correct recall can be seen as a direct positive function of the number of ideas generated. Kroneisen et al. (2021) further showed that the survival processing advantage was most pronounced for objects low in

functional fixedness, in particular for words predefined as being irrelevant, indicating that objects that allow for more elaboration allow for a stronger survival processing advantage.

As a whole, these observations grant credence to a richness-of-encoding hypothesis, which suggests that distinctive and elaborate forms of encoding brought about by a survival scenario predicate the survival processing advantage.

Furthermore, previous research has debated whether the survival processing advantage is attributable to congruity effects. To test for congruity effects within the survival processing paradigm Butler et al. (2009), matched the type of processing (i.e. scenario: robbery or survival) with one of three word lists (irrelevant words, robbery-relevant words, or survival-relevant words) and ran the experiment as per usual. The results showed that the survival-processing advantage disappears when controlling for congruency (robbery wordlist – robbery processing versus survival wordlist – survival processing). Replicating these findings whilst adding a task of writing down any ideas that came to mind whilst performing the word ratings, Röer et al. (2013) found a congruency effect with both more ideas generated and enhanced recall when words were congruent with the imagined context. In contrast, Nairne and Pandeiradas' (2011) findings maintain a robust survival-processing advantage for both irrelevant words, highly congruent words, and for a mix of both. This indicates that the survival-processing advantage is not simply a result of congruent encoding. Whilst there is disagreement to what extent congruity is driving the survival-processing advantage, a point of agreement is that congruity as such leads to improved recall across scenarios.

The findings mentioned above guide the establishment of our main hypothesis: that being in a survival-scenario stimulates the number of functions being generated for an object, which subsequently enhances recall for that object, making up the survival-processing advantage. Moreover, we suppose that congruence between object and scenario is an

indispensable facet of memory for objects, regardless of the scenario, facilitating rich encoding and consequently enhanced recall.

Primary Outcome 1: Demonstrating the Survival Processing Advantage

In an attempt to replicate the survival processing advantage, the first hypothesis of our study maintained that evaluating objects in terms of their relevance in a survival scenario would lead to better recall than doing so in a moving scenario. An increase of eight percent was found for the mean proportion of correct recall for items evaluated in the survival scenario rather than the moving scenario, closely resembling the difference found by Nairne et al. (2007). However, our results were not statistically significant.

Taking into account the pronounced survival-processing advantage that previous research has demonstrated (see e.g., Nairne et al., 2007; Kroneisen & Erdfelder, 2011; Röer et al., 2013; Bell et al., 2015; Nairne & Pandeirada, 2016), we suspect that the lack of significance reflects a lack of power in the study, rather than the absence of survival processing. With the achieved power of our study estimated to be between 51 and 76 percent (depending on the correlation assumed between the repeated measures), calculated using the within-subjects effect-size of .15 for the survival-processing advantage (Schofield et al., 2017). Thus, the current study is below the usual 80% criterion for power.

Primary Outcome 2: The Congruency Effect

The study's second hypothesis asserts that higher relevance-rating of an item will positively predict recall regardless of scenario. In line with Nairne et al. (2007) we were able to replicate a congruency effect, so that objects rated as highly relevant elicited better recall regardless of scenario. However, as relevance-ratings did not differ significantly between the scenarios the congruency effect cannot account for the increased recall-rate in the survival condition.

We also found that the number of arguments that participants made for why an item was irrelevant within the context of the scenario correlated with lower recall rates for the given object. This reveals a similar trend to those identified by Röer et al. (2013), in which objects incongruent with the scenario were recalled at a lower rate than objects congruent with the scenario. These outcomes are also consistent with the depth of processing theory presented by Craik & Tulving (1975), according to which a stimulus that forms an integrated unit with a context is more likely to be remembered.

Primary Outcome 3: Scenario and Elaboration

The study's third hypothesis was that being in a survival scenario stimulates the generation of a larger number of ideas (i.e. functions) for objects than being in a survival irrelevant scenario. Results from our analysis support this conclusion. When operating within the survival scenario participants generated more ideas about the possible uses of an object as compared to within the moving scenario. Engaging in the evaluation task within the survival scenario also prompted elevated levels of elaboration to take place, both in terms of functions related to the goals specified within the scenario and functions related to self-made goals. These results are consistent with the findings by Röer et al. (2013), showing that a survival scenario stimulates the generation of ideas over and above survival irrelevant conditions.

Primary Outcome 4: Elaboration and Recall

It was also hypothesised that the number of functions thought of whilst evaluating the relevance of an object would positively predict recall. In line with the richness-of-encoding hypothesis (Craik & Tulving, 1975), more elaboration during encoding within either scenario should enhance performance on subsequent recall. Our results show that recall was predicted as a positive function of the number of uses generated for an item regardless of scenario. These findings align with previous research in which the survival processing advantage could

be suppressed by restriction of the potential for elaboration (Kroneisen and Erdfelder, 2011; Kroneisen et al., 2021).

Secondary Outcome: Type-Aloud Procedure

Another major finding in this study is that a written adaptation of the think-aloud process tracing procedure can be used to directly study the survival-processing advantage. The type-aloud procedure allowed us to capture a significant amount of information in terms of the thought content of participants at a relatively low resource cost, circumventing the technical challenges of recording audio and the potentially lengthy process of transcription. Furthermore, the written adaptation enabled the possibility of online recruitment and participation in the study. As a method of process tracing the type-aloud procedure gave us direct access to the content of participants' thoughts as they rated objects in terms of their relevance in a survival scenario and in a control scenario. In addition, the strong interrater reliability for relevant functions, other functions, arguments of irrelevance and self-reference indicate that the subsequent scoring procedure is a reliable and useful method for inquiry into the survival processing advantage.

The Search-Inference Framework

The search-inference framework by Baron (2008) was used to establish a general guideline for coding participants' responses (i.e. thoughts) as a series of searches for objects/ functions and inferences on how these might help in achieving a given goal(s). Coding responses in terms of searches for functions was generally easily applicable, with participants promptly and explicitly stating functions when rating items, and high agreement between raters. Goals, however, proved to be difficult to code for (as suggested by lower interrater agreement) as they were generally only hinted at or implicitly touched upon when participants spoke about functions. This makes sense conceptually, as functions always implicitly refer to some aim.

Bridging the Quantitative and the Qualitative

Insights gathered by the type-aloud method pertain to the participant's imagination of the scenarios prior to the engagement in the relevance-rating task. In the participants' initial imagination of the scenarios a notable difference is found between the survival and the moving scenario. Whereas participants imagine relatively ordinary and commonplace concerns for moving (e.g. finding the right location, transporting belongings etc.), they imagine highly vivid, specific and unusual concerns for survival (e.g. participants looking for water sources by seeing if there are any hollow logs to collect rainwater in, speculating whether one could find a sharp rock to use as a knife, set up traps to hunt, etc.)

It appears that most participants, when imagining the moving scenario, mainly consider the scenario at the level of stating their goals (e.g. finding the right location or finding friends). In contrast, participants in the survival scenario are already looking for specific objects, considering their functions, and asserting how these could help them attain their goals within the survival situation. In terms of the search-inference framework participants mainly concern themselves with re-stating goals in the moving-scenario, but already appear to be engaged in a search and inference processes within the initial imagining of the survival scenario; participants search for objects, specify their functions and infer how they could accomplish goals within the scenario.

This finding indicates that the initial imagination of the scenario might have implications for the survival processing advantage beyond the elaboration made during encoding of specific objects in the relevance rating task. That is, the initial richness of the imagined scenario, the initial engagement in a search-inference process, might facilitate, and interact with considerations about the objects during the relevance-rating task to more effectively stimulate elaboration on possible uses.

Limitations and Suggestions for Future Research

Streamlined method development, as well as detailed analysis of individual responses, necessitated a small sample size. Having demonstrated the viability of the type-aloud procedure to directly study the relationship between thought content and memory, we posit that this study serves as a reasonable starting point for further investigation of the topic. Presumably, the implementation of a larger sample size would effectively reproduce the survival processing advantage and would allow for further consolidation of the developed method.

Apart from the overt limitation originating from the small sample size, the current study focuses primarily on the number of possible uses for objects rated and their relation to the subsequent recall. However, many other mechanisms have been thought to be responsible for the survival processing advantage, for example, Bell et al. (2015) tested whether a focus of threat when rating words would elicit a stronger survival processing effect than thinking about functions. In a similar vein, the type-aloud method could be used to explore the content of participants' thinking during a focus on threat or other previously suggested mechanisms responsible for the survival-processing advantage.

As mentioned previously there seems to be a connection between participants' initial imagination of the survival scenario and the generation of functions during the rating task, which subsequently stimulates a survival processing advantage on recall. An experimental procedure could replicate the study by Kroneisen and Erdfelder (2011), in which participants are placed in a moving scenario, the ordinary survival scenario (i.e. three goals), or a shortened version of the survival scenario (i.e. one goal), using our setup and type-aloud protocol. This could allow for an in-depth investigation of the potential connection between the initially imagined scenario and the subsequent amount of elaboration in the rating task.

Conclusion

The current study provides a first-of-its-kind direct exploration of the proximate mechanisms behind the survival processing advantage. It is shown that a write-aloud protocol and a coding scheme specifying thinking about the uses of objects towards particular goals as criteria for thought-evaluation can be used to effectively study such mechanisms. Our study shows that the number of functions thought of during encoding of an object positively predicts the ability for recall and that this effect occurs regardless of the context specified by the scenario. However, we also find that the survival scenario is especially apt at making individuals think about possible uses for objects, with the survival condition revealing a clear effect on the number of functions generated across objects. Finally, we show that objects rated as more relevant to the scenario are recalled at a higher rate, suggesting that objects that are more congruent with the scenario allow for more elaboration and therefore recall. As a whole our findings support a richness-of-encoding account of the survival processing advantage, where an increasing number of potential uses thought of for an object leads to improved recall within a survival scenario. Furthermore, we suggest that our finding fits well within an evolutionary account for the survival processing advantage, according to which ancestral selection pressures have tuned our declarative memory system to generate more ideas during a survival situation. These ideas in turn function as retrieval cues to elicit the survival processing advantage.

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Appendix A

Participants Imagination of the Scenarios

Moving scenario

Participant 1:

"I would be excited to move to a new home. I would look for the new home on property websites and find the best agency. I would fly to that country to go view the houses, when I find the one I love, I find the right transport and move to my new house with all my belongings. Then I would find a job and explore the town/city and hopefully meet new friends that stay more than 3 streets away from me"

Participant 2:

"I find myself moving to a new house in a foreign place. I start looking for houses, I choose one, I buy it and I start to move my things to the new house, while I start exploring the surroundings"

Participant 3:

"Decide on a country and which region I would like to move to. Do lots of research, ask family and friends for opinions. Find a property, potentially fly out and view it before buying. Sell my current home to afford the new one. Ensure that I have all the correct legal documents and things such as my passport. Potentially start to look for new employment in the new country, quit my current job. Start packing up all my belongings, and arrange for them to be transported to the new country, sell anything that is too big to take. Book my flight. Say goodbye to family and friends."

Participant 4:

"planning to move to a new home in a foreign land and will need to device a plan for the move"

Participant 5:

"I am imagining that I would need to secure an appropriate visa first, to ,make my stay in the country I am moving to legal. Then I would start to research house prices and cities with the best quality of life. I want to live near nature and a nice arts scene. When I figured out the city I want to live in I will narrow down specific suburbs that fit my criteria. I will set up inspections for when I arrive in the country, making sure I have the money prepared to buy a house. I will also have accommodation prepared on arrival. I will investigate banking and taxation laws in the new country I plan to live in."

Participant 6:

"First I will be anxious as I will be moving away from my family and friends and in a new place where I don't know anyone. But I will also be thrilled to start afresh."

Participant 7:

"I am slightly stressed about relocating to a foreign land and worry about whether I will find friends and a support structure similar to the one I have at home. The thought of transporting my belongings also worries me right now as I don't know if my belongings would be handled with care or if one of the driver's delivering my things would steal them."

Participant 8:

"In a few months I am moving away to a new place in a foreign land. The next few months will be spent relocating, looking for a new home and also transporting my belongings to that home. It is an extremely challenging process as I will be leaving most of the people I know behind to start a new life somewhere else."

Participant 9:

"I just got the big news that my visa application has been accepted for Canada. I have to now decide what I should bring and what I should sell. I first need to get a few boxes and pack the most important things like clothes and memory boxes and photos. Then I need to call a moving service and pack my bags."

Participant 10:

"I imagined myself moving to the Netherlands. I read an article a while back about this company that recruits employees and offers them a chance to move overseas, one of the countries they dealt with was the Netherlands. I imagined moving there, without knowing anybody in the country and starting my life there. Finding a house, finding local places to visit, meeting new people and friends, sorting out all the minor stuff like bills and healthcare, I imagined it all."

Participant 11:

"My first thought would be to carry out research of potential moving locations online, considering many places that I had travelled abroad to before and whether I found them suitable for spending my life there. I would also contact friends or family for their input, especially if they had travelled to locations abroad too, asking whether they enjoyed it, what it is like, etc. It would take many weeks of research especially if I am not able to travel beforehand to the locations to find which I find the best, something that is likely to be stress inducing. After many weeks of research I would immediately get the ball rolling on moving, putting my old place up for sale, researching if or how I can transport my furniture and belongings, deciding on a couple of properties that I can then finalise to just one option. I would also make sure to start learning some basics of the language if they did not speak the same language as me, as well as researching some of the culture to understand how to act respectfully during my time there. Before leaving, I would have to make sure I spent plenty of time with friends and family, as it will be on the rare occasion that I will get to see them from then onwards."

Participant 12:

"I am imagining myself house hunting for a house that I and my family would love. I'm also thinking about how it's going to be a challenge changing places, especially for my kids."

Survival scenario

Participant 1:

“Thats crazy! Ok, I would build a shelter with the grass by braiding it. Then I would find tree branches and plant them into the soil so that I can twist the grass on it and pray that I dont get rained on for the remaining months im there. For food, I would go haunt for herbivore animals and start fire (TO COOK) with sliding tree branches to the grass like the way its done in movies. For bathing and washing clothes, I would find the nearest lake/dam. And then for entertainment I would just watch the sunset. For social interaction, i would go crazy and try myy best to move away from the grassland”

Participant 2:

“I find myself lost in stranger lands, with nothing on me. I start to think what I'm going to do next, because I need to find supplies to feed myself, to protect myself and start evolving the situation. I'd maybe start by food, see if I can find some fruit trees or animals nearby. Then I try to find some shelter and something to cover me if its cold. Finally, I try to find something dor defence like a sharp glass or something that I can use against predators”

Participant 3:

“I would check to see if there was anyone else around, and get a sense of my environment - try and map it out. Identify what potential threats and predators are around. Collect dry wood and grass and try and start a fire before it gets dark for warmth and to keep predators away. See if there are any water sources near by, if not see if there is anything hollow e.g. hollow log, that I could use to collect rain water. See if there are any sharp stones that could be used as a knife. Set traps to try and catch animals. Identify a safe environment that I could use as a shelter, maybe sleep in a tree to avoid predators.”

Participant 4:

"Being stranded in an island stuck with no supplies and have to consider the danger that lurks in the darkness , predators"

Participant 5:

"If I was stranded in the grasslands of a foreign land, I would first try to find a water source. Once I have found a consistent water source I would Build a small shelter for myself with sticks, leaves and mud. I would sharpen a strong stick to use as a weapon, using a flat rock to sharpen it. I would attempt to fish in the water source or forage for food. Once I have small stockpile I would build a fence with sharpened sticks to protect myself when I am resting."

Participant 6:

"Survival mode, I will need water so I have to find a stream, a place to set my camp then explore the place"

Participant 7:

"I am stranded in this foreign land with no shelter, no sets of clothing, and no food and water. I am extremely afraid and there are a lot of feral predators in these grasslands which makes me an easy target especially since I am weak from not eating enough and having adequate."

Participant 8:

"It has been 3 days since I am stuck in this unfamiliar place I find myself in, I have stranded in this place and all I see from as far as my eye can see is grass. With no basic materials I have to resort to natural ways of getting supplies, food, water, shelter and also protect myself from the dangers of the predators that are endemic to this place. The nights are very cold and I often use the grass as my shleter as I had built a grasshouse for shelter and protection from the freezing night weather and the predators that roam through the night."

Participant 9:

"Theres long grass and tress in the distance, I grab a bundle of long grass and walk towards the trees trying to conserve energy and absorbe my surroundings, keeping an eye out for

predetors likes snakes and lions, or even tigers. once I get to the trees I try to get materials to build a fire and fashion weapons out of branches. I walk around my new campsite looking for berries, fruit or small animals so that I can eat."

Participant 10:

"I imagined I was washed ashore onto a small island after a catastrophic shipwreck. I have no food, no water and no way of contacting for help. I'm basically stranded and all I have is myself to look out for against any threats and predators that inhabit the island. And also against another big threat; my sanity."

Participant 11:

"The area is a dense forest, stretching out as far as the eye can see and then some. The forest in packed with wildlife, mainly creatures of the friendlier ilk, although can still pose a threat if you encroach on their territory. The trees are bustling with noise, the wind rustling the leaves, the birds tweeting throughout the day. The forest is not flat, its on several small slopes and hills, not steep enough to be difficult to walk up, but enough to notice they are there. Atop the mounds there are small streams gently trickling down small pebble pathways, where they end, nobody knows, they seem to wind down the hill endlessly. All you know is, the water seems safe and clean enough at the source. At night is where some of the danger lies, the quiet, calm night sky occasionally interrupted by the howls of wolves, never near enough to tell where they are, never far enough to feel safe."

Participant 12:

"I am panicking in my imagination as I am imagining this."