Mem Cogn (2011) 39:1033–1041
DOI 10.3758/s13421-011-0091-2

Adaptive memory: Stereotype activation is not enough

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Published online: 29 March 2011

Abstract Studies have shown that survival processing leads to superior memorability. The aim of the present study was to examine whether this survival recall advantage might result from stereotype activation. To test this hypothesis, we conducted a pilot study and two experiments in which participants were primed with stereotypes (Experiment 1, professor and elderly person; Experiment 2, survival-stereotype). In Experiment 1, 120 undergraduates were randomly assigned to a survival, professor stereotype, elderly person stereotype, or moving scenario and rated words for their relevance to the imagined scenario. In Experiment 2, 75 undergraduates were given a survival, survival-stereotype (based on our pilot study), or moving scenario. Both experiments showed that survival processing leads to a greater recall advantage over the stereotype groups and control group. These data indicate that the mere activation of stereotypes cannot explain the survival recall advantage.

Keywords Adaptive memory · Stereotypes · Memory · Evolution

Introduction

Memory scholars only seldom look at the functional characteristics of memory. In response to this empirical void, researchers have recently begun to adopt a more functional approach to the study of memory (e.g., Nairne, Thompson, & Pandeirada, 2007; Otgaar, Smeets, & van Bergen, 2010; Weinstein, Bugg, & Roediger, 2008). Taken together, the findings of this recent research line seem to indicate that fitness-relevant processing results in superior memorability. In their original study, Nairne et al. (2007) asked undergraduates to imagine themselves being in a survival situation without any basic necessities and in fear of dangerous predators. Next, they received nouns (e.g., *pepper*, *chair*, *catfish*) that had to be rated for their relevance to the imagined situation. Finally, they were presented with a surprise free recall test. Nairne et al. (2007) showed that relative to control conditions in which the same words were rated from a different perspective (i.e., imagining moving, pleasantness, self-reference), recall performance was superior when the words were encoded for their fitness relevance.

Since the first publication of Nairne et al. (2007), the issue of adaptive memory has rapidly attracted scientific interest. More specifically, researchers have examined under what conditions the survival recall advantage persists by comparing the survival scenario with a host of known memory enhancement techniques (e.g., Kang, McDermott, & Cohen, 2008; Nairne, Pandeirada, Gregory, & Van Arsdall, 2009; Weinstein et al., 2008). To give just a few examples, Nairne, Pandeirada, and Thompson (2008) compared the survival scenario with conditions in which participants had to rate words for imagery and self-reference, while Kang et al. used a control condition that mimicked the survival scenario with respect to arousal, novelty, and media exposure (i.e., planning a bank heist). In both studies, the mnemonic advantage of the survival scenario remained present. Moreover, this superiority was even obtained when other classes of stimuli were employed

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(i.e., pictures; Otgaar et al., 2010) or when the survival scenario was compared with a modern survival situation (i.e., surviving in the city; Nairne & Pandeirada, 2010). Overall, these studies indicate that the survival recall effect is a robust phenomenon.

There are a few studies that could not reproduce the survival recall advantage. Klein, Robertson, and Delton (2010), for example, showed that when the survival group was contrasted with a condition in which words were encoded for future planning (i.e., rating words for relevance to planning to take a camping trip in the forest), the survival group did not demonstrate superior memory performance. Instead, recall was highest for the group that processed words for future planning (see also Klein, Robertson, & Delton, 2011). Although Klein and colleagues explained their finding as evidence that memory has adapted to preferentially process information for future times, one could likewise argue that the survival recall advantage is subject to certain boundary conditions. Indeed, in a recent study, Otgaar and Smeets (2010) showed that processing words for their survival relevance not only prioritizes true recollection, but also promotes false recollections in both adults and children (see also Howe & Derbish, 2010). Furthermore, Otgaar and Smeets found that the survival recall advantage disappeared when net accuracy scores were used that took the total output (i.e., true + false recall) into account. Finally, in a study by Butler, Kang, and Roediger (2009), the survival recall effect vanished when type of processing and materials were congruent with each other.When the authors presented participants in the survival condition with survival-related words (e.g., *rescue*, *fire*, *shelter*), no survival recall advantage emerged (but see Nairne & Pandeirada, 2011). Collectively, these studies provide evidence that the survival recall advantage operates within certain boundaries.

At this point, only a few studies have attempted to investigate the possible causes of the survival-processing advantage. Indeed, Nairne and Pandeirada (2008) argued that "[a]t this point the data say very little about the proximate mechanisms that underlie the survival advantage in memory" (p. 242). A viable candidate for such a proximate mechanism could be stereotype activation, the idea being that survival processing is tied in with the activation of certain stereotypes that could be beneficial to later recall performance. In stereotype activation studies, participants typically have to imagine belonging to a certain stereotype (e.g., a professor; see, e.g., Dijksterhuis & van Knippenberg, 1998), and the instructions used for this are comparable with the survival instruction. Specifically, stereotypes are commonly regarded as schematic knowledge structures containing several trait concepts and are known to be able to guide individuals' behaviors. Bargh, Chen, & Burrows (1996, Experiment 2), for example, showed that participants who were primed with an elderly person stereotype walked significantly slower down the corridor when leaving the lab room than did participants who were not primed. Dijksterhuis and van Knippenberg demonstrated in their study that the activation of stereotypes also impacts intellectual performance. They showed that participants who were asked to think of a college professor and write down everything that they considered typical professor characteristics subsequently answered more Trivial Pursuit questions correctly than did no-prime control participants.

There is additional evidence that stereotype activation affects memory performance. In a study by Levy (1996), elderly participants were primed with positive (e.g., *creative*, *alert*, *wise*) or negative (e.g., *decline*, *senile*, *dementia*) words related to the elderly. Next, they were provided with several memory tasks. As was expected, participants demonstrated improved memory performance when confronted with positive words and showed deteriorated performance when they received negative words. Furthermore, Levy showed that this effect could not be explained by mood differences. This result was replicated by Hess, Hinson, and Statham (2004), who also found that memory performance deteriorated when participants were primed with negative stimuli. In a related study, Dijksterhuis, Aarts, Bargh, and van Knippenberg (2000) demonstrated that after being primed with an elderly person stereotype, memory performance was poor for participants who indicated having a lot of contact with the elderly, as compared with participants who reported having little contact with the elderly.

Furthermore, Van Knippenberg, Dijksterhuis, and Vermeulen (1999) found that stereotype activation affects memory for a criminal act. In their study, a negative (i.e., hard drug addict) or positive (i.e., respectable bank employee) stereotype was activated. Then participants received information about a crime (i.e., breaking into a private home and stealing various items) in either a low processing load (i.e., self-pacing) or a high processing load (i.e., information was presented very quickly). Finally, they were tested for their memory of this criminal action. The authors found that under high load, a negative stereotype resulted in a better memory for incriminating evidence than when a positive stereotype was activated.

Altogether, these findings clearly demonstrate that stereotype activation can impact behavior (e.g., motor behavior) and, more important for our study, even memory performance. In the present study, our hypothesis was that the survival recall advantage is caused by the survival instruction's eliciting a strong stereotype of a person who is mentally (e.g., excellent memory, intelligent) and physically (e.g., healthy, muscular) fit to survive. Our hypothesis was that these positive mental and physical connotationslead to superior memory performance. To examine this, we conducted a pilot study and two experiments.

The goal of our pilot study was to examine whether people would think of a strong stereotype when reading the survival instruction. Thus, we asked participants to read the original survival instruction and write down the type of person they were thinking of when reading the scenario, mentioning the specific (personality or physical) characteristics associated with a person in this survival situation. These descriptions were used for the construction of a survival stereotype instruction that we employed in Experiment 2 (see below).

In Experiment 1, we compared the standard survival condition with two stereotype conditions (a professor or an elderly person), as well as with the standard moving condition. Our reason for including a professor and elderly person stereotype was twofold. To begin with, previous stereotype activation studies have demonstrated that these stereotypes have robust memory effects (Dijksterhuis & van Knippenberg, 1998; Levy, 1996). Second, we included these stereotypes because we were interested in stereotypes that could lead to better (professor) or worse (elderly person) memory performance. Thus, Experiment 1 explored whether a survival recall effect would still emerge when pitting the survival scenario against a strong stereotype (professor) known to enhance memory performance. In the professor stereotype condition, participants had to imagine that they were a professor specialized in the functioning of memory, while participants in the elderly person stereotype condition were instructed to imagine being an elderly person with Alzheimer's disease. As is typical for survival recall studies, participants subsequently were presented with words that had to be rated for their relevance to the imagined scenario and, finally, were given a surprise free recall test. We predicted that the professor stereotype group would match the recall performance ofthe standard survival group and that both conditions would also lead to higher recall levels than would the standard moving scenario. We expectedthat the newly introduced elderlyperson stereotype condition would result in the worst recall performance.

In Experiment 2, the standard survival condition was contrasted with a survival stereotype and the standard moving condition. In the survival-stereotype condition, participants were asked to imagine being a person who was mentally and physically strong enough to survive. Our prediction was that this survival-stereotype condition would match the survival group and lead to higher recall than would the moving condition.

Pilot study

Method

Participants Undergraduate participants (N = 15, M_{age} = 26.13, SD = 5.71; 3 men) were involved in this pilot study. They participated voluntarily, and all were students from the Faculty of Psychology and Neuroscience, Maastricht University.

Procedure Participants were asked to read the standard survival instructions,which were taken from Nairne et al. (2007) and translated into Dutch. Next, they had to write down the type of person they were thinking of when reading the scenario, as well as the specific (personality or physical) characteristics associated with a person in this survival situation. This task lasted for 5 min. The survival instruction read as follows:

> In this task, we would like you to imagine that you are stranded in the grasslands of a foreign land, without any basic materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from predators. We are going to show you some words, and we would like you to rate how relevant each word would be in this survival condition. Some of the words may be relevant and others not-it's up to you to decide.

Results and discussion

We defined positive traits as traits that might be advantageous for physical and psychological well-being and negative traits as traits that could adversely affect physical and psychological well-being. Two independent raters scored the traits. Overall, when describing the type of person, participants mentioned positive traits (n = 118; e.g., *intelligent*, *creative*, *healthy*) more often than negative traits (n = 1; i.e.,*lonely*; interrater reliability, κ = .80). So, in other words, in this pilot study, participants described, in total, 118 positive traits and only 1 negative trait.When we looked at the percentages of specific words (e.g., *healthy*) that participants generated in their descriptions, we found the following. The most frequently mentioned associations written down by the participants—that is, healthy (15%), intelligent (20%), good memory (14%), physically strong (20%), much energy (10%)—together made up 79% of the descriptions.

We found that when people were asked which characteristics they thought of when reading the survival instruction, positive traits predominated in participants' descriptions. As such, these positive traits could result in superior memory performance. To explore whether the survival instruction would outperform often-used stereotypes (Experiment 1) or a new survival stereotype instruction (Experiment 2), we conducted two experiments.

Experiment 1

Method

Participants One hundred twenty undergraduates (M_{age} = 21.18 years, *SD* = 3.73; 33 men) were involved in this experiment. They received course credit or a financial reimbursement (€5) for their participation. Testing took place in separate laboratory rooms at the university. Sessions lasted for approximately 30 min. The experiment was approved by the standing ethical committee of the Faculty of Psychology and Neuroscience, Maastricht University.

Materials We used a Dutch translation of the stimulus materials employed in previous studies (e.g.,*mountain*, *pepper*; Nairne et al., 2007). They contained 30 words of typical members selected from 30 unique categories (Van Overschelde, Rawson, & Dunlosky, 2004).

Design and procedure The present experiment employed a between-subjects design with condition (survival, professor stereotype, elderly stereotype, and moving) as an independent variable. Participants were randomly assigned to the survival (*n* = 30), professor stereotype (*n* = 30), elderly stereotype (*n* = 30), or moving (*n* = 30) group. More precisely, they received a Dutch version of one of the following scenarios:

> *Survival:* In this task, we would like you to imagine that you are stranded in the grasslands of a foreign land, without any basic materials. Over the next few months, you'll need to find steady supplies of food and water and protect yourself from predators. We are going to show you some words, and we would like you to rate how relevant each word would be in this survival condition. Some of the words may be relevant and others not-it's up to you to decide.
>
> *Professor stereotype:* In this task, we would like you to imagine that you are a college professor. You are specialized in the functioning of memory and in how memory can be optimized. We are going to show you some words, and we would like you to rate how relevant each word would be in this professor condition. Some of the words may be relevant and others not-it's up to you to decide.
>
> *Elderly person stereotype:* In this task, we would like you to imagine that you are an elderly Alzheimer's patientin a nursing home. Your memory is extremely poor and sometimes you cannot even recognize your family members. We are going to show you some words, and we would like you to rate how relevant each word would be in thiselderly condition. Some of the words may be relevant and others not-it's up to you to decide.
>
> *Moving:* In this task, 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. We are going to show you some words, and we would like you to rate how relevant each word would be in this moving condition. Some of the words may be relevant and others not-it's up to you to decide.

After they received the instructions, participants were asked to rate the relevance of the 30 words for the imagined scenario. Words were presented on a computer screen,one after the other, in the same random order, each word lasting for 5 s. Before the task started, they received two practice words to make sure that they comprehended the procedure. They had to rate the words on a scoring sheet using a 5-point rating scale with 1 referring to *totally irrelevant* and 5 signifying *extremely relevant*. They were alerted that they had to respond within a 5-s presentation interval, and no information was provided about a later memory test. Next, they had to play Tetris for 2 min as a distractor task. Finally, they were instructed to write down all the words they had encountered during the task. This final recall test lasted about 10 min.

Results and discussion

One-way analyses of variance (ANOVAs) were conductedon the dependent variables (correct recall, false recall, word relevance ratings). Posthoc comparisons were performed using Tukey's honestly significant difference tests. Figure 1 displays the mean proportion of correct recall per condition. We found a significant effect of condition, $F(3, 116) = 15.35$, $p < .001$, $\eta_p^2 = .28$, with the survival group displaying superior retention, as compared with the other three groups (all $ps < .05$). Furthermore, our results showed that participants in the professor stereotype and the moving condition remembered significantly more

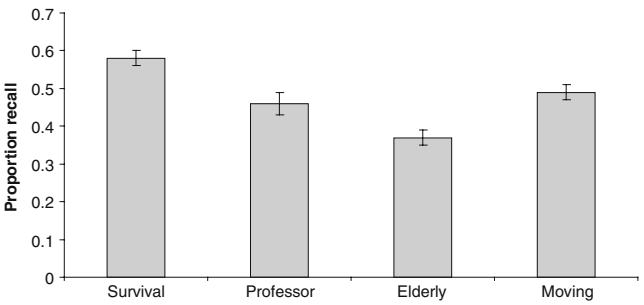

Fig. 1 Mean proportions (and *SEM*s)of correct recall as a function of condition (Experiment 1)

words than did participants in the elderly person stereotype condition ($p < .05$). All other posthoc comparisons failed to reach conventional levels of significance.

For false recall, we looked at recalled words that were not part of the presented words. Results yielded a marginally significant effect of condition, $F(3, 116) = 2.56$, $p = .06$, $\eta_p^2 = .06$, with the moving group reporting more intrusions than did the professor stereotype group (see Table 1). When we conducted an analysis on the relevance ratings, we found a significant effect of condition, $F(3, 104) = 7.73$, $p < .001$, $\eta_p^2 = .18$, with the survival group providing higher ratings than did the moving group ($p < .001$; see Table 1). The other comparisons were not significant. To investigate whether the relevance ratings affected the survival recall advantage, we entered these ratings as covariate and performed an ANCOVA on correct recall data. The effect of condition was still present in the ANCOVA, $F(3, 103) = 15.73$, $p < .001$, $\eta_p^2 = .31$.

In sum, Experiment 1 showed that stereotype activation can influence memory: Participants in the professor condition recalled significantly more words than did those in the elderly person condition. Still, when the survival condition was contrasted withthe other conditions, the survival recall advantage persisted. Of course, one could argue that this finding does not exclude the possibility that the survival recall advantage is driven by a strong survival-related stereotype being activated during survival processing. To tackle this issue, we conducted Experiment 2.

Experiment 2

The purpose of Experiment 2 was to test whether the survival condition is driven by a strong survival stereotype. Specifically, our interest was whether the memory effects of the standard survival instruction would be similar to those of a stereotypical description of a person who is fit enough to survive. To this end, we compared performance of participants in the standard survival group withthat of participants who had to imagine being a person who was mentally and physically strong enough to survive.

Table 1 Mean number of intrusions(with standard deviations,in parentheses) of false recall and word ratings

	False Recall	Word Ratings
Survival	0.36 (0.72)	2.88 (0.37)
Professor	0.07 (0.25)	2.65 (0.73)
Elderly person	0.43 (0.90)	2.87 (0.44)
Moving	0.60 (0.97)	2.30 (0.43)

Method

Participants Seventy-seven undergraduates (M_{age} = 21.61 years, SD = 3.83; 26 men) participated for course credit. They were tested in individual sessions that lasted for approximately 30 min.

Materials The same stimulus materials were used as in Experiment 1.

Design and procedure The present experiment used a between-subjects design, with groups differing as a function of condition (survival[n = 26], survival-stereotype [n = 25], and moving[n = 26]). Participants were randomly allocated to one of the three scenarios. The survival and moving instructions were identical to the ones used in Experiment 1. The survival-stereotype instruction was based on our pilot study,where we asked participants what characteristics they thought of when they read the standard survival instruction. Specifically, we selected traits that were most frequently mentioned by participants (i.e., *healthy*, *intelligent,good memory*, *physically strong*, *much energy*) to develop the following instruction:

> *Survival-stereotype:* In this task, we would like you to imagine that you are a person who is physically and mentally strong enough to survive. You have good health, a high intelligence, and an excellent memory. Because of this, you hardly ever get ill, you always have a lot of energy, and you remember everything very well. We are going to show you a list of words, and we would like you to rate how relevant these words would be for you in this situation. Some of the words may be relevant and others not—it's up to you to decide.

Results and discussion

Figure 2 presents the mean proportions of correct recall as a function of condition. For correct recall, an ANOVA showed a significant effect of condition, $F(2, 74) = 4.21$, $p < .05$, $\eta_p^2 = .10$. Posthoc comparisons yielded significant effects (survival vs. survival-stereotype, $p < .05$; survival vs. moving, $p < .05$), due to the fact that the standard survival group displayed superior retention, as compared with the other two groups.

When we analyzed the false recall data, results revealed a marginally significant effect of condition ($p = .07$), with the survival-stereotype group having higher false recall levels than did the standard survival group (see Table 2). No other comparisons were significant.

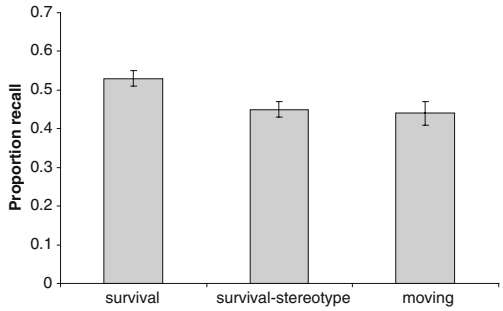

Fig. 2 Mean proportions (and *SEM*s)of correct recall as a function of condition (Experiment 2)

For the relevance ratings, results showed a significant effect of condition, $F(2,74) = 4.30$, $p < .05$, $\eta_p^2 = .10$, with the survival-stereotype group providing higher mean ratings than those in the moving condition (see Table 2).The other posthoc analyses failed to reach significance. To examine whether the relevance ratings affected our survival recall effect, we performed an ANCOVA on correct recall, with ratings as the covariate. As in the previous experiment, the effect of condition remained present, $F(2, 73) = 4.07$, $p < .05$, $\eta_p^2 = .10$.

The findings of Experiment 2 evidently show that the adaptive memory superiority remained intact when we contrasted the survival group with the survival-stereotype group. This implies that the survival recall advantage cannot be accounted for in terms of a stereotype of a robust survival person. Next, we discuss and test two alternative explanations for these findings.

One could still argue that our replication of the survival recall effect might be related to the fact that the survival scenario induces more positive traits than do the other scenarios. To test this interpretation, we presented all scenarios (survival, moving, professor, elderly, survival-stereotype) in a random order to a new sample of participants ($N = 41$, $M_{age} = 21.88$ years, $SD = 3.50$; 12 men) and gave them the same instructions as the ones we used in our pilot study. They had 5 min to provide traits for each scenario. Two raters evaluated the traits (interrater reliability,$\kappa = .72$)

We performed a repeated measures ANOVA on the number of positive traits and found that the original survival scenario($M = 6.40$, $SD = 2.11$) and the new survivalstereotype scenario ($M = 5.60$, $SD = 1.98$) elicited significantly more positive traits than did the moving scenario ($M = 3.68$, $SD = 1.40$), the professor condition ($M = 3.38$, $SD = 1.48$), and the elderly person condition ($M = 0.98$, $SD = 1.21$), $F(4, 156) = 74.26$, $p < .001$; $\eta_p^2 = .10$ (one missing value). The survival scenario and the survival-stereotype scenario did not significantly differ from each other with regard to the number of positive traits ($p = .31$). Interestingly, we also found that the elderly person scenario elicited fewer positive traits than did the other scenarios (all ps $< .001$). We also found that the moving and professor scenarios did not vary concerning the provided positive traits ($p > .05$). Together, our findings show that the survival and survivalstereotype scenarios induced significantly more positive traits than did the other scenarios.

Table 2 Mean number of intrusions(with standard deviations, inparentheses) of false recall and word ratings

	False Recall	Word Ratings
Survival	0.23 (0.51)	2.51 (0.44)
Survivalstereotype	0.92 (1.55)	2.62 (0.42)
Moving	0.77 (0.99)	2.27 (0.44)

One could also argue that the pattern of findings reported in Experiments 1 and 2were caused by the original survival instruction being different on a number of dimensions (i.e., distinctiveness[unusualness], imagery, familiarity, richness) from the other instructions that we used in Experiments 1 and 2. Indeed, it is sometimes claimed that the survival instruction is easier to imagine and more distinctive (see Nairne & Pandeirada, 2010) than are other scenarios thatcould promote superior retention (Hunt & Worthen, 2006; Paivio, 2007).This is important because such dimensions as distinctiveness and imagery are known to enhance memory retention (Hunt & Worthen, 2006; Paivio, 2007).

To examine this issue, we presented an independent group of participants ($N = 19$, $M_{age} = 22.84$ years, $SD = 1.26$; 6 men) with the different scenarios that we used in the present experiments (survival, survival-stereotype, moving, professor, and elderly person, presented in random order) and asked them to rate these scenarios on a number of dimensions (distinctiveness, imagery, familiarity, richness), using 5-point Likert scales (1 = *less distinctive, imagery, familiar, rich in details*; 5=*highly distinctive, imagery, familiar, rich in details*). Repeated measures ANOVAs on these ratings yielded the following findings. We found that the survival scenario was regarded as significantly more distinctive than the other scenarios (see Table 3), $F(4, 72) = 9.90$, $p < .001$, $\eta_p^2 = .33$. With respect to imagery, we found that the moving and professor scenarios were the easiest to imagine, $F(4, 72) = 10.84$, $p < .001$, $\eta_p^2 = .38$. We also found that the survival scenario was the least familiar scenario, relative to the other scenarios, $F(4, 72) = 10.56$, $p < .001$, $\eta_p^2 = .37$. Asto the richness of the scenarios, our analysis indicated that the scenarios differed in richness, $F(4, 72) = 3.06$, $p < .05$, $\eta_p^2 = .15$, and that the survival-stereotype was rated the highest along this dimension; posthoc comparisons did not show any significant differences. These findings are broadly consistent with the results obtained by Nairne and Pandeirada (2010) in that they also show that the survival group was considered to be the most distinctive.

Table 3 Mean ratings of the different scenarios on distinctiveness, imagery, familiarity, and richness

	Distinctiveness	Imagery	Familiarity	Richness
Survival	3.79 (1.40)	3.21 (1.08)	1.58 (0.61)	2.32 (1.11)
Professor	2.21 (0.79)	4.11 (0.87)	3.37 (1.07)	2.37 (1.01)
Elderly person	2.37 (0.96)	2.79 (1.36)	2.94 (1.35)	2.37 (0.76)
Moving	2.47 (0.91)	4.32 (0.82)	2.63 (1.30)	2.32 (1.06)
Survivalstereotype	2.16 (0.83)	3.74 (1.05)	3.31 (1.11)	3.16 (1.21)

General discussion

The goal of the present experiments was to investigate whether the survival recall advantage can be conceptualized in terms of survival-stereotype activation. Neither of our experiments yielded direct support for this hypothesis. In fact, we found that the survival group displayed superior retention in both experiments, even when pitting the survival group against strong stereotypes (i.e., professor, Experiment 1; survival-stereotype, Experiment 2). Thispattern lends further support to an interpretation of the survival recall advantage in functional —that is, adaptive value—terms.

Our hypothesis was that the survival instruction would elicit a strong stereotype that, in turn, would enhance recall performance. The rationale behind this was that studies consistently show that the activation of stereotypes can boost or deteriorate memory performance (e.g., Dijksterhuis et al., 2000). For example, priming an elderly person stereotype activates elderly-related connotations (e.g., *slow*, *bad memory*, *dementia*), and these,in turn, impact memory performance. Hence, we hypothesized that the survival instruction would activate a large number of positive qualities that, together, would boost memory performance. Our pilot study illustrates that the survival instruction elicits stereotypes: Participants attributed positive connotations to the survival instruction and thought mostly about traits such as *intelligent*, *healthy*, *good memory*, and *physically strong*. Furthermore, the results of Experiment 1 confirmed that stereotypes can ameliorate memory, in that the professor group displayed better memory performance, relative to the elderly person group.

We expected in Experiment 1 to find similar recall rates in the professor and survival groups, and we anticipated that those groups would exhibit higher recall levels than would the other groups, but this was not borne out by the data. Although stereotype activation was successful, in the sense that participants in the professor stereotype condition remembered significantly more words than did participants in the elderly person stereotype condition, we found that the survival group outperformed all other groups.

Experiment 2 was based on the characteristics obtained in a pilot study in which we examined the associations people have when they are presented with the survival instruction. In general, people attribute positive connotations to the survival instruction.On the basis of these positive connotations, we constructed a new survival-stereotype instruction. Still, when we compared the group that was given this instruction with the standard survival group, the survival recall advantage remained intact. As in Experiment 1, this result runs counter to our idea that the survival recall effect is caused by stereotype activation.

However, we also asked an independent group of participants to describe the traits that they thought of when reading all the scenarios (survival, moving, professor, elderly person, and survival-stereotype). Interestingly, we found that people described significantly more positive traits when reading the survival and survival-stereotype scenarios than when reading the other scenarios. When these data were looked at more closely, they suggested that although the survival and survivalstereotype scenarios did not differ in the number of elicited positive traits, we still found that the original survival group showed superior memory performance.Thus, the survival-processing advantage cannot be explained in terms of the number of positive traits elicited by the scenario.

In contrast to previous studies, we did not find, in the present experiments, evidence to suggest that survival scenarios enhance false recall (Otgaar & Smeets, 2010; Otgaar et al., 2010; see also Howe & Derbish, 2010). However, as we and others have noted (Howe & Derbish, 2010; Otgaar & Smeets, 2010), adaptive memory studies (Nairne & Pandeirada, 2010; Nairne et al., 2007), such as the present one, were not specifically designed to test whether survival processing amplifies false recall. In order to test such an effect, one should preferably rely on stimuli that are specifically developed to elicit robust levels of false recall (e.g., Deese–Roediger–McDermott word lists; Deese, 1959; Roediger & McDermott, 1995).

The question that remains is which proximate mechanisms might carry the survival recall advantage. Weinstein et al. (2008), for example, argued that the survival recall advantage is the result of the operation of basic memory processes such as enhanced schematic or self-referential processes. However, in their study, they found no evidence for such an interpretation. Also, Kang et al. (2008) hypothesized that the heightened arousal and novelty induced by the survival instruction led to a superior increase in memory recollection. As was mentioned before, they failed to obtain support for this.

It may well be the case that the unique effect of survival processing is related to the survival instruction inducing both item-specific and relational processing. It is well demonstrated that both types of processing lead to superior memory retention (Hunt & McDaniel, 1993). Indeed, a recent study by Burns, Burns, and Hwang (2011) confirmed the idea that the survival recall effect is the result of encoding of both item-specific and relational processing. They showed that the survival recall effect disappeared when control conditions were implemented that also activated item-specific and relational processing.

The scenario ratings that our participants gave on a number of dimensions (i.e., distinctiveness, imagery, familiarity, richness) might also shed some light on the proximate mechanisms behind the survival recall advantage. Like Nairne and Pandeirada (2010), we found that the participants regarded the survival instruction as more distinctive and less familiar than the other scenarios. It might well be the case that distinctive processing fuels the survival recall effect. Although Nairne and Pandeirada (2008) presented evidence that seems to indicate that distinctiveness is an unlikely explanation for the survival recall advantage, more studies are needed to address this issue—in particular, the possibility that it is a combination of distinctiveness, elaboration, and unfamiliarity that produces the survival recall advantage.

A possibility that is closely related to this analysis is provided by attention restoration theory (ART). Berman, Jonides, & Kaplan (2008, Experiment 2) showed their participants either pictures of nature (e.g., scenery of Nova Scotia) or pictures of urban environments (i.e., city of Detroit). They found that the first group subsequently performed better on attentional tasks than did the second group, indicating that interaction with nature leads to more bottom-up stimulation than does interaction with urban environments. The authors argued that interaction with nature provides individuals with the opportunity for attentional recovery and, therefore, cognitive improvement. This line of reasoning might bear relevance to the memory effects of survival processing, since survival instructions strongly evoke a natural environment (but see Nairne et al., 2009).

It is tempting to assume that survival processing maps onto a special cognitive adaptation, a survival *module* that specifically evolved to process fitness-relevant information. However, evolutionary psychologists would contend that the idea of a specific survival module is too broad (see Nairne et al., 2007) and that natural selection would not develop a module for the sole purpose of survival alone. Hence, another option could be that survival processing activates a multitude of different proximate mechanisms that, together, maximize retention (e.g., self-preservation or predator avoidance systems). It is obvious that further studies are needed to unravel the proximate mechanisms behind the adaptive memory effect.

To summarize, the aim of the present study was to examine whether stereotype activation could help explain the survival recall advantage. In two experiments, we found that when the survival groupwas compared with a host of new control conditions eliciting strong stereotypes, the survival recall advantage did not disappear. Thus, stereotype induction is unlikely to explain the survival recall advantage, and therefore our findings add to the generality of the survival recall advantage and to thegrowing body of literature showing that memory is functionally designed.

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