Survival of the Selfish:

Contrasting Self-Referential and Survival-based encoding.

SHORT COMMUNICATION

(24,866 characters including spaces)

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Abstract:

Processing information in the context of personal survival scenarios elicits a memory advantage, relative to other rich encoding conditions such as self-referencing. However, previous research is unable to distinguish between the influence of survival and self-reference because *personal* survival is a self-referent encoding context. To resolve this issue, participants in the current study processed items in the context of their own survival and a familiar other person's survival, as well as in a semantic context. Recognition memory for the items revealed that personal survival elicited a memory advantage relative to semantic encoding, whereas other-survival did not. These findings reinforce suggestions that the survival effect is closely tied with self-referential encoding, ensuring that fitness information of potential importance to self is successfully retained in memory.

Key words: Memory; self; self-reference effect; survival; fitness value

1. INTRODUCTION

1.1 Survival-related processing

Memory researchers have identified adaptive qualities of encoding and retrieval that allow fitness information (i.e., that concerning survival and reproduction) to be preferentially processed (Klein, Cosmides, Tooby, & Chance, 2002; Kang, McDermott & Cohen, 2008; Nairne, 2005; Nairne & Pandeirada, 2008a, 2008b, 2010; Nairne, Thompson & Pandeirada, 2007; New, Cosmides, & Tooby, 2007; Öhman & Mineka, 2001). It is posited that ecological pressures encountered in the ancestral environment of the Pleistocene savannah led to the evolution of specific processing biases in relevant domains such as physical survival (i.e., food, shelter, danger), navigation, reproduction, social exchange, and kinship (Nairne & Pandeirada, 2008b). Of these domains, memory research has focused on physical survival-related processing, demonstrating a robust memory advantage for items encoded in a survival context over non-survival related items (e.g., Burns, Burns, & Hwang, 2011; Kang et al., 2008; Nairne et al., 2007; Nairne & Pandeirada, 2008a, b; Öhman & Mineka, 2001; Weinstein, Bugg, & Roediger, 2008).

The body of research on survival-related memory has grown from a paradigm developed by Nairne et al. (2007). In this study, participants were asked to rate items for importance in the context of a surviving in a foreign grassland, before their item memory was assessed. Memory for this 'survival-related' information was contrasted with memory for information encoded in a non-survival related context (rating the importance of items if moving to a new home abroad), and other

contexts known to elicit superior memory performance (rating words for pleasantness and self-relevance). Nairne et al. found that compared to all the non-survival related tasks tested, the survival-based encoding led to higher recall and recognition, suggesting that memory systems are indeed 'tuned' for fitness value.

Consolidating this conclusion, subsequent studies have shown that the memory advantage associated with survival-based encoding is maximized in contexts that mimic the hunter-gatherer environment. For example, survival-related processing elicits a greater advantage when ancient grasslands rather than modern city contexts are evoked at encoding (Nairne & Pandeirada, 2010; Weinstein et al., 2008), and when specific hunter-gatherer goals are involved (e.g., searching in the grasslands for food to eat v. searching for the same items in a team scavenging game - Nairne, Pandeirada, Gregory, & Van Arsdall, 2009). Together, these studies build a compelling argument for the existence of an adaptive, context-dependent encoding bias that ensures information relating to personal survival is successfully retained.

1.2 The self in survival

An interesting aspect of the memory bias for survival-related information, and the focus of the current inquiry, is the extent to which it is associated with self-referential processing biases (see Burns et al., 2011; Klein, 2012). As Nairne et al. (2007) acknowledge, processing personal survival is clearly a self-referential encoding context. Indeed, as Klein comments, "few things are *more* self-relevant than one's own survival" (2012, p. 2, emphasis added).

This self-processing and survival-processing conflation is of theoretical interest because encoding information in a context of self-relevance also elicits a strong memory bias (the self-reference effect (SRE) in memory - Rogers, Kuiper & Kirker, 1977). The SRE has received an enormous amount of empirical attention for more than three decades, so that we now have a rich understanding of the mechanisms through which it is elicited (for review, see Symons & Johnson, 1997). There is evidence that self-referencing promotes better organization in memory, and leads to relatively rich representations due to elaboration by the detailed and accessible self-concept (Klein & Kihlstrom, 1986; Klein & Loftus, 1988; Symons & Johnston, 1997). Recent research also suggests that automatic responses to self-reference such as increased attention and physiological arousal may also contribute to the rich, elaborative encoding that characterizes self-referential memories (Turk, Cunningham, & Macrae, 2008; Turk, Van Bussel, Waiter, & Macrae, 2011a; Turk, Van Bussel, Brebner, Toma, Krigolson, & Handy, 2011b). If the survival effect is related to self-referential processing, then such explanations could provide a useful account of the proximate mechanisms underlying the impact of survival-related encoding on memory.

Nairne et al. (2007) make the valid point that survival-related retention in their experiments exceeded control conditions that evoked self-reference (i.e., deciding what items would be necessary for a *personal* move abroad). However, Klein (2012) has pointed out concerns with these tasks. In particular, the self-referencing task used by Nairne et al. may have failed to elicit self-referential memories because participants were asked to rate the likelihood of items evoking autobiographical memories, rather than instructed to recall the memories themselves. Klein

replicated Nairne et al.'s experiments using a more standard self-referential instructions and found that the memory advantage for survival-based over self-referential processing was rendered non-significant.

Interestingly, the effect of 'removing' the self from survival tasks has been explored previously. Weinstein et al. (2008) employed a between groups design to contrast memory from both first and third-person survival encoding tasks (i.e., rating words in relation to survival of self, friend or a stranger), and found a similar effect in each referent condition. Further, Kang et al. (2008) found that processing information in terms of its fitness for survival enhanced memory performance even when the referent was a cartoon character. However, an issue with both of these studies is that they use a between groups design – when participants are imaging what another person would do in a survival context that is unfamiliar to them, it is likely that they would project self to complete the task (i.e., *"If it were me trying to survive, I would need…"*). It may be that the utilization of a between groups design does not elicit the necessary self-other distinction at encoding. The current inquiry seeks to overcome this issue and provide a direct test of the influence of self-referential versus survival-based encoding on subsequent memory.

1.3 The current inquiry

This inquiry sought to directly compare self- and other-survival using a variation of Nairne et al.'s (2007) grassland survival task. In a repeated-measures experiment, participants were asked to rate the usefulness of items in the context of their *own*

survival in a grasslands context, or the survival of a familiar *other* person. A semantic encoding context was also included for contrast. By specifically generating the need for a self versus other contrast at encoding we predicted that an advantage for survival-related processing over semantic processing would be found when the referent is self, which would be attenuated or eliminated in the other-referent condition.

2. METHOD

2.1 Participants and design

Forty undergraduate students (25 females, mean age 19.1 years) from the University of Aberdeen took part in the experiment in return for course credits. All participants had normal or corrected-to-normal eyesight. Participants gave informed consent in accordance with the guidelines set by the University of Aberdeen's Psychology Ethics Committee. A single-factor (Encoding condition: Self, Other, Semantic) within-subjects design was employed.

2.2 Procedure and stimulus materials

Participants were tested individually and the experiment was delivered using E-prime version 1.1 experimental software (Psychology Software Tools Inc., Pittsburgh, PA). A total of 180 objects derived from the Clark and Paivio (2004) norms, were sorted into six lists of 30 items each, matched for familiarity, imagery and frequency.

At encoding, one list was presented in a 'self' condition block, one in the 'other' condition block and one in the 'semantic' condition block. The three remaining lists were reserved for use as foils in the subsequent recognition test. The use of lists as self, other, semantic or test lists was counterbalanced across participants. Block order was also counterbalanced across participants, and item order was randomised within each block. Instructions as to how the items should be rated were given at the start of each block and were as follows:

> **_Self condition_**_:_ **"**In this task, try to imagine that you are stranded in the grasslands will need to find steady supplies of food, water and protect yourself from predators. You will now be shown a list of words and you are asked to rate their relevance to you in this survival situation on a scale of 1-5 (1 being not relevant and 5 being extremely relevant). Some of the words may be relevant and others may not. It is up to you to decide."

> **_Other condition_**: **"**In this task, try to imagine that David Cameron is stranded in the grasslands of a foreign land, without basic survival materials. Over the next few months he will need to find steady supplies of food, water and protect himself from predators. You will now be shown a list of words and you are asked to rate their relevance to David Cameron's survival situation on a scale of 1-5 (1 being not relevant and 5 being extremely relevant). Some of the words may be relevant and others may not. It is up to you to decide."

> **_Semantic condition_**_:_ "In this task, you will be presented with a series of words, some of these items can be found in the city, others in nature or sometimes in both. You will be asked to rate these words as follows: 1= Only found in the city,

2= Mostly found in the city, 3= Found in both city and nature, 4= Mostly found in

nature, 5= Only found in nature. It is up to you to decide."

Participants entered their responses via a keypress. Following the encoding phase,

participants performed a 10-min digit recall filler task, after which a self-paced

surprise recognition test was administered. The 90 previously-presented (Old) items

and 90 New items were presented individually in a random order. Participants

responded with an Old or New keypress.

3. RESULTS

Eight participants demonstrated poor performance on the rating task with more

than 10% of words in any condition being unrated within the timeframe allowed.

Analysis was therefore confined to the 32 remaining participants.

3.1 Recognition accuracy data

Proportional hit scores and false alarm scores calculated and transformed to

accuracy scores to correct for guessing[1]. These scores were submitted to a single

factor ANOVA (encoding condition: self, other, semantic). Mauchly's test indicated

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[1] An accuracy score was calculated to correct for guessing following the procedure
outlined by Snodgrass and Corwin (1988):
   Hit Rate = (Number of Hits + .5)/(Total possible hits +1)
   False Alarm Rate = (number of false alarms +.5)/(Total possible false alarms + 1)
   Accuracy score = Hit Rate – False Alarm Rate

that the assumption of sphericity had been violated (χ2(2) = 16.8, $p < .001$),

therefore degrees of freedom were corrected using Greenhouse-Geisser estimates

of sphericity (ε =.78). This showed a significant main effect of encoding condition,

$F(1.57,48.72) = 9.03$, $p = .001$, $\eta^2 = .23$, see Figure 1A. Planned contrasts indicated

significant differences between the self-survival and other-survival condition, $t(31) =$

2.76, $p = .01$, and between the self-survival condition and semantic condition, $t(31) =$

5.85, $p < .001$. However, there was no observed difference in memory performance

between the other-survival and semantic condition, $t(31) = 1.04$, $p = .31$. These

results indicate that memory performance is significantly better following self-

survival encoding than following either other-survival or semantic encoding. The

other-survival scenario did not elicit a memory advantage.

3.2 Ratings and response latencies

Participants' tendency to provide high or low ratings for the 30 items in each

condition was contrasted to exclude rating bias. Mean rating values were calculated

for each participant for the three encoding conditions (see Figure 1B), and subjected

to a one-way ANOVA (Encoding Condition: self, other, semantic). This revealed no

significant main effect of condition on fitness ratings $F(2,62) = 1.65$, $p = .2$, $\eta^2 = .05$.

Average response latencies for the ratings for each condition are shown in Figure

1C. An ANOVA revealed a significant effect of encoding condition, $F(2,62) = 6.71$, $p <$

.005, $\eta^2 = .18$. Response times for self- and other-survival did not differ, $t(31) = -.74$,

$p = .46$. However latencies for the semantic task were significantly longer than for

self-survival, *t*(31) = -3.43, *p* < .005, and other-survival conditions, *t*(31) = -2.56, *p* =

.015. These data suggest that in line with previous research (e.g., Nairne et al., 2007)

effortfulness at encoding did not predict memory retention.

[FIGURE 1 ABOUT HERE]

4. DISCUSSION

The current enquiry asked a simple question: does the memory-enhancing effect

of survival-related encoding arise when survival is not personal? Our findings suggest

that the answer to this question is no; when participants encoded information in the

context of a familiar other person's survival, no significant memory advantage (over

semantic encoding) accrued. In contrast, when information was encoded in the

context of personal survival, the standard memory enhancement effect was found.

This self-survival advantage was not underpinned by increased fitness ratings, nor

was it indexed by differences in response latency compared with the other-survival

condition. The current data therefore illustrate that human memory systems may

well have been tuned for survival (Nairne al., 2007), but that this tuning is

functionally specific the continued existence of the self.

4.1 Linking the self and survival

Given the theoretical overlap between the self and personal survival, it is not

surprising that the independent contribution of these processing biases has proved

difficult to reliably assess. For example, while Nairne et al. (2007) reported a memory advantage following survival-related encoding but *not* self-referencing, Klein (2012) has shown the effects of the two to be equivalent. Somewhat counter-intuitively, previous research suggested that a survival encoding advantage can be observed for a third person such as a character in a video clip (Kang et al., 2008), and can be equivalent across self-referent and other-referent survival processing conditions (Weinstein et al., 2008). However, in both of these studies participants were only required to process items in relation to the survival of a single referent, perhaps prompting self-projection (i.e., using self-survival thoughts to determine the relevance of items to other referents). Using a within-subjects design to reduce the influence of self-projection, the current findings clarify the impact of referent on survival processing.

What the current study offers is an exploration of survival-based processing from the paradigm perspective of the SRE literature, in which it accepted that to understand the role of the self, self-referent processing should be directly compared with other-referent processing (see Symons & Johnson, 1997). Like the much of the current survival research, early SRE studies compared self-referencing with other encoding strategies such as semantic processing and physical properties (e.g., Rogers et al., 1977). It has become more standard to closely match encoding conditions to directly compare self- and other-reference, allowing a more confident assertion of the influence of the self. The value of the current study is that for the first time, to our knowledge, this same approach is applied in the survival literature. Thus we can confidently conclude that the self is a critical element to the survival

effect; the encoding context of other people's survival clearly does not evoke the same processing biases as consideration of one's own survival.

It is important to note that, like Klein (2012), we do not suggest that the survival effect can be reduced to an artefact of self-referential processing. The body of research demonstrating that grassland encoding contexts and hunter-gatherer goals are particularly effective at eliciting a memory advantage provide strong evidence for an adaptive, functional property of memory (e.g., Nairne et al., 2007; Weinstein et al., 2008). However, what is clear from the current inquiry is that like grassland settings and hunter-gatherer goals, self is a critical element of the encoding context that gives rise to a survival-related memory advantage.

4.2 Personal survival goals

The influence of the self in a survival context may reflect the failure of other people's survival to activate relevant goals. The role of task goals in survival-related encoding has been highlighted by research showing heightened memory for survival items when hunter-gatherer goals are evoked (e.g., location for food in a survival task vs. a scavenging game – Nairne al., 2009). Further, congruent goals can mimic survival effects, such that non survival-related items that are less likely to be recalled in a survival task, are more likely to be recalled if they are relevant to the goal in the encoding context (e.g., an alarm in the context of a burglary – Butler, Kang, & Roediger, 2009). This congruence effect is not surprising as current goals have been shown in other spheres of memory research to be highly influential in determining

encoding effects (see Moskowitz, Gollwitzer, Wasel, & Schaal, 1999). Current task goals effectively prime relevant information in memory, supporting the encoding of congruent over incongruent items. What the current research makes clear is that non-self-relevant processing goals may be ineffective at eliciting a memory advantage; scenarios involving other people's survival goals are simply less effective encoding devices.

This specificity to self is logical in the context of ecological pressures. There is an advantage in remembering information related to oneself. This importance is reflected in our attention to self-relevant stimuli – whether this comprises catching one's own name in a group discussion (Cherry 1953; Moray, 1956), remembering experiences that have happened to oneself (Conway & Dewhurst, 1995), or keeping track of one's possessions (Cunningham, Turk, MacDonald, & Macrae, 2008). As pointed out elsewhere, "while we are all likely to notice the sound of glass breaking in our vicinity, we are likely to attend to it more, and process it more deeply, when our memory and inference mechanisms identify it as the sound of *OUR* glass breaking." (Wilson & Sperber, 2004, p. 610 (emphasis added), quoted by Friedman & Ross, 2011). In terms of memory functionality, then, it seems plausible to suggest that the survival effect is driven by a combination of survival-based priming and the frequently activated goal of attending and retaining any information that is relevant to self. Like taking the hunter-gatherer goal out of the encoding context, taking self out of the survival context removes the immediate value of the processing bias and reduces the impact on memory accordingly.

4.3 Proximate causes

One advantage of exploring the link between the memory effects associated with survival-based and self-referential encoding is that it offers potential insights into the proximate mechanisms that are likely to drive the memory advantage for survival-based processing. While these are not explored directly in the current inquiry, speculative interpretations suggests a rich potential for future research.

The SRE has been explored widely in behavioral research using a range of encoding and retrieval strategies, and more recent neuroimaging studies offer new insights (Gray, Ambady, Lowenthal, & Deldin, 2004; Turk et al., 2011a,b). The enriched encoding and relational processing advantages offered by both survival-related and self-referential processing are discussed in depth elsewhere (Burns et al., 2011; Klein, 1012). However, we suggest that empirical attention be applied to additional mechanisms identified in SRE research, based on increased arousal and attention capture. An emotional basis to the SRE has been proposed (Turk et al., 2011a), combined with an increase in attentional resources directed to self-relevant information (Bargh, 1982; Gray et al., 2004; Turk et al., 2011b), which combine to enhance memory for self-relevant material even when the self-item association is minimal (Turk et al., 2008). The grasslands survival effect has previously been discussed in terms of increased arousal (Weinstein et al., 2008), although Nairne et al. (2007) have argued against such an explanation for lack of plausibility, point out that survival related words are not arousing. However the link between survival and self may render this account more conceivable. Like other aspects of self-processing,

considering one's own survival is likely to be an arousing and attention-capturing encoding context (see Öhman, Flykt, & Esteves, 2001).

A further avenue for future research would be to examine the interaction between referent and scenario in terms of survival-based processing. The ability to survive is not only a reflection of an organism's fitness to adapt to the environment (which may include the ability to escape predation by other species), but also about competition for resources within its own species (i.e., competition with other people). However, social and family relationships were critical to ancestral survival (hence Nairne & Pandeirada's (2008b) suggestion that kinship is another domain in which evolved processing biases would be expected). SRE research has demonstrated that the mnemonic difference between self-referent and other-referent information can be attenuated (even eliminated) when the other-referent is closely connected to self, such as a parent or best friend (Bower & Gilligan, 1979; Symons & Johnson, 1997). It could be predicted, therefore, that if participants in the current experiment had been asked to encode information in the context of their mother's survival, the pattern of recognition memory performance would have been more in line with self than David Cameron. This prediction notwithstanding, if the function of memory is to enhance fitness for survival, is seems plausible that the maximal benefit of this function would be the continued existence of the individual organism; of the self. Our results demonstrably support this principle.

5. CONCLUSIONS

There is compelling evidence that a memory advantage can be produced by encoding information in ancestral scenarios, in the context of survival-related goals. Adding to this knowledge, the current inquiry clearly demonstrates that a critical element of the survival-related memory effect is the self: encoding information in the context of survival by other people fails to elicit the standard memory advantage. This finding is compatible with the purported functional adaptations of memory, as well as providing an insight into the mechanisms that might give rise to survival effects on memory. In short, memory has adapted to preferentially process survival information, as long as the survival in question is one's own.

Acknowledgements

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FIGURE

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Figure Captions:

Figure 1A: Mean accuracy data for each of the encoding conditions. Error bars represent one standard error from the mean.

Figure 1B: Mean rating data for each of the three encoding conditions. Error bars represent one standard error from the mean.

Figure 1C: Mean response latency for rating responses during encoding. Error bars represent one standard error from the mean.

A. Recognition Accuracy

B. Rating

C. Response Time