Survival processing versus self-reference: A memory advantage following descriptive self-referential encoding

Stephen A. Dewhurst, Rachel J. Anderson, Lydia Grace, and Jennifer Boland

University of Hull

Author note.

Stephen A. Dewhurst, Rachel J. Anderson, Lydia Grace, and Jennifer Boland, Psychology, School of Life Sciences, University of Hull, UK.

Correspondence concerning this article should be addressed to Stephen A. Dewhurst, Psychology, School of Life Sciences, University of Hull, Cottingham Road, Hull, HU6 7RX, UK. Email: s.dewhurst@hull.ac.uk.

Abstract

Previous research has shown that rating words for their relevance to a survival scenario leads to better retention of the words than rating them for self-reference. Past studies have, however, relied exclusively on an autobiographical self-reference task in which participants rate how easily a common noun brings to mind a personal experience. We report five experiments comparing survival processing to a descriptive self-reference task in which participants rated how well trait words described them. Rating trait adjectives for survival value led to higher levels of recall and recognition than rating them for their relevance to a moving home scenario. Rating the adjectives for self-reference, however, led to higher levels of recall (Experiments 1 and 3) and recollection (Experiment 2) than survival rating. Experiment 4 replaced trait adjectives with trait nouns and found that self-reference led to greater recognition accuracy than survival processing. Experiment 5 used trait nouns followed by tests of free recall and found a memory advantage following self-reference that was not influenced by the imageability of the stimuli. The findings are discussed in terms of theories of the survival processing and self-reference effects and the relationship between them.

Keywords: Survival processing; self-reference effect; recall; recognition

Survival Processing Versus Self-Reference: A Memory Advantage Following Descriptive Self-Referential Encoding

The survival processing effect, first reported by Nairne and colleagues (e.g., Nairne, Thompson, & Pandeirada, 2007; Nairne, Pandeirada, & Thompson, 2008; Nairne & Pandeirada, 2010), refers to the finding that rating information for its relevance to a survival scenario enhances recall of the information, relative to other rating tasks. In the initial study by Nairne et al. (2007), participants were instructed to imagine a survival scenario in which they were stranded in the grasslands of a foreign country. They then rated a series of common nouns for their relevance to the scenario. In a surprise recall test, participants in the survival condition recalled more of the nouns than participants who rated them for pleasantness, self-reference, or relevance to a 'moving home' scenario. The survival processing effect has been replicated in many subsequent studies (see Nairne, 2014, for a review) and has been extended to other stimuli, including pictures (Otgaar, Smeets, & van Bergen, 2010) and object locations (Nairne, VanArsdall, Pandeirada, & Blunt 2012).

Researchers have also been concerned with identifying the mechanisms that underlie the survival processing effect. Nairne et al. (2007) proposed an evolutionary account whereby memory systems are tuned to remember information that is relevant to survival. This view was supported by Klein (2012) who made the point that a memory system will be maximally efficient when current demands match those for which it evolved. Other proposals have drawn on traditional memory theories. For example, Kroneisen and Erdfelder (2011) presented evidence that the survival processing effect is the product of rich or distinctive encoding (Craik & Tulving, 1975), while Burns, Burns, and Hwang (2011) attributed the survival memory advantage to the combined effects of item-specific and relational processing (Einstein & Hunt, 1980; Hunt & Einstein, 1981). The survival processing advantage is also eliminated under conditions of cognitive load, suggesting that the effect is due to increased

elaboration of encoding (Kroneisen, Rummel, & Erdfelder, 2014; Nouchi, 2013). The congruity of the stimuli, whereby a word is more likely to be recalled if the response to a rating task is 'yes' rather than 'no' (Schulman, 1974), has also been shown to be an important factor (Butler, Kang, & Roediger, 2009, but see Nairne & Pandeirada, 2011).

The point of departure for the current study is the proposal by Burns et al. (2011) that self-reference may be one of the mechanisms underlying the survival processing effect. As noted above, Burns et al. suggested that the survival processing effect occurs because survival rating activates both item-specific and relational processing. In support of this, they found that survival rating led to higher levels of recall and recognition relative to an orienting task that only recruited relational processing (a category sorting task) or a task that recruits only item-specific processing (sorting items into ad hoc categories). Burns et al. noted that the only other orienting task that recruits both relational and item-specific processing, rather than a trade-off between the two, is self-reference (see Klein & Loftus, 1988). This led Burns et al. to speculate that the survival processing and self-reference effects may have similar underlying mechanisms. As the authors observed, "After all, what is more self-relevant than considering one's own survival?" (2011, p. 216).

As Burns et al. (2011) acknowledged, the proposal that self-reference may underlie the survival processing effect is at odds with the findings of Nairne et al. (2007) that survival processing led to higher retention levels than self-reference (see also Kostic, McFarlan & Cleary, 2012; Nairne, Pandeirada, & Thompson, 2008; Nouchi & Kawashima, 2012). This view is also inconsistent with the findings of Weinstein, Bugg, and Roediger (2008) who compared first person ("Imagine that you are stranded in the grasslands of a foreign land…") and third person ("Imagine that a friend is stranded in the grasslands of a foreign land…") versions of the survival processing task. Although the first person perspective led to higher levels of recall when the survival instructions were set in a city scenario, Weinstein et al.

found no advantage for the first person perspective in the grasslands scenario. They concluded that the survival processing effect cannot be solely attributable to self-reference. This conclusion is supported by the findings of Kang, McDermott, and Cohen (2008) who showed that the survival processing advantage still occurs when the rating task refers to the survival of a third person.

In contrast, the findings of Klein (2012) provide support for the role of self-reference in producing the survival processing effect. Klein compared survival processing with two self-reference conditions; one that required participants to retrieve autobiographical events and one that did not. Earlier work by Klein and colleagues (Klein, Loftus, & Burton, 1989) showed that the self-reference task is effective only when participants are instructed to retrieve an autobiographical event. Asking participants simply to rate how easy it would be to recall an autobiographical event did not produce the same memory advantage. Klein (2012) found that recall levels following survival processing were significantly higher than those produced by self-referential processing, but only when participants were not instructed to retrieve autobiographical events. Self-referential instructions that required participants to retrieve autobiographical events produced equivalent levels of recall to those produced by survival processing.

The importance of self-reference in the survival processing effect was further illustrated by Cunningham, van den Bos, Gill, and Turk (2013) who compared self- versus other-referent versions of the survival paradigm. The self-referent version consisted of the original survival processing procedure developed by Nairne et al. (2007) in which participants were instructed to imagine being stranded in the grasslands of a foreign land and then rate the relevance of a series of common objects. Cunningham et al. compared this to an other-referent condition in which participants imagined David Cameron (British Prime Minister at the time) stranded in the grasslands. They found that recognition accuracy for the

object nouns was significantly higher in the self-reference condition than in the other-reference condition, which was not significantly higher than a semantic rating condition. Cunningham attributed the inconsistency between their findings and those of Weinstein et al. (2008) to differences in experimental design. Specifically, their within-subjects manipulation of rating task may have rendered the difference between self and other conditions more salient than the between-subjects manipulation used by Weinstein et al.

Given the powerful effects on memory of both survival processing and self-reference, it is important to establish the relationship between them and to determine the degree to which self-referential encoding underlies the survival processing effect. It is notable, however, that previous comparisons of survival and self-referential encoding have used only one type of self-reference task. As described above, participants in survival rating conditions are presented with lists of common nouns and asked to rate their relevance to a survival scenario. Performance in this condition has typically been compared to a self-reference condition in which participants are asked to rate how readily each noun brings to mind an autobiographical memory. Klein et al. (1989) referred to this as an *autobiographical* self-reference task. There is, however, an alternative form of self-reference task, developed by Rogers, Kuiper, and Kirker (1977), in which participants are presented with lists of trait adjectives (e.g., *friendly*, *optimistic*) and asked to indicate how well the traits describe them. Compared to valence ratings or rating the words for how well they describe another person, self-reference significantly enhances memory for the traits. Klein et al. referred to this as a *descriptive* self-reference task. As Klein et al. discussed, distinguishing between the two types of self-reference task clarifies some inconsistent findings within the self-reference literature. The studies reviewed by Klein et al. also indicate that, in terms of enhancing memory, the descriptive self-reference task is more effective than the autobiographical self-reference task.

In the current study, we attempted to compare the mnemonic effects of survival and self-referential processing by comparing survival processing with the descriptive self-reference task developed by Rogers et al. (1977). Rather than the common nouns used in previous survival processing studies, Experiments 1 to 3 reported below featured trait adjectives, which participants were instructed to rate either for self-reference or for their importance in a survival scenario. The survival rating instructions developed by Nairne et al. (2007) were adapted to direct participants to the importance of the personality traits in a survival scenario (see below for the full rating instructions). If survival processing leads to better retention of the trait adjectives, this would provide compelling support for the effectiveness of survival processing as a mnemonic aid, above and beyond the effects of self-reference. If, on the other hand, self-reference leads to equivalent or higher levels of retention than survival processing, such a finding would i) provide important information about the boundary conditions of the survival processing effect and ii) support the proposal by Burns et al. (2011) and Klein (2012) that self-referential encoding is a potential proximate mechanism for the survival processing effect.

Studies of the self-reference effect have typically found significant effects with relatively small sample sizes. For example, Bower and Gilligan (1979; Experiment 1) found a recall advantage for self-reference over a semantic rating task with eight participants in each condition. Bower and Gilligan (Experiment 2) also found an advantage for self- versus other-reference with 10 participants in each group. More recently, Conway and Dewhurst (1995) found reliable self-reference effects in recognition memory with 12 participants in each group (see Conway, Dewhurst, Pearson, & Sapute, 2001, for discussion of effect sizes in self-reference studies). The first comparison between self-reference and survival processing was reported by Nairne et al. (2007). As discussed above, however, Nairne et al. used the autobiographical self-reference task rather than the descriptive task. Nairne et al. also used a

within-subjects design in which participants took part in both the survival and the self-reference conditions (within-subjects manipulations of self versus survival processing were also used by Cunningham et al., 2013, Kostic et al., 2008, and Weinstein et al., 2012). As discussed by Conway et al. (2001), however, within-subject designs are problematic for the self-reference effect because of the danger of carry-over effects. In order to avoid carry-over effects in the current study, we elected to use a between-subjects design but, owing to the powerful mnemonic effect of survival processing compared to other rating tasks, we recruited larger participant numbers than have typically been used in studies of the self-reference effect.

Experiment 1

Method

Participants. Ninety undergraduates (73 females) from the University of Hull participated for course credit. All were native English speakers between the ages of 18 and 29. They were tested at individual workstations in groups of up to five.

Stimuli and design. Thirty trait adjectives were selected from Anderson (1968). Previous research has shown that the self-reference effect is enhanced for positive traits (D'Argenbeau, Comblain, & Van der Linden, 2005). In order to investigate whether trait type dissociates self-reference and survival processing, we included 15 positive traits that were rated by Anderson as high in likableness (range 481-549; mean = 518) and 15 negative traits rated as low in likableness (range 52-196; mean = 114). Participants rated the traits on a 5-point scale in one of three conditions (survival, self-reference, and valence) manipulated between groups, with 30 participants in each condition. The traits were presented in one of two random orders.

Procedure. Participants were told that the aim of the study was to investigate how people think about personality traits. An incidental learning procedure was used whereby no

mention was made of the forthcoming recall test. Prior to the presentation of the lists, participants received one of the following sets of instructions:

Survival condition. *In this task, I would like you to imagine that you are stranded alone 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. I am going to show you a list of personality traits that may or may not describe you. What I would like you to do is rate how important these personality traits would be for you in this survival situation. Some of the traits may be important and others may not - it's up to you to decide.*

Self-reference condition. *In this task, I am going to show you a list of words describing personality traits. What I would like you to do is rate how well each of these words describes you. Some of the words may describe you well and others not well - it's up to you to decide.*

Valence condition. *In this task, I am going to show you a list of words describing personality traits. What I would like you to do is rate the words for whether they are positive or negative. Some of the traits may be positive and others may be negative - it's up to you to decide.*

These instructions were supplemented with additional information about how to use the 5-point rating scale. The traits were then read aloud at a rate of one every 10 seconds. Participants rated the words using a three-page response booklet. The traits were not included in the booklet. Participants in the survival condition were asked to rate the importance of each trait on a 5-point scale from 1 = *not important* to 5 = *very important*. The rating scale for the self-reference condition ranged from 1 = *not well* to 5 = *very well*, and the rating scale for the valence condition ranged from 1 = *negative* to 5 = *positive*. After rating the traits, participants were engaged in maths problems for two minutes. This was followed by a surprise recall test in which they were instructed to recall as many words as possible, in any order, on a response

sheet provided. Participants were allowed 5 minutes to complete the recall test.

Results and Discussion

Alpha was set at .05 for all main effects and interactions. All pairwise comparisons were bonferroni-adjusted. Table 1 shows mean levels of correct and false recall as a function of rating task and likeableness. Correct recall scores were analysed in a 3 (rating task: survival vs. self-reference vs. valence) x 2 (likeableness: high vs. low) Analysis of Variance (ANOVA) with repeated measures on the second factor. The main effect of rating task was significant, F (2,87) = 5.49, MSE = 4.12, p = .006, η_p^2 = .11. Pairwise comparisons indicated that the self-reference group recalled significantly more traits than the survival group, p = .01, and the valence group, p = .03. The latter two did not differ reliably from one another, p = 1.00. A significant main effect of likeableness was also observed, F (1,87) = 36.90, MSE = 2.47, p < .001, η_p^2 = .30, whereby recall of high-likeableness traits exceeded recall of low-likeableness traits. The interaction between rating task and likeableness was not significant, F<1. A one-way between-groups ANOVA on the numbers of intrusions found that they were not significantly affected by rating task, F < 1.

Study ratings for the three encoding conditions were analysed in a one-way between groups ANOVA. This revealed a significant main effect of rating task, F (2,87) = 33.15, p < .001. Pairwise comparisons indicated that ratings were significantly lower in the survival condition (M = 2.65, SD = 0.42) relative to the self-reference (M = 3.24, SD = 0.26) and valence (M = 3.14, SD = 0.15) conditions, both ps < .001. The self-reference and valence conditions did not differ reliably from one another, p = .70.

The main finding from Experiment 1 is that rating trait adjectives for self-reference led to significantly higher levels of correct recall than rating them for survival value. This finding confirms the effectiveness of self-referential encoding as a mnemonic aid and indicates that it can be even more effective than survival processing. Burns et al. (2011) and

Klein (2012) proposed that self-reference is a proximate mechanism for the survival processing effect. If that was the case, one would expect to find equivalent levels of false recall across the two tasks. The finding that self-reference leads to higher levels of recall than survival processing suggests that remembering information that is relevant to one's self-concept is the higher priority. Traits rated by Anderson (1968) as high in likeableness were more likely to be recalled than traits rated as low in likeableness. This effect did not, however, interact with rating task. The higher study ratings for self-reference relative to the survival condition means that we cannot rule out the possibility that the memory advantage is driven by congruity. This is addressed in Experiment 3. Prior to that, we report Experiment 2 in which we compared the effects of self-reference and survival processing on recognition memory.

Experiment 2

Experiment 1 showed that self-referential encoding led to higher levels of recall than survival processing. Nairne et al. (2007, Experiment 3) extended the survival processing paradigm to recognition memory and found that survival processing led to higher levels of recognition than a moving home scenario. The aim of Experiment 2 was to compare the effects of survival processing and self-reference on a surprise test of recognition memory. As well as comparing the effects of rating task on overall hit rates, we used the 'remember-know' procedure (Tulving, 1985; Gardiner, 1988) to investigate how the rating tasks influenced the subjective experience of recognition memory. In this procedure, participants are instructed to categorize positive recognition decisions as 'remember' responses if they consciously recollect some aspect of an item's study presentation, or as 'know' responses if an item is recognized in the absence of conscious recollection (see Procedure section).

An additional aim of Experiment 2 was to address the surprising finding from Experiment 1 that survival processing did not enhance correct recall relative to the valence

condition. In other words, we failed to replicate the survival processing effect reported by Nairne and colleagues. Before we can argue that self-reference leads to a greater memory enhancement than survival processing, we need to show that survival processing can enhance memory for trait adjectives, relative to other encoding tasks. It is possible that valence judgements involve a social desirability judgement that is also invoked by self-reference (see Ferguson, Rule, & Carlson, 1983), which would suggest that it is not a neutral comparison task (we consider this further in the General Discussion). In order to enable more direct comparison with previous studies, we replaced the valence condition with a 'moving home' scenario in Experiment 2.

Method

Participants. Participants were a new group of 90 undergraduates (61 females) from the University of Hull who participated for payment or course credit. All were native English speakers between the ages of 18 and 32. They were tested at individual workstations in groups of up to five.

Stimuli and design. Stimuli consisted of 72 trait adjectives selected from Anderson (1968) and divided into two sets of 36. As likeableness did not interact with rating task in Experiment 1, it was not manipulated in Experiment 2 and the two sets were simply matched for mean likableness. Each participant rated one set of traits presented in a random order, with 30 participants in each condition (self-reference, survival, and moving home). The recognition test consisted of all 72 traits presented in a random order. Traits not presented at study served as the lures in the recognition test. The rating task and recognition test were presented using E-Prime software (Schneider, Eschman, & Zuccolotto, 2002).

Procedure. As in Experiment 1, participants were told that the aim of the study was to investigate how people think about personality traits, with no mention of the forthcoming

recognition test. The self-reference and survival rating instructions were the same as Experiment 1. Participants in the moving home scenario received the following instructions:

In this task, I 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. I am going to show you a list of personality traits that may or may not describe you. What I would like you to do is rate how important these personality traits would be for you in accomplishing this task. Some of the traits may be important and others may not - it's up to you to decide.

The words were presented in a different random order for each participant at a rate of one every 5 seconds. Each word remained on the screen for the full 5 seconds regardless of how quickly participants responded. E-Prime software (Schneider et al., 2002) was used to present the stimuli and record the ratings. After rating the traits, participants were engaged in maths problems for 5 minutes and were then given the instructions for the remember/know recognition task. For each test item, participants made an old/new decision followed by a remember/know/guess decision if the item was identified as old. Definitions of remember, know, and guess responses were adapted from Dewhurst and Anderson (1999). In brief, participants were instructed to make a remember response to a test item if they could consciously recollect seeing it in the study list and could recall contextual details such as thoughts, images, and associations that came to mind at the time. They were instructed to make a know response if the word felt familiar from the study list but they were unable to recollect any detail of its occurrence. If they were unable to decide if a word was old or new, they were given the option of making an 'old' response and then categorising it as a guess. Test items appeared one at a time on the computer and participants were instructed to make old/new decisions by pressing the 1 and 2 keys on the number pad with the first and second

fingers of their dominant hand. If they made an 'old' response, participants were prompted to press 1 for remember, 2 for know, or 3 for a guess.

Results and Discussion

Table 2 shows mean levels of correct recognition, false recognition, and d prime (*d'*) as a function of rating task and response type. Statistical analyses consisted of one-way between-subjects ANOVAs with rating task as the independent variable. Overall recognition rates (remember plus know) are reported first, followed by separate analyses of remember and know responses, then *d'* analyses. Guess responses were not included in the analyses because they were made below chance levels. In order to avoid proportions of 0 and 1 in the analysis of *d'*, we used the correction recommended by Snodgrass and Corwin (1988) whereby 0.5 was added to hit and false alarm rates and the corrected scores were divided by the maximum possible score +1.

Analysis of overall hit rates showed a significant effect of rating task F (2,87) = 6.54 MSE = 18.14, p = .002, η_p^2 = .13. Pairwise comparisons showed that both self-reference and survival led to higher hit rates than moving, p = .004 and p = .015 respectively. No significant difference was observed between self-reference and survival, p = 1.00. The analysis of correct remember responses also showed a significant effect of rating task, F (2,87) = 17.20, MSE = 36.41, p < .001, η_p^2 = .28. Pairwise comparisons showed that self-reference led to higher levels of correct remember responses than survival, p = .021, and moving, p < .001. Survival also led to higher levels of correct remember responses than moving, p = .008. A significant effect of rating task was also observed in the analysis of correct know responses, F (2,87) = 8.79, MSE = 26.78, p < .001, η_p^2 = .17. Pairwise comparisons showed that self-reference led to significantly lower levels of correct know responses than survival, p = .017, and moving, p < .001, which did not differ significantly from each other, p = .65.

Analysis of overall false alarm rates showed a significant effect of rating task, F (2,87) = 4.58, MSE = 5.40, p = .013, η_p^2 = .10. Pairwise comparisons showed that moving led to higher levels of false alarms than self-reference, p = .011. No significant differences were observed between self-reference and survival, p = .74, or between survival and moving, p = .21. False remember responses were low and not significantly affected by rating task, F (2,87) = 1.50, MSE = 2.16, p = .23, η_p^2 = .03. There was a significant effect of rating task in false know responses, F (2,87) = 5.38, MSE = 2.01, p = .006, η_p^2 = .11. Pairwise comparisons showed that moving led to significantly more false know responses than self-reference, p = .005, but not survival, p = .38. Self-reference and survival did not differ significantly from each other, p = .26.

Analysis of overall d' rates showed a significant effect of rating task F (2,87) = 9.48 MSE = .39, p < .001, η_p^2 = .18. Pairwise comparisons showed that moving led to significantly lower recognition accuracy than survival, p = .003, and self-reference, p < .001. No significant difference was observed between survival and self-reference, p = 1.00. The analysis of d' for remember responses also showed a significant effect of rating task, F (2,87) = 18.55, MSE =.31, p < .001, η_p^2 = .30. Pairwise comparisons showed that self-reference led to significantly higher levels of remember accuracy than survival, p=.041, and moving home, p<.001. Survival also led to higher levels of remember accuracy than moving, p = .002. The main effect of rating task in d' for K responses was not significant, F (2,87) = 2.80, MSE = .36, p = .066, η_p^2 = .06.

Study ratings were also analysed in a between-subjects ANOVA. This showed a significant main effect of rating task, F (2,69) = 14.61, MSE =.13, p < .001, η_p^2 = .30. Pairwise comparisons showed that mean ratings were higher in the self-reference condition (M=3.45, SD=.22) than in the survival (M=2.95, SD=.43) and moving (M=2.98, SD=.38)

conditions, both *p*s < .001. The survival and moving conditions did not differ significantly from each other, $p = 1.00$.

The main finding of Experiment 2 is that, although there was no difference in overall hit rates, self-referential encoding led to more remember responses and fewer know responses than survival processing. Self-reference thus led to an increase in recollection, as measured by remember responses, rather than overall recognition. This pattern was observed both in raw scores and in the *d'* rates. The selective increase in remember responses mirrors findings from previous investigations of the self-reference effect. Conway and Dewhurst (1995) found no difference between self-reference and valence ratings in overall recognition memory, but self-reference led to more remember and fewer know responses than valence ratings. The same pattern was also reported by Conway et al. (2001), who argued that self-referential processing facilitates the encoding of new experiences within the autobiographical knowledge base (see Conway & Pleydell-Pearce, 2000).

An important finding from Experiment 2 is that the survival condition led to higher recognition scores than the moving condition, in terms of both overall hit rates and remember responses. This allows us to rule out the possibility that the advantage for self-referential encoding is due to a failure to replicate the survival processing effect. One concern, however, is that study ratings were again higher in the self-reference condition than in the survival condition. Although the two conditions did not feature the same rating task, the difference in rating scores means we cannot rule out the possibility that the superior memory performance in the self condition was due to greater congruity, as higher scores indicate more positive responses. Comparison between the survival and moving scenario suggests that congruity may not be the critical factor, as survival led to higher levels of recognition despite there being no difference in study ratings. Nevertheless, it is important to rule out the possible effects of congruity on the difference between survival processing and self-reference.

Previous research has shown that the effect of survival processing on memory for common nouns is enhanced when the nouns are congruent with a survival scenario (Butler et al., 2009, Nairne & Pandeirada, 2011).

In order to address the effect of congruity within the current study, we conducted a third experiment in which participants studied trait adjectives that were pre-rated as important in a survival scenario. This was essentially a replication of Experiment 1 but with a new set of traits, half of which were pre-rated as being important in a survival scenario (e.g., resourceful, alert) and half of which were pre-rated as not being important (e.g., dignified, charming). If the lower performance in the survival condition relative to the self-reference condition was due to the lower ratings in the survival condition, then it should be possible to reverse the effect using traits that are more likely to be rated as important in a survival scenario. We also replaced the valence condition with the moving scenario.

An additional aim of Experiment 3 was to investigate the proposal by Klein, Robertson, and Delton (2011) that it is not survival processing per se, but the future planning aspect of survival processing, that it critical to the survival processing effect. Klein et al. compared three encoding tasks: Survival, future planning in a non-survival scenario, and survival plus planning. They found that the two conditions involving planning led to higher levels of recall than the survival condition. In Experiment 3, we adapted the survival processing instructions to emphasise planning. In short, Experiment 3 featured two modifications to the design of Experiment 1 that were intended to facilitate memory performance in the survival rating condition.

Experiment 3

Method

Participants. A new group of 90 undergraduates (66 females) from the University of Hull participated for course credit. All were native English speakers between the ages of 18 and 36. They were tested at individual workstations in groups of up to five.

Stimuli and design. A new set of 24 trait adjectives was selected from Anderson (1968). Twelve of the traits were selected by the authors as likely to be rated as important in a survival situation and 12 as likely to be rated as not important. Five independent raters were asked to rate the traits for their importance in a survival situation using the 5-point scale used in the survival study phase of Experiment 1. Mean importance ratings were 4.18 for the high importance traits and 1.88 for the low importance traits. The mean likableness ratings were 414 for the high importance list and 435 for the low importance list.

Procedure. As in Experiment 1, participants were told that the aim of the study was to investigate how people think about personality traits. The traits were presented in a different random order for each participant and E-Prime software (Schneider et al., 2002) was used to present the stimuli and record the ratings. After rating the traits, participants were engaged in maths problems for two minutes and were then given a surprise recall test. The rating instructions for the self-reference and moving home conditions were the same as in Experiment 2. The survival rating instructions were amended to emphasise planning, as follows:

In this task, I would like you to imagine that you are stranded alone in the grasslands of a foreign land, without any basic survival materials. You need to plan how you are going to survive until you are rescued. Your plans must include finding steady supplies of food and water and protecting yourself from predators. I am going to show you a list of words describing personality traits. What I would like you to do is rate how important each of these personality traits would be in planning how to survive in this situation. Some of the traits may be important and others may not—it's up to you to decide.

Results and Discussion

Table 3 shows mean levels of correct and false recall as a function of rating task and survival value. A 3 (rating task: survival vs. self-reference vs. moving) x 2 (survival value: high vs low importance) ANOVA on correct recall scores showed a significant main effect of rating task, F (2,87) = 33.66, MSE = 2.87, $p < .001$, $\eta_p^2 = .44$. Pairwise comparisons showed that recall levels were higher in the self-reference than the survival condition, $p = .04$, which in turn were higher than in the moving condition, $p < .001$. Neither the main effect of survival value, F (2,87) = 2.03, MSE = 2.30, $p = .16$, $\eta_p^2 = .02$, nor the interaction, $F < 1$, were significant. A one-way between-subjects ANOVA on the number of intrusions also showed a significant main effect of rating task, F (2,87) = 13.84 MSE = 1.46, $p < .001$, $\eta_p^2 = .24$. Pairwise comparisons showed that false recall levels were higher in the moving condition than in the survival condition, $p = .001$, and the self-reference condition, $p < .001$, which did not differ reliably from each other, $p = .73$.

Study ratings were analysed in a 3 (rating task) x 2 (survival value) mixed ANOVA. The main effect of rating task was not significant, F (2,87) = 2.53, MSE = .28, $p = .09$, $\eta_p^2 = .06$. There was a significant main effect of survival value, whereby high value traits were given higher ratings than low value traits, F (2,87) = 154.70, MSE = .18, $p < .001$, $\eta_p^2 = .64$. This was qualified by a significant rating task x survival value interaction, F (2,87) = 135.12, MSE = .17, $p < .001$, $\eta_p^2 = .76$. Pairwise comparisons showed that, as expected, participants in the survival condition rated the high value traits (M = 4.27, SD = 0.33) as significantly higher in survival value than low value traits (M = 2.17, SD = 0.55), $p < .001$. Participants in the moving condition also rated the high value traits (M = 3.74, SD = 0.45) as more useful in a moving scenario than the low value traits (M = 3.13, SD = 0.64), $p < .001$. In contrast, participants in the self-reference condition rated the high value traits (M = 3.18, SD = 0.43) as less self-relevant than the low value traits (M = 3.56, SD = 0.41), $p < .001$. High value traits

were given higher ratings in the survival and moving conditions than the self-reference condition, both *p*s < .001. In contrast, the low value traits were given higher ratings in the self-reference condition than in the survival and moving conditions, both *p*s < .001.

The findings of Experiment 3 are broadly consistent with those of Experiments 1 and 2. Rating trait adjectives for self-reference led to reliably better memory for the traits than rating them for survival value. This was the case even though the survival instructions emphasised planning, which has previously been show to enhance the mnemonic benefit of survival rating (Klein et al., 2011). Nor was the effect of survival rating on memory influenced by the congruity of the traits. Traits that were pre-rated as important for survival were no more likely to be recalled than traits that were pre-rated as unimportant, and both sets of traits were more likely to be recalled following self-reference rating than survival rating. Thus, even when encoding conditions were especially conducive to survival processing, self-reference still led to significantly higher levels of recall.

One limitation of the experiments reported thus far is that they have all relied on the use of trait adjectives as the to-be-remembered stimuli. This raises questions about the generality of the advantage for self-reference over survival processing. There has been considerable debate about whether a self-reference effect occurs with nouns. The autobiographical self-reference task typically uses nouns as stimuli and, as discussed above, this type of self-reference task is less effective as a mnemonic device than the descriptive self-reference task (see Klein et al., 1989). As discussed above, it has also been shown to be a less effective mnemonic device than survival processing (e.g., Nairne et al., 2007).

A number of studies have incorporated stimuli other than trait adjectives into a descriptive self-reference task. For example, Keenan, Golding, and Brown (1992) found that occupation terms were recalled better following self-reference than following reference to Ronald Reagan. More recently, Serbun, Shih, and Gutchess (2011) found that participants

who rated pictures of common objects for self-reference had higher recognition scores than participants who them for reference to their mother or to Bill Clinton. In contrast, Maki and McCaul (1985) found that self-reference led to higher recall of trait adjectives and lower recall of nouns, relative to conditions in which the words were rated for reference to the participant's mother or to Ronald Reagan. The effects of self-reference on memory for nouns also appears to depend on the type of noun. For example, Czienskowski and Giljohann (2002) compared the effects of self-reference and reference to an intimate or non-intimate other on the recall of concrete and abstract nouns. They found that self-reference reduced recall of concrete nouns relative to the other-reference conditions, but increased recall of abstract nouns relative to the non-intimate other condition.

A problem with using object nouns in the self-reference task is that, compared to trait adjectives, they are difficult to relate to oneself in a descriptive sense (see Keenan et al., 1992, for further discussion of this). Estimating how likely one is to use an object is unlikely to initiate the same degree of self-referential encoding as rating how well a trait describes oneself. As noted by Maki and McCaul (1985), traits reflect central aspects of one's self-schema but objects may not. Based on the results of two experiments, they concluded that "self-reference facilitates memory for traits but fails to improve memory for nouns" (p.171). It seems unlikely, however, that the self-reference effect is constrained by the grammatical class of the stimuli. It is more likely that the critical factor is how meaningfully the stimuli can be evaluated in reference to oneself. In order to address this, we conducted Experiment 4 in which we replaced trait adjectives with trait nouns.

Experiment 4

Method

Participants. A new group of 90 undergraduates (65 females) from the University of Hull participated for course credit. All were native English speakers between the ages of 18 and 46. They were tested at individual workstations in groups of up to five.

Stimuli and design. Eighty trait nouns were selected from Saucier (2003) and divided into two sets of 40. Examples included *optimist*, *genius*, *poet*, and *leader*. Participants rated the nouns on a 5-point scale in one of three conditions (survival, self-reference, and moving) manipulated between groups, with 30 participants in each condition. The nouns were presented in a different random order for each participant.

Procedure. Participants were again told that the study investigated how people think about personality traits. Prior to the presentation of the lists, participants received one of the following sets of instructions:

Survival condition. *In this task, I would like you to imagine that you are stranded alone in the grasslands of a foreign land, without any basic survival materials. You need to plan how you are going to survive until you are rescued. Your plans must include finding steady supplies of food and water and protecting yourself from predators. I am going to show you a list of words that might be used to describe someone. What I would like you to do is rate how important each of these traits would be in planning how to survive in this situation. Some of the traits may be important and others may not—it's up to you to decide.*

Self-reference condition. *In this task, I am going to show you a list of words that might be used to describe someone. What I would like you to do is rate how well each of these traits describes you. Some of the traits may describe you well and others not well - it's up to you to decide.*

Moving condition. *In this task, I 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. I am going to show you a list of words*

that might be used to describe someone. What I would like you to do is rate how important each of these traits would be for you in accomplishing this task. Some of the items may be important and others may not—it's up to you to decide.

Participants in the survival and moving conditions were asked to rate the importance of each trait on a 5-point scale from 1 = *not important* to 5 = *very important*. The rating scale for the self-reference condition ranged from 1 = *not well* to 5 = *very well*. After rating the traits, participants were engaged in maths problems for 5 minutes and then given a surprise recognition test. The test included all 80 trait nouns presented in a different random order for each participant. Traits not presented at study served as the lures in the recognition test. Instructions for remember, know and guess responses were the same as Experiment 2.

Results and Discussion

Table 4 shows mean levels of correct recognition, false recognition, and *d'* as a function of rating task and response type. Statistical analyses consisted of separate one-way between-subjects ANOVAs with rating task as the independent variable. Analysis of overall hit rates showed a significant effect of rating task F (2,87) = 9.28 MSE = 14.70, $p < .001$, η_p^2 = .18. Pairwise comparisons showed that moving led to significantly lower hit rates than both the self-reference, $p < .001$, and survival, $p = .008$, which did not differ from each other, p = .90. The same pattern emerged in the analysis of correct remember responses. The effect of rating task was significant, F (2,87) = 10.91, MSE = 68.86, $p < .001$, η_p^2 = .20, and pairwise comparisons showed that moving led to significantly lower correct remember rates than both the self-reference, p=.001 and survival, p=.003, which did not differ from each other, p= .97. A significant effect of rating task was also observed in the analysis of correct K responses, F (2,87) = 4.57, MSE = 54.13, $p = .013$, η_p^2 = .10. Pairwise comparisons showed that moving led to higher levels of correct know responses than self-reference, $p = .016$. The differences

between between moving and survival, $p = .075$, and between self-reference and survival, $p = 1.00$, were not significant.

Analysis of overall false alarm rates showed a significant effect of rating task, $F(2,87) = 4.44$, $MSE = 3.50$, $p = .015$, $\eta_p^2 = .09$. Pairwise comparisons showed that survival led to higher levels of false alarms than self-reference, $p = .012$. No significant differences were observed between self-reference and moving, $p = .65$, or between survival and moving, $p = .27$. False remember responses were not significantly affected by rating task, $F < 1$. There was a significant effect of rating task in false know responses, $F(2,87) = 6.56$, $MSE = 1.42$, $p = .002$, $\eta_p^2 = .13$. Pairwise comparisons showed that survival led to significantly more false know responses than self-reference, $p = .002$. No significant differences were observed between self-reference and moving, $p = .59$, or between survival and moving, $p = .076$.

Analysis of overall d' rates showed a significant effect of rating task $F(2,87) = 7.60$, $MSE = .39$, $p = .001$, $\eta_p^2 = .15$. Pairwise comparisons showed that self-reference led to significantly higher recognition accuracy than survival, $p = .047$, and moving, $p = .001$ which did not differ significantly from each other, $p = .51$. The analysis of remember d' also showed a significant effect of rating task, $F(2,87) = 11.24$, $MSE = .50$, $p = .001$, $\eta_p^2 = .21$. Pairwise comparisons showed that both self-reference and survival led to significantly higher levels of remember accuracy than moving, $p < .001$, and $p = .006$ respectively. The difference between self-reference and survival was not significant, $p = .45$. The main effect of rating task in know d' was also significant, $F(2,87) = 6.03$, $MSE = .57$, $p = .004$, $\eta_p^2 = .12$. Pairwise comparisons showed that moving led to lower know d' than both survival, $p = .009$, and self-reference, $p = .012$, which did not differ significantly from each other, $p = 1.00$.

Study ratings were also analysed in a repeated measures one-way ANOVA. The effect of rating task was significant, $F(2,87) = 3.38$, $MSE = .25$, $p = .039$, $\eta_p^2 = .07$, though none of the pairwise comparisons reached statistical significance. Mean ratings for survival, self-

reference and moving were 2.22 (*SD* = 0.44), 2.53 (*SD* = 0.43), and 2.27 (*SD* = 0.59), respectively.

The main finding from Experiment 4 is that the survival and self-reference conditions both led to higher levels of correct recognition than the moving condition. In contrast to the findings of Experiments 2, survival and self-reference led to equivalent levels of recognition, both in terms of overall hit rates and in terms of correct remember responses. However, self-reference led to more accurate recognition performance than survival processing as measured by *d'*, which appears to be be due to the higher levels of false alarms in the survival condition. The increase in false recognition following survival processing is consistent with findings reported by Howe and Derbish (2010) using the DRM procedure (Deese, 1959, Roediger & McDermott, 1995). Howe and Derbish found that survival processing led to higher levels of false recognition than moving and pleasantness ratings (see Otgaar & Smeets, 2010, for a similar effect in false recall).

Experiment 4 also showed that a self-reference effect can be observed with trait nouns as well as trait adjectives, although the difference between self-reference and survival processing was observed in recognition accuracy rather than hit rates. We consider this pattern further in the General Discussion. Prior to that, we report a fifth experiment in which we investigated the effects of imageability on self-reference and survival processing. Two recent studies (Bell, Roer, & Buckner, 2013, and Kroneisen & Makerud, 2016) showed that the survival processing advantage is eliminated when the stimuli are abstract or of low imageability. Kroneisen and Makerud suggested that the survival advantage is confined to high-imageability words because participants can more readily imagine practical uses of items that are easily visualized. As noted above, Czienskowski and Giljohann (2002) found that the self-reference effect was more likely to be observed for abstract than for concrete nouns. These findings are relevant to the current study because trait adjectives are typically

abstract and of low imageability. It is possible, therefore, that the failure to find a survival advantage relative to self-reference in Experiments 1-3 was due to the use of low-imageability stimuli. This possibility was investigated in Experiment 5, in which imageability was included an independent variable.

The MRC Psycholinguistic Database (Coltheart, 1981) includes ratings of imageability on a scale of 100 to 700. The high-imageability words used by Kroneisen and Makerud (2016) had mean ratings of 583. In contrast, the mean imageability ratings for the trait adjectives used in Experiments 1 to 3 are 399, 396, and 397. These are closer to the low-imageability words used by Kroneisen and Makerud, which had a mean rating of 334. Mean imageability ratings of the trait nouns used in Experiment 4 are higher at 494, but ratings were only available for 19 of the 80 nouns. However, one advantage of trait nouns is that, compared to trait adjectives, it is possible to find more items that are of high imageability. To illustrate, the trait adjective *artistic* has an imageability rating of 440 whereas the trait noun *artist* has an imageability rating of 600. This greater variation in the imageability of trait nouns enabled us to construct a study list in which half the nouns were of high imageability and half were of low imageability.

Experiment 5

Method

Participants. A new group of 90 undergraduates (67 females) from the University of Hull participated for course credit. All were native English speakers between the ages of 18 and 45 (M = 20.43, SD = 4.27). They were tested at individual workstations in groups of up to five.

Stimuli, design, and procedure. Twenty-four trait nouns were selected from Saucier (2003), of which 12 were rated as high-imageability (*angel*, *animal*, *artist, brat, chatterbox, chicken, child, clown, friend, star, victim, wreck*) and 12 as low-imageability (*amateur, bore,*

character, cynic, eccentric, fool, liar, *menace, mortal, radical, saint, thinker*). Mean imageability ratings from the MRC Psycholinguistic Database (Coltheart, 1981) were 578 for the high-imageability set and for 395 the low-imageability set. An independent samples t-test confirmed a significant difference in imageability ratings between the two sets, t (22) = 14.15, $p < .001$. The stimuli are comparable to those used by Kroneisen and Makerud (2016), which had mean imageability ratings of 583 and 334. The ratings of the low-imageability items are also comparable to those of the trait adjectives using in Experiment 1 to 3 (see above). Participants rated the nouns on a 5-point scale in one of three conditions (survival, self-reference, and moving) manipulated between groups, with 30 participants in each condition. The nouns were presented in a different random order for each participant. The rating instructions were the same as those used in Experiment 4. After rating the traits, participants were engaged in maths problems for 2 minutes and then given a surprise free recall test.

Results and Discussion

Table 5 shows the mean levels of correct recall as a function of rating task and imageability, plus the mean levels of false recall as a function of rating task. A 3 (rating task: survival vs. self-reference vs. moving) x 2 (imageability: high versus low) ANOVA on correct recall scores showed a significant main effect of rating task, F (2,87) = 13.81, MSE = 2.96, $p = .001$, $\eta_p^2 = .24$. Pairwise comparisons showed that correct recall scores were higher in the self-reference condition than in the survival condition, $p = .044$, and the moving condition, $p < .001$. Correct recall scores were also higher in the survival condition than in the moving condition, $p = .021$. The main effect of imageability was also significant, F (1,87) = 14.14, MSE = 2.97, $p < .001$, $\eta_p^2 = .14$, with higher recall scores for high-imageability nouns relative to low-imageability nouns. The interaction between rating task and imageability was not significant, F (1,87) = 2.14, MSE = 2.97, $p = .12$, $\eta_p^2 = .05$. A one-way

between-subjects ANOVA on the number of intrusions also showed a significant main effect of rating task, F (1,87) = 3.31, MSE = 1.46, p = .041, η_p^2 = .07. Pairwise comparisons showed that false recall levels were lower in the self-reference condition than in the moving condition, p = .036. The self and survival conditions did not differ significantly, p = .42, nor did the survival and moving conditions, p = .87.

The analysis of study ratings showed a significant main effect of rating task, F (2,87) = 5.36, MSE =.23, p = .006, η_p^2 = .11. Mean study ratings were significantly higher in the self-reference condition relative to the moving condition, p = .005. No significant differences were observed between self-reference and survival, p = .34, or between survival and moving, p = 30. Mean ratings for survival, self-reference and moving were 2.27 (SD=.47), 2.47 (SD = 0.35), and 2.07 (SD = 0.58), respectively.

The main finding from Experiment 5 is that self-reference again led to higher recall levels than survival and moving, replicating the results of Experiments 1 and 3. The nonsignificant interaction between rating task and imagery indicates that the effects observed in Experiments 1 and 3 were not simply due to the use of low imagery stimuli. As can be seen from Table 5, correct recall scores were numerically higher in the self-reference condition, relative to the survival and moving conditions, for both high and low imagery traits. We consider this further in the General Discussion.

General Discussion

Previous studies have shown that survival processing leads to better recall and recognition of common nouns, relative to a self-referential encoding task in which participants rate how easily each noun cues an autobiographical memory (e.g., Nairne et al., 2007). The current studies compared the mnemonic effects of survival processing with a descriptive self-referential encoding task in which participants rated personality traits for self-reference. Participants in the survival condition rated the traits for their importance in a

survival situation. Survival processing led to a memory advantage relative to a control condition in which the traits were rated for their importance in a moving home scenario, thus replicating the survival processing effect observed in previous research (e.g., Nairne et al., 2007). However, in contrast to studies that used the autobiographical self-reference task, descriptive self-referential encoding led to better retention of the trait adjectives than survival processing. This effect was observed in both free recall (Experiments 1 and 3) and in the recollection component of recognition memory (Experiment 2). Experiment 4 replaced trait adjectives with trait nouns and found equivalent levels of correct recognition following survival processing and self-reference, but higher levels of recognition accuracy in the self-reference condition. Experiment 5 found a recall advantage for trait nouns following self-referential encoding using a combination of high- and low-imageability nouns. Below, we discuss a number of possible explanations of these findings.

The most salient difference between the current study and previous investigations of the survival processing effect is the use of trait adjectives rather than common nouns. In terms of the evolutionary account proposed by Nairne and colleagues (see Nairne, 2014, Nairne et al., 2007), it is possible that the instruction to evaluate trait adjectives, even those that would be important in a survival scenario, failed to activate the ancestral priorities proposed by this account. In contrast, the self-reference effect is more likely to occur with trait adjectives than with common nouns (e.g., Maki & McCaul, 1985). The current findings may, therefore, reflect the degree to which the stimuli were compatible with the survival and self-referential rating tasks.

Experiment 4 attempted to address this issue by replacing trait adjectives with trait nouns. In contrast to the findings of Experiments 1 to 3, self-reference and survival processing produced equivalent levels of correct recognition. However, self-reference was associated with higher levels of recognition accuracy than the survival condition, due to

lower false alarm rates. This changed pattern provides some support for the role of stimulus type in the current findings. Nevertheless, the findings of Experiment 4 are still consistent with our argument that the advantage of survival processing over self-reference observed in previous studies is due to the use of an autobiographical self-reference task rather than a descriptive self-reference task. As an aside, to the best of our knowledge there have been no previous investigations of the self-reference effect (i.e., comparison between self-reference and other-reference conditions) using trait nouns. Such an investigation may help resolve the debate about whether the self-reference effect extends to nouns (see Keenan et al., 1992, and Maki & McCaul, 1985, for further discussion).

A self-reference advantage for trait nouns was again observed in Experiment 5, in which memory was tested by recall rather than recognition. Experiment 5 also showed that the effects observed in Experiments 1 and 3 were not simply due to the use of stimuli low in imageability. Recent studies by Bell et al. (2013) and Kroneisen and Makerud (2016) found that the survival processing advantage was eliminated when the stimuli were of low imageability. In Experiment 5, however, the advantage following self-referential encoding was still observed when study lists consisted of both high- and low-imageability trait nouns. The nonsignificant interaction between rating task and imageability suggests the effect was not confined to the low-imageability items. Table 5 shows that self-reference led to higher recall levels than survival processing for both high- and low-imageability traits. It is also apparent, however, that the advantage for self-referential encoding was numerically higher for the low-imageability items than for the high-imageability items, suggesting that a role for imageability in mediating the survival and self-reference effects cannot be entirely ruled out. Further research into the effects of imageability and type of stimuli (traits versus object nouns) is needed to clarify this issue.

As discussed in the Introduction, Burns et al. (2011) attributed the survival processing effect to the combined activation of item-specific and relational processing (Einstein & Hunt, 1980; Hunt & Einstein, 1981). Burns et al. noted that the only other orienting task that activates both relational and item-specific processing, rather than a trade-off between the two, is self-reference. While this view is consistent with the findings of Klein et al. (2012) that survival processing and self-reference promote equivalent levels of recall when the self-reference instructions require the retrieval of personal experiences, it cannot explain the findings from Experiments 1 to 3 that self-reference led to *higher* retention levels than survival processing. This explanation is also at odds with the finding from Experiment 4 that survival processing led to higher levels of false recognition than self-reference. Previous research has shown that false recognition is enhanced by relational encoding (e.g., McCabe, Presmanes, Robertson, & Smith, 2004). The pattern observed in Experiment 4 suggests that relational processing plays a more prominent role in survival processing than in self-reference, though the low false alarm rate means this suggestion should be made with caution.

A number of explanations of the self-reference effect have previously been proposed (see Symons & Johnson, 1997, for review). Although these pre-date the development of the survival processing paradigm, it is useful to consider the current findings in relation to them. One view is that self-reference boosts memory by enhancing the organization of to-be-remembered stimuli (e.g., Klein & Kihlstrom, 1986). Descriptive self-reference judgements can result in the organization of the stimuli into two categories: those that are self-descriptive and those that are not. The tasks against which self-reference is typically compared (e.g., semantic judgements) do not typically give rise to the same level of organization. There are two reasons, however, why the current findings are unlikely to reflect differences in the organization of the stimuli. First, participants in the survival and moving rating conditions

had the same opportunity to organize the traits into two categories: those that would be useful in the scenario and those that would not. This is particularly true of the survival scenario used in Experiment 3, in which the stimuli were pre-rated as being either high or low in survival value. Despite the enhanced opportunity for organization into two categories in this condition, retention levels were still lower than in the self-reference condition. Second, the claim that self-reference leads to the creation of two categories is based on studies in which participants made yes/no decision about whether trait adjectives described them (e.g., Bower & Gilligan, 1979; Rogers et al, 1977). The organization of the traits into two categories is less likely to occur when ratings are collected on a likert scale, as in the current study.

According to some researchers (e.g., Ferguson et al., 1983), self-reference enhances memory because it involves an evaluative component that is typically absent from other encoding tasks. In the current study, both the self-reference and the survival processing tasks required participants to evaluate the trait adjectives, therefore the involvement of evaluation *per se* cannot account for the current findings. It is likely, however, that the different ratings instructions led to differences in *how* the traits were evaluated (as they were designed to do). For example, rating traits for self-reference typically involves a social desirability judgement that is unlikely to have been activated in the survival condition, and it is this that may have led to the superior retention levels in the self-reference condition (see Ferguson et al.). The mnemonic advantage of social desirability is also suggested by the finding of Experiment 1 that valence judgements, which are likely to reflect judgements of social desirability, led to numerically higher levels of recall than survival rating.

One of the most influential accounts of the self-reference effect attributes the superior retention to enhanced elaboration of encoding (e.g., Keenan & Baillet, 1980; Markus, 1977; Rogers et al., 1977). As noted by Maki and McCaul (1985), the self-reference effect depends on the degree to which to-be-remembered stimuli can be encoded in relation to well-

organized schema. One's knowledge of oneself is typically rich and frequently used, therefore processing information in relation to oneself leads to higher levels of elaboration and greater ease of encoding relative to other encoding tasks (see Symons & Johnson, 1997). Trait dimensions are also the most common criteria on which individuals judge themselves (Markus & Kitayama, 1991), therefore rating trait adjectives for self-reference is likely to lead to greater elaboration than rating them for their survival value.

Interestingly, the survival processing effect has itself been attributed to enhanced elaboration. For example, Kroneisen et al. (2014) found that the survival processing advantage, relative to a moving home scenario, was eliminated when participants performed a concurrent task that engaged working memory processes (monitoring auditory tones). Kroneisen et al. concluded that the survival processing effect relies on effortful, elaborative processes rather than the automatic processes implied by the "selective tuning" hypothesis, as proposed by Nairne et al. (2007; see also Nairne, Vasconcelos, & Pandeirada, 2011). Of particular relevance to the current study is the finding by Nouchi (2013) that the mnemonic advantage of survival processing relative to self-reference was also eliminated by concurrent working memory load. Nouchi used the autobiographical self-reference task rather than the descriptive self-reference task employed in the current study, therefore the results cannot be directly compared. However, the role of elaboration indicated by these findings raises the possibility that rating trait adjectives for self-reference leads to greater elaboration than rating them for survival value. One way to test this account would be to adopt the procedure used by Nouchi and by Kroneisen et al. (2014) and instruct participants to rate the trait adjectives under conditions of concurrent load. We are currently investigating this possibility.

It is also possible that the current findings reflect differences in the degree to which the survival processing and self-reference tasks cue episodic memories at study. Support for the importance of this factor comes from the findings of Klein (2012) that recall scores

produced by the autobiographical self-reference task, relative to survival processing, depend on whether or not the self-reference task requires the retrieval of episodic memories. Klein found that survival processing led to higher recall scores when the self-reference task required participants to rate how easily the words would cue a personal experience, but not when participants were instructed to *retrieve* a personal experience prior to rating how easily it came to mind. In other words, the retrieval of personal experiences at encoding led to recall levels equivalent to those produced by survival processing. It is possible, therefore, that the effects of survival processing and self-reference on memory reflect the degree to which the orienting tasks cue the activation of episodic memories. In order to account for the higher levels of recall and recognition following self-reference, one would have to assume that rating trait adjectives for self-reference is more likely to activate personal experiences than rating them for survival value. This is entirely plausible given the frequency with which individuals judge themselves in terms of personality traits and the relative unfamiliarity of the survival scenario. This possibility is also supported by the findings from Experiment 2 that rating trait adjectives for self-reference led to a selective increase in *remember* responses, which has been attributed to facilitation of the integration of new experiences into autobiographical memory (Conway et al., 2000).

To summarise, the current findings show that rating personality traits for self-reference leads to greater retention of the traits than rating them for their importance in a survival scenario. Whereas previous studies have shown that survival processing leads to higher retention levels than an autobiographical self-reference task (Kostic et al., 2012; Nairne et al., 2007, 2008; Nouchi & Kawashima, 2012), the current studies show that self-reference leads to higher retention levels than survival processing when the descriptive self-reference task is used. These findings indicate important boundary conditions of the survival processing effect and underline the mnemonic value of self-referential encoding. The

question of whether this effect is confined to personality traits, and the respective roles of factors such as imageability, elaboration, and the activation of personal memories, are issues that future research might profitably investigate.

References

Anderson, N.H. (1968). Likableness ratings of 555 personality trait words. *Journal of Personality & Social Psychology, 9*, 272-279. DOI:10.1037/h0025907.

Bower, G. H., & Gilligan, S. G. (1979). Remembering information related to one's self. *Journal of Research in Personality, 13*, 420-432. DOI: 10.1016/0092-6566(79)90005-9.

Burns, D. J., Burns, S. A., & Hwang, A. J. (2011). Adaptive memory: Determining the proximate mechanisms responsible for the memorial advantage of survival processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 37,* 206-218. DOI:10.1037/a0021325.

Butler, A. C., Kang, S. H.K., & Roediger, H. L. (2009). Congruity effects between materials and processing tasks in the survival processing paradigm. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 35*, 1477– 1486. DOI:10.1037/a0017024.

Coltheart, M. (1981). The MRC Psycholinguistic Database. *Quarterly Journal of Experimental Psychology, 33A*, 497-505. DOI: 10.1080/14640748108400805.

Conway, M.A., & Dewhurst, S.A. (1995). The self and recollective experience. *Applied Cognitive Psychology, 9*, 1-19. DOI: 10.1002/acp.2350090102.

Conway, M.A., Dewhurst, S.A., Pearson, N., & Sapute, A. (2001). The self and recollection reconsidered: How a "failure to replicate" failed and why trace strength accounts of recollection are untenable. *Applied Cognitive Psychology, 15,* 673-686. DOI: 10.1002/acp.740.

Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self memory system. *Psychological Review, 107*, 261–288. DOI:10.1037/0033-295X.107.2.261.

Craik, F. I. M., & Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology: General, 104,* 268–294. DOI:10.1037/0096-3445.104.3.268.

Cunningham, S.J., van den Bos, M.B., Gill, L., & Turk, D.J. (2013). Survival of the selfish: Contrasting self-referential and survival-based encoding. *Consciousness & Cognition, 22*, 237-244. DOI:10.1016/j.concog.2012.12.005.

Czienskowski, U., & Giljohann, S. (2002). Intimacy, concreteness, and the "self-reference" effect. *Experimental Psychology, 49*, 73-79. DOI:10.1027//1618-3169.49.1.73.

D'Argembeau, A., Comblain, C., & Van der Linden, M. (2005). Affective valence and the self-reference effect: Influence of retrieval conditions. *British Journal of Psychology*, *96*, 457–466. DOI:10.1080/09658210802010463.

Dewhurst, S.A., & Anderson, S.J. (1999). Effects of exact and category repetition in true and false recognition memory. *Memory & Cognition, 27*, 665-673. DOI:10.3758/BF03211560.

Einstein, G. O., & Hunt, R. R. (1980). Levels of processing and organization: Additive effects of individual item and relational processing. *Journal of Experimental Psychology: Human Learning and Memory, 6,* 588–598. DOI:10.1037/0278-7393.6.5.588.

Ferguson, T. J., Rule, G. R., & Carlson, D. (1983). Memory for personally relevant information. *Journal of Personality and Social Psychology, 44,* 251-261. DOI:10.1037/0022-3514.44.2.251.

Gardiner, J.M. (1988). Functional aspects of recollective experience. *Memory & Cognition, 16*, 309-313. DOI: 10.3758/BF03197041.

Howe, M.L., & Derbish, M.H. (2010). On the susceptibility of adaptive memory to false memory illusions. *Cognition, 115*, 252-267. DOI: 10.1016/j.cognition.2009.12.016.

Hunt, R. R., & Einstein, G. O. (1981). Relational and item-specific information in memory. *Journal of Verbal Learning and Verbal Behavior, 20,* 497–514. DOI:10.1016/S0022-5371(81)90138-9.

Keenan, J. M., & Baillet, S. D. (1980). Memory for personally and socially significant events. In R. S. Nickerson (Ed.), *Attention and performance* (Vol. 8, pp. 651-669). Hillsdale, NJ: Erlbaum. DOI: 10.1521/soco.1992.10.1.79.

Keenan, J.M., Golding, J.M., & Brown, P. (1992) Factors controlling the advantage of self-reference over other-reference. *Social Cognition, 10*, 79-94. DOI: 10.1521/soco.1992.10.1.79.

Klein, S. B. (2012). A role for self-referential processing in tasks requiring participants to imagine survival on the Savannah. *Journal of Experimental Psychology: Learning, Memory and Cognition, 38*, 1234-1242. DOI:10.1037/a0027636.

Klein, S. B., & Kihlstrom, J. F. (1986). Elaboration, organization, and the self-reference effect in memory. *Journal of Experimental Psychology: General, 115,* 26-38. DOI:10.1037/0096-3445.115.1.26.

Klein, S. B., Loftus, J., & Burton, H. A. (1989). Two self-reference effects: The importance of distinguishing between self-descriptiveness judgments and autobiographical retrieval in self-referent encoding. *Journal of Personality and Social Psychology, 56,* 853-865. DOI:10.1037/0022-3514.56.6.853.

Klein, S. B., Robertson, T. E., & Delton, A. W. (2011). The future orientation of memory: Planning as a key component mediating the high levels of recall found with survival processing. *Memory, 19,* 121-139. DOI:10.1080/09658211.2010.537827.

Kostic, B., McFarlan, C. C., & Cleary, A. M. (2012). Extensions of the survival advantage in memory: examining the role of ancestral context and implied social isolation. *Journal*

of Experimental Psychology: Learning, Memory and Cognition, 38, 1091-1098. DOI: 10.1037/a0026974.

Kroneisen, M., & Erdfelder, E. (2011). On the plasticity of the survival processing effect. *Journal of Experimental Psychology: Learning, Memory,and Cognition, 37,* 1553-1562. DOI:10.1037/a0024493.

Kroneisen, M., Rummel, J,. & Erdfelder, E. (2014). Working memory load eliminates the survival processing effect. *Memory, 22*, 92-102. DOI:10.1080/09658211.2013.815217.

Maki, R. H., & McCaul, K. D. (1985). The effects of self-reference versus other reference on the recall of traits and nouns. *Bulletin of the Psychonomic Society, 23,* 169—172. DOI:10.3758/BF03329817.

Markus, H. (1977). Self-schemata and processing information about the self. *Journal of Personality and Social Psychology, 35,* 63-78. DOI:10.1037/0022-3514.35.2.63.

Markus, H., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98,* 224-253. DOI:10.1037/0033-295X.98.2.224.

McCabe, D. P., Presmanes, A. G., Robertson, C. L., & Smith, A. D. (2004). Item-specific processing reduces false memories. Psychonomic Bulletin & Review, 11, 1074–1079. DOI:10.3758/BF03196739.

Nairne J. S. (2014). Adaptive memory: Controversies and future directions. In B. L. Schwartz, M. L. Howe, M. P. Toglia, & H. Otgaar (Eds.). *What is adaptive about adaptive memory?* New York: Oxford University Press. DOI:10.1093/acprof:oso/9780199928057.003.0016.

Nairne, J. S., Pandeirada, J. N. S. (2010). Adaptive memory: Ancestral priorities and the mnemonic value of survival processing. *Cognitive Psychology, 61*, 1-22. DOI:10.1016/j.cogpsych.2010.01.005.

Nairne, J. S., Pandeirada, J. N. S. (2011). Congruity Effects in the Survival Processing Paradigm. *Journal of Experimental Psychology: Learning, Memory, and Cognition. 37*, 539-549. DOI:10.1037/a0021960.

Nairne, J. S., Pandeirada, J. N. S., & Thompson, S. R. (2008). Adaptive memory: The comparative value of survival processing. *Psychological Science, 19*, 176- 180. DOI:10.1111/j.1467-9280.2008.02064.x.

Nairne, J. S., Thompson, S. R., & Pandeirada, J. N. S. (2007). Adaptive memory: Survival processing enhances retention. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 33*, 263- 273. DOI:10.1037/0278-7393.33.2.263.

Nairne, J. S., VanArsdall, J. E., Pandeirada, J. N. S., & Blunt, J. R. (2012). Adaptive memory: Enhanced location memory after survival processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition. 38*, 495- 501. DOI:10.1037/a0025728.

Nairne, J. S., Vasconcelos, M., & Pandeirada, J. N. S. (2011). Adaptive memory and learning. In N. M. Seel (Ed.), *Encyclopedia of the sciences of learning* (pp. 118-121). New York, NY: Springer.

Nouchi, R (2013). Can the memory enhancement of the survival judgment task be explained by the elaboration hypothesis?: Evidence from a memory load paradigm. *Japanese Psychological Research, 55*, 58-71. DOI:10.1111/j.1468-5884.2012.00531.x.

Nouchi, R., & Kawashima, R. (2012). Effect of the survival judgment task on memory performance in subclinically depressed people. *Frontiers in Psychology, 3*, article 114. DOI:10.3389/fpsyg.2012.00114.

Otgaar, H., & Smeets, T. (2010). Adaptive memory: Survival processing increases both true and false memory in adults and children. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 36*, 1010-1016. DOI: 10.1037/a0019402.

Otgaar, H., Smeets, T., & van Bergen, S. (2010). Picturing survival memories: Enhanced memory after fitness-relevant processing occurs for verbal and visual stimuli. *Memory & Cognition, 38,* 23-28. DOI:10.3758/MC.38.1.23.

Rogers, T. B., Kuiper, N. A., & Kirker, W. S. (1977). Self-reference and the encoding of personal information. *Journal of Personality and Social Psychology, 35,* 677-688. DOI:10.1037/0022-3514.35.9.677.

Saucier, G. (2003). Factor structure of English-language personality type-nouns. *Journal of Personality & Social Psychology, 2003*, 85, 695–708. DOI:10.1037/0022-3514.85.4.695.

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-prime user guide*. Pittsburgh: Psychology Software Tools.

Schulman, A. I. (1974). Memory for words recently classified. *Memory & Cognition, 2,* 47–52. DOI:10.3758/BF03197491.

Serbun, S.J., Shih, J.Y., & Gutchess, A.H. (2011). Memory for details with self-referencing. *Memory, 19*, 1004–1014. DOI:10.1080/09658211.2011.626429.

Snodgrass, J.G., & Corwin, J. (1988). Pragmatics of measuring recognition memory: Applications to dementia and amnesia. *Journal of Experimental Psychology: General, 117,* 34-50. DOI: 10.1037/0096-3445.117.1.34.

Soderstrom, N.C., & McCabe, D.P. (2011). Are survival processing memory advantages based on ancestral priorities? *Psychonomic Bulletin & Review, 18*, 564-569. DOI:10.3758/s13423-011-0060-6.

Symons, C.S., & Johnson, B.T. (1997). The self-reference effect in memory: A meta-analysis. *Psychological Bulletin, 121*, 371-394. DOI:10.1037/0033-2909.121.3.371.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychologist, 26,* 1-12. DOI: 10.1037/h0080017.

Table 1

Mean numbers (with standard deviations) of trait adjectives correctly recalled as a function of rating task and trait likeableness.

Likeableness	*Survival*	*Self-reference*	*Valence*
High (max=15)	6.03 (0.37)	7.33 (0.37)	6.00 (0.27)
Low (max=15)	4.63 (0.31)	5.57 (0.37)	4.90 (0.28)
Total (max=30)	10.67 (0.54)	12.90 (0.62)	10.90 (0.38)
Intrusions	1.93 (1.99)	1.80 (1.97)	1.53 (1.87)

Table 2

Mean proportions (with standard deviations) of trait adjectives correctly and falsely recognized as a function of rating task and response type.

Response type	*Survival*	*Self-reference*	*Moving home*
Total hits	.84 (.12)	.86 (.09)	.75 (.14)
Correct remember	.63 (.18)	.75 (.12)	.50 (.19)
Correct know	.21 (.18)	.10 (.09)	.26 (.20)
Total false alarms	.07 (.06)	.05 (.04)	.10 (.08)
False remember	.03 (.03)	.02 (.03)	.04 (.05)
False know	.05 (.04)	.03 (.03)	.06 (.05)
Total d'	2.59 (.72)	2.69 (.50)	2.04 (.64)
Remember d'	2.25 (.59)	2.61 (.38)	1.75 (.65)
Know d'	.78 (.56)	.49 (.43)	.83 (.76)

Table 3

Mean numbers (with standard deviations) of trait adjectives correctly recalled as a function of rating task and survival value.

Survival value	*Survival planning*	*Self-reference*	*Moving home*
High (max=12)	5.27 (1.72)	5.73 (1.51)	3.60 (1.63)
Low (max=12)	5.40 (1.28)	6.50 (1.94)	3.67 (1.49)
Total (max=24)	10.66 (1.50)	12.33 (1.73)	7.27 (1.56)
Intrusions	0.83 (0.87)	0.47 (0.73)	2.03 (1.75)

Table 4

Mean proportions (with standard deviations) of trait nouns correctly and falsely recognized as a function of rating task and response type.

Response type	*Survival*	*Self-reference*	*Moving home*
Total hits	.89 (.10)	.91 (.06)	.81 (.12)
Correct remember	.74 (.21)	.79 (.20)	.55 (.21)
Correct know	.15 (.17)	.12 (.21)	.26 (.17)
Total false alarms	.06 (.06)	.02 (.03)	.04 (.04)
False remember	.03 (.04)	.02 (.03)	.03 (.03)
False know	.03 (.05)	.01 (.01)	.01 (.02)
Total d'	2.93 (.68)	3.33 (.59)	2.71 (.61)
Remember d'	2.68 (.73)	2.94 (.75)	2.10 (.64)
Know d'	.78 (.56)	.49 (.43)	.83 (.76)

Table 5

Mean numbers (with standard deviations) of trait nouns correctly recalled as a function of rating task and imageability.

Imageability	*Survival*	*Self-reference*	*Moving home*
High (max=12)	5.57 (1.77)	6.00 (1.55)	5.00 (1.82)
Low (max=12)	4.57 (1.41)	5.70 (1.97)	3.40 (1.75)
Total (max=24)	10.13 (2.29)	11.70 (2.15)	8.40 (2.81)
Intrusions	0.83 (1.49)	0.37 (0.72)	1.17 (1.29)