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Imagining a Better Memory: Self-Imagination in Memory-Impaired Patients

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Abstract

Recent research has demonstrated that self-referential strategies can be applied to improve memory in memory-impaired populations. However, little is known regarding the mnemonic mechanisms and relative effectiveness of self-referential strategies in memory-impaired individuals. This study investigated the benefit of a new self-referential strategy known as *self-imagination*, traditional self-referential strategies, and non-self-referential strategies on free recall in memory-impaired patients with acquired brain injury and in healthy control respondents. The data revealed an advantage of self-imagining in free recall relative to all other strategies in patients and control respondents. Findings also demonstrated that, in the patients only, a self-referential strategy that relied on semantic information in self-knowledge was more effective than a self-referential strategy that relied on autobiographical episodic information. This study provides new evidence to support the clinical utility of self-imagining as a memory strategy and has implications for the future development and implementation of self-referential strategies in memory rehabilitation.

Keywords

memory, intervention, neuropsychology, autobiographical memory

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How can we improve memory in memory-impaired patients with acquired brain injury? Research has demonstrated that strategies that incorporate cognitive and memory mechanisms that are spared in acquired brain injury are very useful, whereas strategies thought to rely on mechanisms that are compromised by acquired brain injury have limited and variable success (for a review, see Glisky, 2004). Therefore, the clinical utility of novel interventions in memory rehabilitation may depend on the extent to which they capitalize on preserved, as opposed to impaired, cognitive and memory mechanisms. This study investigated this notion in an area that has received increased focus in clinical psychological science: self and memory.

The sense of self is thought to have a close relation with long-term memory (Baddeley, 1988; Conway & Pleydell-Pearce, 2000; Neisser, 1988; Robinson, 1986). Current models propose that the self may be represented in long-term memory by semantic information as well as by episodic information (Conway, 2005; Klein, in press). According to these models, self-relevant semantic information in long-term memory, or *semantic self-knowledge*, consists of conceptual information abstracted from one's life experiences such as factual knowledge (e.g., I lived in Tucson while in graduate school) and personality traits. In contrast, self-relevant episodic information in long-term memory, or *episodic self-knowledge*, includes memories that are associated with a specific time and location (e.g., my first hike in the Grand Canyon) and may contain records of emotions, personal thoughts, and sensory-perceptual details (Tulving, 1983).

Numerous studies with healthy adults have demonstrated that processing to-be-remembered information in relation to self-knowledge improves memory more than other cognitive strategies do—a mnemonic advantage known as the *self-reference effect* (SRE; Rogers, Kuiper, & Kirker, 1977; for a review, see Symons & Johnson, 1997). In line with the notion that the self may be accessed through semantic and episodic information in long-term memory, Klein (in press) contends that there are two distinct SREs: a semantic SRE (SSRE) based on the processing of semantic self-knowledge (i.e., semantic self-referential processing) and an episodic SRE (ESRE) based on the processing of episodic self-knowledge (i.e., episodic self-referential processing). Research with healthy adults has shown that these two types of self-referential processing are

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equally effective memory strategies despite the fact that they rely on distinct mechanisms (Klein, Loftus, & Burton, 1989).

Recent findings from studies with older adults (Dulas, Newsome, & Duarte, 2011; Glisky & Marquine, 2009; Gutchess, Kensinger, Yoon, & Schacter, 2007; Hamami, Serbun, & Gutchess, 2011) and brain-injured patients (Marquine, 2009) indicate that the SRE extends to memory-impaired populations, suggesting that self-referential processing may be a viable approach to memory rehabilitation. However, less attention has been directed toward investigating the precise aspects of the self that produce memory improvement in memory-impaired populations. For instance, to our knowledge, no study has investigated directly whether semantic self-referential processing and episodic self-referential processing are equally effective strategies for improving memory in memory-impaired patients with acquired brain injury.

Studies of brain-injured patients, however, have revealed that semantic self-knowledge may be relatively well preserved in the face of severe deficits in episodic self-knowledge (Cermak & O'Connor, 1983; Klein & Lax, 2010; Marquine, 2009; Rathbone, Moulin, & Conway, 2009). If semantic self-knowledge is more accessible than episodic self-knowledge in memory-impaired patients with acquired brain injury, strategies that rely on the former may be more successful than strategies that rely on the latter. Furthermore, strategies that rely on episodic self-referential processing may be no more effective than non-self-referential strategies. In other words, efforts to improve memory with self-referential strategies in memory-impaired patients, in contrast to healthy adults, may need to target a specific type of self-referential processing.

Self-imagination—the imagination of an event from a personal perspective—is a newly developed cognitive strategy that has been shown to successfully enhance recognition memory (Grilli & Glisky, 2010), cued recall (Grilli & Glisky, 2011), and prospective memory (Grilli & McFarland, 2011) in memory-impaired patients with acquired brain injury and in healthy adults. The self-imagination technique has been demonstrated to improve memory more than cognitive strategies that rely on simple visual imagery, semantic elaboration, and other-person processing. In addition, research suggests that the mnemonic advantage of self-imagining, which we have referred to as the *self-imagination effect* (SIE), is not attenuated by severity of memory deficit (Grilli & Glisky, 2010, 2011). Based on these findings, we suggest that self-imagination may be a promising strategy in the cognitive rehabilitation of memory and that the SIE may be attributable to mnemonic mechanisms related to the self.

However, questions remain regarding the clinical utility of the self-imagination technique. For instance, no study has investigated the effect of self-imagination on free recall in memory-impaired patients. Free recall, in addition to being very difficult, is often required in everyday life. Whether self-imagining improves free recall in memory-impaired patients, therefore, has important clinical implications. In addition, questions remain regarding the mechanisms of the SIE. No study has directly investigated whether the SIE is attributable to mechanisms of semantic self-knowledge or episodic self-knowledge in memory-impaired patients or healthy adults. Both types of self-referential processing might contribute to our ability to imagine events from a personal perspective. For example, if asked to imagine that you are enjoying a day at the beach, you may access semantic self-knowledge of your personality traits and identity roles to know whether you are the type of person who would most likely spend your time surfing or drinking a piña colada under a beach umbrella. You may also retrieve sensory-perceptual, emotional, or contextual details from episodic autobiographical memories (Buckner & Carroll, 2007; D'Argembeau, Ortovela, Jumentier, & Van der Linden, 2010; Schacter & Addis, 2007).

In this study, we investigated further the clinical utility of the self-imagination technique by testing the effect of self-imagination on free recall in memory-impaired patients with acquired brain injury and in healthy control adults. We also investigated the type of self-referential processing involved in self-imagination and the relative effectiveness of self-referential strategies by comparing self-imagining to two self-referential strategies that are thought to target semantic self-referential processing and episodic self-referential processing, respectively. A non-self-referential semantic elaboration task and a baseline task were included for comparison.

In the patient group, the mnemonic effects of self-imagining and semantic self-referential processing were hypothesized to be better preserved than episodic self-referential processing for two reasons: (a) Previous research suggests that semantic self-knowledge may be relatively intact in memory-impaired patients, and (b) the ability to imagine an event from a personal perspective may rely on the retrieval of semantic self-knowledge in this group. Whether self-imagining would outperform semantic self-referential processing in the patients or control respondents was an empirical question. In the healthy control respondents, the semantic self-referential processing condition and the episodic self-referential processing condition were hypothesized, based on previous research, to result in similar memory performance.

To investigate further the cognitive mechanisms of the mnemonic benefit of self-referential processing, we investigated whether the self-descriptiveness of the to-be-remembered information influenced the magnitude of the memory effects. If any of the encoding conditions require access to a self-schema in semantic memory, then to-be-remembered information that is self-descriptive and thus congruent with the self-schema may be elaborated to a greater degree and may be more memorable than information that is not self-descriptive. Given that semantic self-referential processing is believed to involve the retrieval of semantic self-knowledge, it was predicted that the self-descriptiveness of the to-be-remembered information would be related to the benefit of semantic self-referential processing such that self-descriptive information would be more memorable than non-self-descriptive information. Furthermore, because self-imagining may be

primarily related to semantic self-knowledge in memory-impaired patients, a similar effect of self-descriptiveness was expected in the self-imagining condition in the patient group.

Method

Participants

Fifteen patients (7 men and 8 women; mean age = 51.3; mean education = 15.2 years; mean IQ = 111.1) with acquired brain injury of mixed etiology (13 with traumatic brain injury), and 15 healthy control respondents (7 men and 8 women; mean age = 50.7; mean education = 15.9 years; mean IQ = 112.1) participated in the study. Patients with acquired brain injury had a memory impairment indicated by a difference of at least 1 standard deviation (i.e., 15 points) between premorbid intelligence, estimated with the North American Adult Reading Test (Spreen & Strauss, 1998), and memory functioning, measured with the General Memory Index (M = 82.4) from the Wechsler Memory Scale (3rd ed.; Wechsler, 1997), and were at least 3 years posttrauma.

Materials

Experimental stimuli were 120 trait adjectives (40 positive, 40 neutral, and 40 negative) selected from a pool of normalized personality trait words (Anderson, 1968). The trait adjectives were separated into five lists of 24 (8 of each valence), matched on meaningfulness, valence, and word length. To ensure that each patient's performance was not on the floor, each 24-item list was divided into four equivalent 6-word lists; respondents in the control group received a single 24-item list in each condition. All lists were presented with 2 primacy and 2 recency buffer words, and lists were counterbalanced across conditions.

Procedure

There were five intentional encoding conditions. For the memory-impaired patients, experimental testing was split into two sessions completed on consecutive days, with three conditions on Day 1 and two conditions on Day 2. Control respondents completed all five conditions on a single day. The order of encoding conditions was counterbalanced across participants within groups. The study and test phases for each encoding condition were blocked, and each test phase was followed by a 4-min trivia game, which was included to prevent interference effects. Words were randomly mixed for each participant and presented visually on a computer with DMDX (Forster & Forster, 2003).

In each trial, the target trait adjective was presented in the middle of the computer screen for 10 seconds (7 seconds for control respondents), and a beep signaled the end of the trial. A statement that specified the orienting task for each condition appeared above the target word. The statements for each condition were as follows: baseline, "Try to think of words that rhyme with this personality trait"; semantic elaboration, "Try to think of a definition of this personality trait"; semantic self-referential processing, "Try to think about how well this personality trait describes you"; episodic self-referential processing, "Try to remember an event from your life when you acted out this personality trait"; and self-imagining, "Try to imagine you are acting out this personality trait." Three practice trials preceded each encoding condition, ensuring that the participants understood the instructions and how to perform the task. On each trial, participants were instructed to press the *X* key once they started to perform the orienting task and to continue performing the task until the computer beeped.

Each study phase was followed by an immediate free-recall test during which participants recalled words aloud. The tests were self-paced, and no feedback was provided.

At the end of all memory tests, the experimenter administered a yes–no self-descriptiveness task for all of the target trait adjectives (n = 120). Participants were told to indicate whether each trait adjective was self-descriptive or not self-descriptive by pressing a key on the keyboard labeled *Yes* or *No*, respectively. The task was self-paced, and the order of the trait adjectives was random.

Results

Effect of encoding condition on free recall in patients and healthy control respondents

Table 1 shows the free-recall data split by encoding condition in patients and healthy control respondents. Note that overall

Table 1. Means for Free Recall and Number of Orienting Tasks Completed (out of 24) for Memory-Impaired Patients and Healthy Control Respondents

	Free recall		Orienting tasks completed	
Encoding task	Memory impaired	Healthy control	Memory impaired	Healthy control
Baseline	3.2 (1.6)	3.2 (2.2)	12.5 (8.1)	15.2 (7.6)
Semantic elaboration	4.7 (2.7)	4.8 (1.7)	22.9 (1.8)	21.1 (5.2)
Episodic self	5.7 (2.6)	6.3 (3.0)	16.0 (7.7)	20.4 (4.8)
Semantic self	7.3 (3.7)	6.0 (1.7)	21.9 (3.8)	23.3 (1.7)
Self-imagining	9.3 (3.4)	8.1 (2.5)	21.1 (4.0)	21.5 (4.7)

Note: Memory-impaired patients received four trials of 6 items in each condition, whereas healthy control respondents received a single trial of 24 items in each condition. Standard deviations are in parentheses.

performance levels cannot be compared directly because of between-group differences in list lengths.

In the patient group, a one-way repeated measures analysis of variance (ANOVA) demonstrated a main effect of encoding condition, $F(4, 56) = 17.35$, $p < .001$, $\eta^2 = .55$. Self-imagining resulted in better free recall than did baseline processing, $F(1, 14) = 54.07$, $p < .001$, $\eta^2 = .79$; semantic elaboration, $F(1, 14) = 31.8$, $p < .001$, $\eta^2 = .69$; episodic self-referential processing, $F(1, 14) = 28.47$, $p < .001$, $\eta^2 = .67$; and semantic self-referential processing, $F(1, 14) = 5.46$, $p < .05$, $\eta^2 = .28$. In contrast to the findings of prior research with healthy adults, semantic self-referential processing enhanced free recall more than episodic self-referential processing did, $F(1, 14) = 4.73$, $p < .05$, $\eta^2 = .25$, and episodic self-referential processing was not significantly different from semantic elaboration, $F(1, 14) = 1.34$, $p < .27$. Thus, in the memory-impaired patient group, the mnemonic benefit of self-referential processing relative to semantic elaboration was evident only when it involved access to semantic self-knowledge. Finally, semantic elaboration and episodic self-referential processing both resulted in better free recall than baseline processing did, $F(1, 14) = 5.16$, $p < .05$, $\eta^2 = .27$, and $F(1, 14) = 10.67$, $p < .01$, $\eta^2 = .43$, respectively.

In the healthy control group, a one-way repeated measures ANOVA demonstrated a main effect of encoding condition, $F(4, 56) = 14.62$, $p < .001$, $\eta^2 = .51$. Self-imagining resulted in better free recall than did baseline processing, $F(1, 14) = 33.42$, $p < .001$, $\eta^2 = .71$; semantic elaboration, $F(1, 14) = 20.96$, $p < .001$, $\eta^2 = .60$; episodic self-referential processing, $F(1, 14) = 7.53$, $p < .05$, $\eta^2 = .35$; and semantic self-referential processing, $F(1, 14) = 11.15$, $p < .01$, $\eta^2 = .44$. Unlike the patients' data, the control respondents' data showed that free recall following semantic self-referential processing was not significantly different from free recall following episodic self-referential processing, $F(1, 14) = 0.23$, $p = .64$, and both enhanced free recall more than semantic elaboration did, $F(1, 14) = 5.56$, $p < .05$, $\eta^2 = .28$, and $F(1, 14) = 3.53$, $p = .08$, $\eta^2 = .20$, respectively. Therefore, in contrast to the patients' data, in the control respondents' data both of the traditional self-referential strategies demonstrated an SRE relative to semantic elaboration. Finally, semantic elaboration resulted in better free recall than baseline processing did, $F(1, 14) = 11.29$, $p < .01$, $\eta^2 = .45$.

Difficulty of the encoding tasks in patients and healthy control respondents

We considered whether the findings could be related to the differential difficulty of the encoding tasks. In particular, we suspected that patients may have had problems retrieving memories in the episodic self-reference condition and that this may have accounted for their relatively poorer memory performance. Because people were asked to press a key when they had retrieved the required information, we were able to analyze the number of trials (out of 24) successfully completed by patients and control respondents (see Table 1; analyses of the patient group in this subsection are based on a sample size of 14 because of a computer recording error for 1 patient). A 2 (Group) × 5 (Encoding Condition) mixed ANOVA with a Greenhouse-Geisser adjustment demonstrated a main effect of encoding condition, $F(2.62, 70.76) = 21.33$, $p < .001$, $\eta^2 = .44$; no effect of group, $F(1, 27) = 1.2$, $p = .28$; and a marginally significant interaction $F(2.62, 70.76) = 2.51$, $p = .07$, $\eta^2 = .09$. Overall, participants successfully completed fewer trials in the baseline condition than in all other conditions (all ps $< .01$), and the only difference between groups was in the episodic self-reference condition, $t(23.32) = 1.87$, $p = .07$. Both patients and control respondents were less successful at retrieving rhyme words relative to the other encoding conditions, but the patients, relative to the control respondents, had specific difficulties only when the task required the retrieval of episodic memories. The weaker memory enhancement demonstrated by the patients in the episodic self-referential processing condition might therefore be attributable to the difficulty of the encoding task. However, a paired-samples t test of successful and unsuccessful trials in the episodic self-referential processing condition was not significant, $t(13) < 1$. Furthermore, additional paired-samples t tests comparing the relative effectiveness of episodic self-referential processing to the other encoding conditions on *successful trials only* produced findings consistent with the results of the ANOVA.

Relation among the memory effects in patients and healthy control respondents

Memory effects in patients and in control respondents were calculated in relation to the baseline condition to take into account the different patterns of results found in the two groups. Free recall in the baseline condition was subtracted from free recall in each of the other conditions to produce measures of each of the memory effects: SIE, SSRE, ESRE, and the levels-of-processing (LOP) effect. In patients, Pearson product-moment correlations revealed that the SIE was significantly correlated with the SSRE, $r = .54$, $p < .05$, and with the ESRE, $r = .64$, $p < .05$, but not with the LOP effect, $r = .44$, $p = .10$. The SSRE and ESRE were significantly correlated with each other, $r = .65$, $p < .01$. Only the SSRE was significantly correlated with the LOP effect, $r = .53$, $p < .05$. In control respondents, the SIE was significantly correlated with the SSRE, $r = .66$, $p < .01$, and with the ESRE, $r = .66$, $p < .01$, and in contrast to the patients, with the LOP effect, $r = .52$, $p < .05$. Consistent with the patient results, there was a moderate but nonsignificant correlation between the SSRE and ESRE, $r = .44$, $p = .10$, and the LOP effect was significantly correlated with the SSRE, $r = .57$, $p < .05$, but not with the ESRE, $r = .11$, $p = .70$.

Relation of trait self-descriptiveness to the memory effects

The proportions of self-descriptive and non-self-descriptive trait adjectives that were recalled were calculated for each

encoding condition based on the trait adjective yes–no judgments made at the end of the experiment (see Table 2). Paired-samples *t* tests revealed that, in the patients, self-descriptive trait adjectives were recalled more than non-self-descriptive trait adjectives in the self-imagining and semantic self-referential processing conditions, $t(14) = 2.16$, $p < .05$, and $t(14) = 2.51$, $p < .05$, respectively, but not in the other conditions (all ps > .17). In the healthy control respondents, self-descriptive trait adjectives were significantly better recalled than non-self-descriptive trait adjectives only in the semantic self-referential processing condition, $t(14) = 2.22$, $p < .05$ (all other ps > .23).

Discussion

The findings indicate that the SIE extends to free recall in memory-impaired patients with acquired brain injury and in healthy control respondents. In fact, in both patients and healthy control respondents, self-imagination improved free recall more than the traditional self-referential strategies did, indicating that the mnemonic benefit of self-imagination may be very powerful.[1] These results bolster the possibility that the self-imagination technique may be useful for cognitive rehabilitation. For instance, clinicians might be able to apply the self-imagination technique to teach memory-impaired patients to use electronic memory aids, such as smartphones, to remember everyday events (e.g., taking medication, purchasing items at the grocery store, attending social events). The self-imagination technique may also be used to help brain-injured patients learn complex skills in order to return to the workplace. For example, a clinician might have a patient imagine performing the steps required to submit an invoice at work. This self-imagination process could be repeated with the clinician gradually reducing the amount of cueing until the patient consistently executes the task without assistance. Thus, combining self-imagining with other existing techniques such as errorless learning or vanishing cues may enhance the benefits.

These results support the hypothesis that self-imagination falls into the category of self-referential mnemonic strategies, albeit a very effective one. This study revealed moderate to strong correlations between the SIE, SSRE, and ESRE in patients and healthy control respondents. Furthermore, the correlations between the LOP effect and the SIE, SSRE, and ESRE were relatively weaker, suggesting that there is additional shared variance among the self-referential strategies over and above semantic elaboration.

Findings from this study imply that, as hypothesized, the benefit of self-imagining in memory-impaired patients may be related to mechanisms of semantic self-referential processing more than to mechanisms of episodic self-referential processing. The attenuated benefit of episodic self-referential processing in the patients was the only difference in the overall pattern of results between patients and healthy control respondents, and the patients found the episodic self-referential processing task to be more difficult to perform successfully than the self-imagining task. If the SIE was largely attributable to episodic self-referential processing in the patients, then the benefit of self-imagining should have demonstrated a similar drop in effectiveness, and we might have expected these tasks to be of equal difficulty. Furthermore, in the patients, self-descriptive personality traits were recalled more than non-self-descriptive personality traits in the self-imagining and semantic self-referential processing conditions but not in the other encoding conditions, suggesting that, at least in memory-impaired patients, the benefits of self-imagining and semantic self-referential processing may rely on a common mechanism that is not involved in episodic self-referential processing or semantic elaboration.

What might account for the common mechanism of self-imagining and semantic self-referential processing in memory-impaired patients? One possibility is that these memory effects are partly attributable to the processing of information in relation to a well-developed and well-organized self-schema. Indeed, as originally proposed by Rogers and colleagues (1977), at least some types of self-referential processing may rely on a superordinate self-schema that allow very effective encoding and retrieval processes. Moreover, this superordinate self-schema may be intact in many memory-impaired patients with acquired brain injury.

The finding that the mechanisms of self-imagination may be partly distinct from the mechanisms of episodic self-knowledge

Table 2. Means for Proportion of Self-Descriptive and Non-Self-Descriptive Trait Adjectives Subsequently Recalled in Memory-Impaired Patients and Healthy Control Respondents

	Memory impaired		Healthy control	
Encoding condition	Self-descriptive	Non-self- descriptive	Self- descriptive	Non-self-descriptive
Baseline	.16 (.12)	.11 (.08)	.12 (.10)	.15 (.12)
Semantic elaboration	.18 (.11)	.24 (.21)	.20 (.10)	.21 (.14)
Episodic self	.22 (.13)	.25 (.14)	.26 (.18)	.25 (.16)
Semantic self	.34 (.17)	.22 (.19)	.28 (.09)	.23 (.08)
Self-imagine	.45 (.16)	.31 (.22)	.36 (.15)	.30 (.15)

Note: Standard deviations are in parentheses.

in the patients is important for another reason. Previous research has shown that memory-impaired adults with acquired brain injury, relative to control respondents, may produce fewer self-relevant episodic details in their imagined events (Hassabis, Kumaran, Vann, & Maguire, 2007; Klein, Loftus, & Kihlstrom, 2002; Race, Keane, & Verfaellie, 2011). The results of the present study suggest that this population's impaired ability to incorporate the same amount of episodic detail into their imaginings as healthy individuals may nevertheless have minimal influence on the generation of an SIE.

One possible explanation for why self-imagining enhanced free recall more than the traditional self-referential strategies did is that self-imagining may be particularly flexible in the type of self-referential information that is retrieved and incorporated into the imagined event. For instance, self-imagining may involve the retrieval of semantic self-knowledge of personality traits, identity roles, and lifetime periods, whereas the trait self-descriptiveness task included in the present study may specifically target personality trait self-knowledge. Similarly, according to the constructive episodic simulation hypothesis (Schacter & Addis, 2007), the imagination of an event may involve the flexible retrieval and recombination of details from multiple episodic memories, whereas the episodic self-referential processing task used in the present study may have restricted participants to a single episodic memory. Therefore, the advantage of self-imagining may be related to the amount or variety of self-referential processing involved and thus the number or quality of retrieval cues that are later available.

The findings from this study have implications for the future development of self-referential cognitive strategies, indicating that not all types of self-referential processing are equally effective in memory-impaired populations. Although semantic self-referential processing may be particularly beneficial in brain-injured patients with memory deficits, episodic self-referential processing may be no more effective than ordinary semantic elaboration processes. The potential impact of these findings may go beyond brain injury as episodic memory deficits are linked with other conditions such as autism, depression, and normal aging. Finally, the notion that imagined events might be associated with one's self-schema and can be very memorable suggests that the self-imagination technique has the potential to influence future behavior, which may have implications for the treatment of a variety of psychological conditions, including emotional disorders.

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Declaration of Conflicting Interests

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

Note

1. We found a free-recall advantage of self-imagining relative to traditional self-referential strategies in a preliminary study with 20 healthy young adults.

References

Anderson, N. H. (1968). Likableness ratings of 555 personality-trait words. *Journal of Personality and Social Psychology*, *9*, 272–279.

Baddeley, A. (1988). But what the hell is it for? In M. M. Gruneberg, P. E. Morris, & R. N. Sykes (Eds.), *Practical aspects of memory: Current research and issues* (Vol. 1, pp. 1–13). New York, NY: Wiley.

Buckner, R. L., & Carroll, D. C. (2007). Self-projection and the brain. *Trends in Cognitive Science*, *11*(2), 49–57.

Cermak, L. S., & O'Connor, M. (1983). The anterograde and retrograde retrieval ability of a patient with amnesia due to encephalitis. *Neuropsychologia*, *21*, 213–234.

Conway, M. A. (2005). Memory and the self. *Journal of Memory and Language*, *53*, 594–628.

Conway, M. A., & Pleydell-Pearce, C. W. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review*, *107*, 261–288.

D'Argembeau, A., Ortovela, C., Jumentier, S., & Van der Linden, M. (2010). Component processes underlying future thinking. *Memory & Cognition*, *38*, 809–819.

Dulas, M. R., Newsome, R. N., & Duarte, A. (2011). The effects of aging on ERP correlates of source memory retrieval for self-referential information. *Brain Research*, *1377*, 84–100.

Forster, K. I., & Forster, J. C. (2003). DMDX: A window display program with millisecond accuracy. *Behavior Research Methods, Instruments, & Computers*, *35*, 116–124.

Glisky, E. L. (2004). Disorders of memory. In J. Ponsford (Ed.), *Cognitive and behavioral rehabilitation: From neurobiology to clinical practice* (pp. 100–128). New York, NY: Guilford Press.

Glisky, E. L., & Marquine, M. J. (2009). Semantic and self-referential processing of positive and negative trait adjectives in older adults. *Memory*, *17*, 144–157.

Grilli, M. D., & Glisky, E. L. (2010). Self-Imagining enhances recognition memory in memory-impaired individuals with neurological damage. *Neuropsychology*, *24*, 698–710.

Grilli, M. D., & Glisky, E. L. (2011). The self-imagination effect: Benefits of a self-referential encoding strategy on cued recall in memory-impaired individuals with neurological damage. *Journal of the International Neuropsychological Society*, *17*, 929–933.

Grilli, M. D., & McFarland, C. P. (2011). Imagine that: Self-imagination improves prospective memory in memory-impaired individuals with neurological damage. *Neuropsychological Rehabilitation*, *21*, 847–859.

Gutchess, A. H., Kensinger, E. A., Yoon, C., & Schacter, D. L. (2007). Ageing and the self-reference effect in memory. *Memory*, *15*, 822–837.

Hamami, A., Serbun, S. J., & Gutchess, A. H. (2011). Self-referencing enhances memory specificity with age. *Psychology and Aging*, *26*, 636–646.

Hassabis, D., Kumaran, D., Vann, S. D., & Maguire, E. A. (2007). Patients with hippocampal amnesia cannot imagine new experiences. *Proceedings of the National Academy of Science, USA*, *104*, 1726–1731.

Klein, S. B. (in press). Self, memory, and the self-reference effect: An examination of conceptual and methodological issues. *Personality and Social Psychology Review*.

Klein, S. B., & Lax, M. L. (2010). The unanticipated resilience of trait self-knowledge in the face of neural damage. *Memory*, *18*, 918–948.

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-relevant encoding. *Journal of Personality and Social Psychology*, *56*, 853–865.

Klein, S. B., Loftus, J., & Kihlstrom, J. F. (2002). Memory and temporal experience: The effects of episodic memory loss on an amnesic patient's ability to remember the past and imagine the future. *Social Cognition*, *20*, 353–379.

Marquine, M. J. (2009). Self-knowledge and self-referential processing in memory disorders: Implications for neuropsychological rehabilitation. *Dissertation Abstracts International: Section B. Sciences and Engineering*, *69*, 4432.

Neisser, U. (1988). Five kinds of self-knowledge. *Philosophical Psychology*, *1*, 35–59.

Race, E., Keane, M. M., & Verfaellie, M. (2011). Medial temporal lobe damage causes deficits in episodic memory and episodic future thinking not attributable to deficits in narrative construction. *Journal of Neuroscience*, *31*, 10262–10269.

Rathbone, C. J., Moulin, C. J. A., & Conway, M. A. (2009). Autobiographical memory and amnesia: Using conceptual knowledge to ground the self. *Neurocase*, *15*, 405–418.

Robinson, J. A. (1986). Autobiographical memory: A historical prologue. In D. C. Rubin (Ed.), *Autobiographical memory* (pp. 19–24). Cambridge, England: Cambridge University Press.

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.

Schacter, D. L., & Addis, D. R. (2007). The cognitive neuroscience of constructive memory: Remembering the past and imagining the future. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *362*, 773–786.

Spreen, O., & Strauss, E. (1998). *A compendium of neuropsychological tests* (2nd ed.). New York, NY: Oxford University Press.

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

Tulving, E. (1983). *Elements of episodic memory*. New York: Oxford University Press.

Wechsler, D. (1997). *Wechsler Memory Scale–Third edition: Administration and scoring manual*. San Antonio, TX: Psychological Corporation.