Journal of the International Neuropsychological Society (2011), **17**, 929–933.

doi:10.1017/S1355617711000737

BRIEF COMMUNICATION

The Self-Imagination Effect: Benefits of a Self-Referential Encoding Strategy on Cued Recall in Memory-Impaired Individuals with Neurological Damage

Matthew D. Grilli and Elizabeth L. Glisky
Department of Psychology, University of Arizona, Tucson, Arizona

(Received August 23, 2010; Final Revision April 28, 2011; Accepted April 28, 2011)

Abstract

Knowledge of oneself is preserved in many memory-impaired individuals with neurological damage. Therefore, cognitive strategies that capitalize on mechanisms related to the self may be particularly effective at enhancing memory in this population. The present study investigated the effect of “self-imagining,” imagining an event from a personal perspective, on short and long delayed cued recall in memory-impaired individuals with neurological damage. Sixteen patients intentionally encoded word pairs under four separate conditions: visual imagery, semantic elaboration, other person imagining, and self-imagining. The results revealed that self-imagining led to better performance than other-imagining, semantic elaboration, and visual imagery. Furthermore, the “self-imagination effect” (SIE) was preserved after a 30-min delay and was independent of memory functioning. These findings indicate that self-imagining provides a mnemonic advantage in brain-injured individuals, even those with relatively poor memory functioning, and suggest that self-imagining may tap into mnemonic mechanisms related to the self. (*JINS*, 2011, *17*, 929–933)

Keywords: Imagination, Self, Memory disorders, Memory rehabilitation, Episodic memory, Brain injury

INTRODUCTION

Previous research has demonstrated that methods that capitalize on preserved cognitive functions to compensate for memory impairment, such as vanishing cues and errorless learning, may be more successful in individuals with neurological damage than traditional cognitive strategies including semantic elaboration and visual imagery (Glisky, 2004; Wilson & Kapur, 2008). The relative success of these methods provides a clear message: strategies that incorporate cognitive or memory mechanisms that are spared in neurological damage may be particularly effective.

Patient studies have revealed that knowledge of oneself is preserved in at least some memory-impaired individuals with neurological damage (Cermak & O’Connor, 1983; for a review, see Klein and Gangi, 2010; Rathbone, Moulin, & Conway, 2009). Although numerous studies have demonstrated robust benefits of self-referential strategies in healthy individuals (Rogers, Kuiper, & Kirker, 1977; for a review, see Symons & Johnson, 1997), little research has focused on the mnemonic effect of self-referential processing in memory-impaired populations. However, recent studies have demonstrated benefits of self-referential encoding strategies in individuals who have compromised memory function including individuals with neurological damage (Marquine, 2009). Therefore, in contrast to traditional cognitive strategies, self-referential strategies may be particularly effective in memory-impaired individuals for at least two reasons: First, self-referential strategies typically generate substantial mnemonic enhancements, and second, memory mechanisms related to the self may be intact in many individuals with neurological damage.

In an effort to uncover a mnemonic strategy that capitalized on self-referential processing, we developed a technique that we called “self-imagination”—or the imagination of an event from a realistic, personal perspective (Grilli & Glisky, 2010). In that study, we found that all 14 memory-impaired individuals demonstrated a mnemonic advantage for self-imagination in recognition memory in comparison to semantic elaboration—what we have called the self-imagination effect (SIE)—and similar results were found in the healthy controls. Additional findings from Grilli & Glisky (2010) revealed that

---

Correspondence and reprint requests to: Matthew D. Grilli, Department of Psychology, University of Arizona, 1503 E. University Blvd., P.O. Box 210068, Tucson, AZ 85721. E-mail: mdgrilli@email.arizona.edu

the magnitude of the SIE was not influenced by memory functioning as measured by the General Memory Index (GMI) of the Wechsler Memory Scale (WMS-III; Wechsler, 1997) or by subjective ratings of imagery vividness, although benefits of semantic elaboration were smaller in individuals with poorer memory functioning. Based on those findings, we posited that the advantage of self-imagination in recognition memory may be attributable to mnemonic mechanisms related to the self, and self-imagining may be a very effective mnemonic strategy in individuals with neurological damage.

Although the results from Grilli & Glisky (2010) were promising, questions remained regarding the utility and mnemonic mechanisms of self-imagining. For instance, although the previous study measured recognition memory after a short delay (i.e., 2 min), demands on memory in everyday life usually involve fewer environmental cues and longer delays. Furthermore, the previous study did not include an "other-imagining" encoding task, and therefore could not rule out the possibility that the SIE was partly attributable to person processing in general and not the self *per se*. Similarly, although imagery ratings were not significantly correlated with the SIE, the extent to which the SIE could be explained by benefits of simple visual imagery was not directly assessed.

The present study had two principal aims: (1) to investigate further self-imagination as a valid strategy for memory enhancement in individuals with neurological damage using a cued recall task and a longer delay, and (2) to investigate several alternative explanations for the mnemonic mechanisms underlying self-imagining. On the basis of our previous study (Grilli & Glisky, 2010), we predicted that self-imagining would result in greater cued recall than visual imagery, semantic elaboration, and other-imagining. We predicted further that the advantage of self-imagining over the other encoding strategies would not be dependent on memory functioning.

METHODS

Participants

Sixteen individuals, ages 38 to 65 (7 male/9 female), with neurological damage of mixed etiology (12 with traumatic brain injury [TBI]) participated in the study. Individuals were recruited from the pool of participants in our laboratory, 11 of whom participated in a previous study (Grilli & Glisky, 2010). All participants had a self-reported decline in memory functioning related to their brain injury and were at least 1 year post-trauma. Table 1 shows the demographic information and neuropsychological test measures.

Neuropsychological Measures

Participants were administered neuropsychological tests to measure intellectual function (North American Adult Reading Test; Spreen & Strauss, 1998), memory function (Wechsler Memory Scale III [WMS-III] and California Verbal Learning Test [CVLT], Delis, Kramer, Kaplan & Ober, 1987), and executive function. All participants' GMIs were at least 1 standard deviation below their IQs. Furthermore, in all participants except for participant 8, both the long delay free and cued recall scores from the CVLT were at least 1 standard deviation below their age- and gender-corrected mean. Patients also completed a group of tests designed to measure executive functions associated with prefrontal cortex. Because encoding and retrieval strategies depend at

Table 1. Descriptive characteristics for individuals with neurological damage

Participant	Etiology	Neurological damage	Years since injury	Gender	Age	IQ	GMI	CVLT LDFR*	CVLT LDCR*	EF composite*
1	TBI	rFL/rTL/diffuse	24	Male	44	125	110	−1.0	−1.0	0.70
2	TBI	rFL/diffuse	29	Female	53	125	96	−2.0	−2.0	0.18
3	TBI		32	Male	50	97	78	−1.0	−1.0	−1.36
4	TBI		16	Female	53	103	63	−2.5	−2.5	−1.92
5	Tumor	TLs/rFL	12	Female	55	95	70	−3.0	−3.5	−1.53
6	Aneurysm	FLs	22	Male	46	127	81	−1.0	−1.0	1.45
7	Anoxia		36	Female	54	98	79	−1.5	−2.0	−1.60
8	TBI	FLs (r > l)	27	Female	46	115	73	−1.0	−0.5	−0.08
9	TBI	FLs/rTL/diffuse	11	Female	47	118	98	−3.5	−1.0	−0.84
10	TBI		18	Male	42	107	70	−1.0	−1.0	−1.77
11	TBI		25	Female	38	98	51	−5.0	−5.0	−1.46
12	TBI	rTLs/FLs	9	Male	57	106	89	−1.5	−1.0	−0.59
13	TBI		4	Female	58	110	78	−3.0	−2.5	−0.75
14	TBI	FLs	3	Male	65	108	91	−1.0	−1.0	0.02
15	TBI		9	Female	38	118	100	−1.0	−1.0	0.93
16	Encephalitis		4	Male	52	104	86	−1.0	−1.0	−1.12
Mean			17.6		49.9	109.6	82.1	−1.88	−1.69	−0.61
Standard deviation			10.6		7.4	10.6	15.1	1.20	1.20	1.04

Note. TBI = traumatic brain injury; r = right; l = left; FL = frontal lobe; TL = temporal lobe; CVLT = California Verbal Learning Test; LDFR = Long delay free recall; LDCR = Long delay cued recall; EF = Executive functioning; * = data represent z-scores.

least partly on prefrontal brain regions and many of our participants had damage to these areas, we wanted to assess whether impaired executive function might also affect their ability to benefit from self-imagination. We therefore constructed a composite measure of executive function based on five tests previously found to cluster together in factor analysis (Glisky, Polster, & Routhieaux, 1995; Glisky, Rubin, & Davidson, 2001) and hypothesized to reflect some aspects of executive function associated with working memory (Glisky & Kong, 2008). These tests included Modified Wisconsin Card Sorting Task (WCST) (Hart, Kwentus, Wade, & Taylor, 1988), Mental Control (WMS-III), Mental Arithmetic from the Wechsler Adult Intelligence Scale – Revised (WAIS-R) (Wechsler, 1981), the FAS test of word fluency (Spreen & Benton, 1977), and Digit Span Backwards (WMS-III). The composite score for each individual represents the unweighted average of the *Z*-scores for the five tests. *Z*-scores were based on published normative data for each neuropsychological test.

Individuals completed the neuropsychological testing when they initially enrolled in our laboratory with 12 of the patients tested within 2 years of participating in the present study. All individuals were at least 1.5 years post-injury at time of testing and were deemed to be cognitively stable at that time.

Materials

Experimental stimuli were 64 object–location word pairs which were separated into 4 lists of 16 matched on concreteness, imageability, and length. The object words were selected through the MRC Psycholinguistic Database Version II (Coltheart, 1981) and were previously rated on concreteness and imageability (on scales ranging from 100 to 700). Object words were rated as highly concrete with a mean concreteness rating of 597.05 and highly imageable with a mean imageability rating of 589.72. Object words were matched with unique spatial locations that, based on pilot testing, were rated as moderately related to the objects. Examples of word pairs are “crown–museum” and “typewriter–attic.” Word pairs were randomly mixed for each participant and presented visually on a HP laptop computer with DMASTR DirectX (DMDX; Forster & Forster, 2003).

Procedures

Participants provided written informed consent before taking part in the study, and all data were collected in compliance with regulations of the University of Arizona Institutional Review Board. The study was divided into two sessions administered 1 week apart. Each session was approximately 60 min in duration and consisted of two study-test phases, one for each encoding condition. To limit carry-over effects, the first study phase in each session was either a visual imagery or a semantic elaboration encoding condition and the second study phase was either another-imagining or a self-imagining encoding condition. Word pairs were counterbalanced across encoding conditions, and encoding conditions were counterbalanced across sessions such that visual imagery and semantic elaboration were paired with other- and self-imagining an equal number of times. Each study phase consisted of 16 target word pairs presented between two primacy and two recency buffer word pairs and was preceded by three practice trials so that participants were fully informed of the nature of the memory test.

Target word pairs were presented one at a time in the middle of the screen for seven seconds before a “beep” signaled the conclusion of the trial. In the visual imagery study phase, participants were instructed to form a visual image of the object in the spatial location and maintain the visual image for the remainder of the trial. In the semantic elaboration study phase, participants were instructed to generate a sentence that incorporated the object and spatial location in a meaningful way and to say the sentence aloud. In the other-imagining study phase, participants were instructed to imagine with as much detail as possible Arnold Schwarzenegger interacting with the object in the spatial location. Participants were encouraged to imagine the event realistically and as though it could actually take place. Arnold Schwarzenegger was selected for the other-imagining task because he is generally well known for his roles in a variety of contexts (i.e., actor, politician, and athlete) and he has experienced a relatively high degree of exposure in multiple media outlets for the past several decades. All participants were able to form a vivid visual image and demonstrate general knowledge of Arnold Schwarzenegger. In the self-imagining study phase, participants were instructed to imagine themselves interacting with the object in the spatial location. Participants were encouraged to imagine the event from a realistic, personal perspective by including thoughts, feelings, and sensory experiences that they themselves might have if they were actually interacting with the object in the spatial location. In all encoding conditions, the instructions appeared on the top of the screen for each trial, and in the visual imagery, other-imagining, and self-imagining study phases, participants were encouraged to close their eyes to assist in image construction, but this was not mandatory.

Each study phase was followed by 2 min of counting backward followed immediately by a cued recall test for the 16 target word pairs presented in the study phase. Object words were presented visually as cues and participants had to recall aloud the spatial location word that was paired with each object word. These short delay cued recall tests were self-paced such that participants had as much time as they needed to name the location word or say that they could not remember. Responses were recorded by the experimenter, but no feedback was provided. After completion of the short delay cued recall test for the second study phase in a session, participants were engaged in a 30-min computerized trivia game, which required participants to answer multiple-choice general knowledge questions. The trivia game was followed by a long delay, self-paced cued recall test for the 16 target word pairs that were from the first study phase and then the 16 target word pairs that were from the second study phase. Instructions for the long delay cued recall tests were the same as the short delay tests.

Table 2. Mean proportion correct in short (2 min) and long (30 min) delayed cued recall (and standard deviations) in the visual imagery, semantic elaboration, other-imagining, and self-imagining conditions

Encoding task	Short delay	Long delay
Visual imagery	.50 (.29)	.43 (.30)
Semantic elaboration	.49 (.32)	.45 (.33)
Other-imagining	.43 (.29)	.39 (.29)
Self-imagining	.61 (.27)	.56 (.28)

RESULTS

Effects of Encoding Conditions and Delay on Cued Recall in Individuals with Neurological Damage

Table 2 shows mean cued recall performance for the brain-injured individuals. A 4 (encoding condition) × 2 (delay) repeated measures analysis of variance (ANOVA) revealed a significant effect of encoding condition, $F(3,45) = 5.05$; $p < .01$; $\eta^2 = .25$; a significant effect of delay, $F(1,15) = 22.84$; $p < .001$; $\eta^2 = .60$; and no interaction, $F < 1$. Subsequent contrasts revealed that self-imagining enhanced cued recall more than visual imagery, $F(1,15) = 11.09$; $p < .01$; $\eta^2 = .43$; semantic elaboration, $F(1,15) = 6.36$; $p < .05$; $\eta^2 = .30$; and other-imagining, $F(1,15) = 17.94$; $p < .001$, $\eta^2 = .55$. In addition, semantic elaboration performance did not differ from visual imagery or other-imagining, both Fs < 1; nor did visual imagery differ from other-imagining, $F(1,15) = 2.69$; $p = .12$. Furthermore, participants showed a decline in performance across the 30-min retention interval that did not differ as a function of encoding condition.

Relation of SIE to Neuropsychological Functioning

Pearson product-moment correlations were performed to examine whether the SIE was correlated with memory functioning as measured by GMI scores, with IQ, or with executive functioning as measured by the composite score. The SIE was derived by averaging performance (i.e., collapsed across short and long delayed cued recall) in the other three encoding conditions (i.e., other-imagining, semantic elaboration, and visual imagery) and subtracting it from performance based in the self-imagining condition. GMI scores were non-significantly correlated with the SIE, $r = -.34$, $p = .19$, indicating that the advantage of self-imagining over the other encoding conditions was not attenuated by severity of memory impairment. In fact, similar to our previous study (Grilli & Glisky, 2010), the negative correlation suggested that the SIE was slightly *larger* in individuals with *poorer* memory functioning. The SIE was not significantly correlated with IQ, $r = .05$, $p = .85$; or executive functioning, $r = -.04$, $p = .89$.

DISCUSSION

The findings from the present study provide new evidence that self-imagining elicits a robust advantage over and above other encoding strategies and that this benefit occurs irrespective of memory functioning and in a cued recall memory task. Although the rate of decline in self-imagining was not significantly different from the other encoding strategies, the advantage of self-imagining was preserved after a relatively long, 30-min delay. Therefore, although additional research is necessary to explore further the feasibility of implementing self-imagining in memory rehabilitation, these results indicate that self-imagining had an advantage over other cognitive strategies, even in individuals with relatively poor memory functioning.

The present study also sheds some light on the potential mnemonic mechanisms of the SIE, and calls into question several possible explanations for the advantage of self-imagining. Indeed, although self-imagining may involve a visual imagery component and elaborative processing, the mnemonic advantage of self-imagining appears not to be attributable solely to either of these cognitive processes. Furthermore, the present results indicate that self-imagining provides benefits beyond those that might be associated more generally with person processing. Instead, the findings from the present study suggest that the advantage of self-imagining over these other strategies may be a result of encoding and retrieval mechanisms related to the self, which may be preserved in individuals with neurological damage. Of course, further research is necessary to explore more directly the mechanisms underlying the SIE and to address alternative explanations. For example, the present study cannot rule out the possibility that the advantage of self-imagining may be related to intimate knowledge of a person and not the self *per se*. Furthermore, the effect of including personal thoughts, feelings, and sensory experiences remains unclear since the other-imagining instructions did not require participants to simulate Arnold Schwarzenegger's thoughts and feelings.

CONCLUSIONS

The present study further validates self-imagining as a method for improving memory in individuals with neurological damage. However, only 16 individuals with neurological damage were tested, memory impairment was variable among participants, and a majority of the individuals in the present study experienced their neurological damage from TBIs. In addition, 11 of the individuals from the present study participated in Grilli and Glisky (2010), and we, therefore, cannot rule out the possibility that these results may reflect some idiosyncrasy of the sample of patients. However, we think this is not likely given the fact that we have demonstrated similar benefits in healthy controls (Grilli & Glisky, 2010).[1] Nevertheless, additional research is needed to replicate the SIE in a different sample of patients and to investigate whether benefits of self-imagining are experienced by

---

[1] Although not reported in the present study, we found a similar advantage of self-imagining relative to other-imagining, semantic elaboration, and visual imagery in a cued recall task in a group of 16 healthy controls matched to the memory-impaired patients on age, education, and IQ.

individuals with brain injuries of different etiologies. The findings from the present study, however, are promising and suggest that self-imagination may provide a particularly effective method for memory rehabilitation.

ACKNOWLEDGMENTS

This research was supported by National Institute on Aging Grant AG14792. The authors have no conflicts of interest.

REFERENCES

Cermak, L.S., & O'Connor, M. (1983). The anterograde and retrograde retrieval ability of a patient with amnesia due to encephalitis. *Neuropsychologia*, *21*(3), 213–234.

Coltheart, M. (1981). The MRC psycholinguistic database. *The Quarterly Journal of Experimental Psychology A: Human Experimental Psychology*, *33A*(4), 497–505.

Delis, D.C., Kramer, J., Kaplan, E., & Ober, B.A. (1987). *The California Verbal Learning Test*. San Antonio, TX: Psychological Corporation.

Forster, K.I., & Forster, J.C. (2003). DMDX: a window display program with millisecond accuracy. *Behavioral Research Methods, Instruments, & Computers*, *35*(1), 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., & Kong, L.L. (2008). Do young and older adults rely on different processes in source memory tasks? A neuropsychological study. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, *34*(4), 809–822.

Glisky, E.L., Polster, M.R., & Routhieaux, B.C. (1995). Double dissociation between item and source memory. *Neuropsychology*, *9*, 229–235.

Glisky, E.L., Rubin, S.R., & Davidson, P.S. (2001). Source memory in older adults: An encoding or retrieval problem? *Journal of Experimental Psychology: Learning, Memory, & Cognition*, *27*, 1131–1146.

Grilli, M.D., & Glisky, E.L. (2010). Self-Imagining enhances recognition memory in memory-impaired individuals with neurological damage. *Neuropsychology*, *24*(6), 698–710.

Hart, R.P., Kwentus, J.A., Wade, J.B., & Taylor, J.R. (1988). Modified Wisconsin Cart Sorting Test in elderly normal, depressed, and demented patients. *Clinical Neuropsychologist*, *2*, 49–56.

Klein, S.B., & Gangi, C.E. (2010). The multiplicity of self: neuropsychological evidence and its implications for the self as a construct in psychological research. *Annals of the New York Academy of Sciences*, *1191*, 1–15.

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

Rathbone, C.J., Moulin, C.J., & Conway, M.A. (2009). Autobiographical memory and amnesia: Using conceptual knowledge to ground the self. *Neurocase*, *15*(5), 405–418.

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*(9), 677–688.

Spreen, O., & Benton, A.L. (1977). *Neurosensory Center Comprehensive Examination for Aphasia (NCCEA)*. Victoria: University of Victoria Neuropsychology Laboratory.

Spreen, O., & Strauss, E. (1998). *A compendium of neuropsychological tests: Second edition*. 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*(3), 371–394.

Wechsler, D. (1981). *Wechsler adult intelligence scale-revised*. New York: Psychological Corporation.

Wechsler, D. (1997). *Wechsler memory scale-third edition: Administration and scoring manual*. San Antonio, TX: The Psychological Corporation.

Wilson, B.A., & Kapur, N. (2008). Memory rehabilitation for people with brain injury. In D.T. Stuss, G. Winocur, & I.H. Robertson (Eds.), *Cognitive neurorehabilitation: Evidence and application* (2nd ed., pp. 522–540). New York, NY: Cambridge Press.