RUNNING HEAD: Expressive Writing and Long-Term Memory

The Benefits of Expressive Writing on Long-Term Memory Performance

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Author Note

Portions of this research were presented at the 47th annual meeting of the Psychonomic Society, Houston, Texas, in November 2006. We thank Megan Tiffany and Kathryn Parr for assistance with data collection. Correspondence concerning this article should be sent to Tracy Linderholm, School of Human Development and Organizational Studies in Education, University of Florida, PO Box 117046, Gainesville, FL 32611-7046, Email: linderholm@coe.ufl.edu; or Lise Abrams, Department of Psychology, University of Florida, PO Box 112250, Gainesville, FL, 32611-2250, Email: abrams@ufl.edu.

ABSTRACT

Previous research has shown that expressive writing can be beneficial to cognition by increasing working memory performance. The present study examined whether expressive writing about negative life events could facilitate long-term memory performance. Participants either wrote about a negative life event or completed a neutral, non-writing task involving math calculations. Participants then completed a fan effect task involving long-term memory, where they learned subject-location sentences (subjects were paired with multiple locations) and later attempted to recognize a particular subject-location as quickly and as accurately as possible. The results showed that following expressive writing, subject-location pairs were learned faster relative to the neutral task. There was also some evidence that participants who wrote expressively recognized subject-location pairings more quickly and more accurately than participants in the neutral condition. We conclude that expressive writing has the potential to facilitate cognition beyond immediate recall, which has important educational implications.

Keywords: Expressive writing, long-term memory, cognition, fan effect task

INTRODUCTION

Expressive writing has been shown to be a beneficial strategy for those attempting to enhance emotional well-being and improve health (Klein, 2002; Mosher & Danoff-Burg, 2006; Pennebaker & Chung, 2007). Most interesting to cognitive psychologists (Hayes, 2006) is the finding that expressive writing can actually facilitate cognitive performance as well (Klein & Boals, 2001). Specifically, expressive writing has enhanced performance on working memory tests and improved overall grade point averages for students who wrote expressively over a period of time (Klein, 2002; Klein & Boals, 2001; Yogo & Fujihara, 2008). The purpose of the present study was to investigate whether expressive writing can facilitate other cognitive processes dependent on working memory, such as long-term memory.

In the pivotal study that showed a connection between expressive writing and cognitive performance, Klein and Boals (2001) asked college students to write about positive life events, negative life events, or time management, with writing occurring three times over the course of a semester. Participants were also given the operation span task developed by Engle and associates to measure working memory (e.g., Engle, 2002; Rosen & Engle, 1998) at the beginning and end of the semester. They found that people who wrote about personally-experienced negative events significantly increased their operation span performance at the end of the semester, compared to those in positive or neutral writing conditions. Klein and Boals (2001) suggested that there was a purging mechanism involved in expressive writing that allowed working memory resources to be better managed. For example, they proposed that recalling a personally-experienced negative event may cause “clutter” in working memory due to unwanted, intrusive thoughts about the event. Consequently, writing may serve to organize the ideas about a negative emotional event and purge distracting thoughts from working memory, freeing up working memory resources to process other information more effectively. In contrast, recalling neutral or positive events does not generate excess information in working memory, so writing about these events does not affect working memory. A similar pattern of findings was observed by Yogo and Fujihara (2008). They asked participants to write during three different sessions over the course of six weeks under one of three types of writing instructions: writing about a traumatic experience, writing about their best possible future selves, or writing about a trivial topic. Working memory performance, assessed using the operation span task, improved over the course of the experimental sessions but only in the condition where participants wrote about traumatic events. It therefore seems to be necessary to write about negative life events for cognitive benefits to occur.

The findings of Klein and Boals (2001) and Yogo and Fujihara (2008) inspire many questions about the cognitive benefits of expressive writing. Perhaps most important for educational purposes is the question of whether the benefits of expressive writing generalize to other cognitive tasks besides working memory tests. To be truly usable as a remedial strategy, for example in academic domains, the benefits from writing should generalize to longer-lasting cognitive processes, such as long-term learning and memorization of information. It is logical to predict that a task that facilitates working memory performance will also enhance long-term memory, presumably because long-term memory depends on working memory. For example, in studies of reading comprehension, individuals with lower working-memory capacities showed limits in strategic processing during reading, and the kind of processing engaged in during reading influenced how much and the detail of information that is remembered about the text after reading (e.g., Linderholm & van den Broek, 2002). Specifically, low working-memory capacity readers engaged in shallow processing strategies (e.g., simple repetition and paraphrasing) during some reading conditions, which in turn decreased long-term recall of text information (e.g., Linderholm & van den Broek, 2002).

In a related domain, researchers have found that working-memory capacity is linked to performance on the fan effect task (Anderson, 1974), which is a measure of long-term memory organization (Bunting, Conway, & Heitz, 2004; Cantor & Engle, 1993). Although researchers may debate how long the delay must be between exposure to stimuli and its assessment to call it a "long-term" memory task, the fan effect task is certainly more reliant on long-term memory storage and retrieval than the previously used working memory tasks. In the fan effect task, participants learn a series of facts that involve a subject and its location, for example, *the lawyer was in the store*. Participants are given a number of facts where the subject stays the same but the location varies (e.g., *the lawyer was in the store*; *the lawyer was in the park*). The number of facts that a participant must learn is called the set size, with previous research using set sizes from one to six facts. The “fan effect” corresponds to the well-documented finding that the more facts one must learn about the same subject (the larger the set size), the more difficult it is to recognize any single fact from the set (e.g., Radvansky, 1999). This same pattern has been observed across many different stimuli (e.g., face recognition and learning arithmetic facts) and methodologies, both behavioral and neurological (see Anderson & Reder, 1999).

To study the effects of expressive writing on long-term memory, we chose to measure how well one organizes and retrieves information stored in long-term memory, using the fan effect task. If processing in working memory is essential to good long-term memory organization, then expressive writing should reduce the fan effect, making it easier to recognize a specific fact after a set of related facts were learned. Using a task that emphasizes long-term memory functioning allowed us to explore whether expressive writing could potentially increase performance on more complex tasks involving learning, rather than a task of immediate recall as was done in previous studies (Klein & Boals, 2001; Yogo & Fukihara, 2008). Furthermore, the fan effect task is dependent on successful integration of ideas and prevention of interference (Cantor & Engle, 1993; Gomez-Ariza & Bajo, 2003), processes that are also important for successful reading comprehension. During reading, one must be able to manage attentional resources and inhibit information that is irrelevant to task performance to be able to integrate ideas across several sentences or paragraphs. When performing the fan effect task, one must also manage attentional resources to learn and retrieve subject-location pairs and to suppress irrelevant pairings of items so that a mental representation of the to-be-learned items can be developed. Thus, if fan effects are diminished following writing about negative events in one's life, then it is possible that the benefits of writing can be generalized to other domains relevant to learning and academics, such as reading comprehension.

In the present experiment, we had two "cognitive activity" conditions, an expressive writing condition that required writing about personally-experienced negative events and a neutral, non-writing condition. The expressive writing condition was employed to replicate the negative life events manipulation used by Klein and Boals (2001). The expressive writing condition was compared with a neutral, non-writing condition involving math calculations. If expressive writing benefits long-term memory, then learning and recognition of subject-locations pairs in the fan effect task are expected to be faster and more accurate for participants who engaged in expressive writing compared to those who did not. If correct, this finding would potentially support the notion that expressive writing has long-term memory benefits, extending previous research demonstrating benefits for working memory (e.g., Klein & Boals, 2001).

METHOD

Participants

Fifty-seven participants from a large southeastern university participated in this study in partial fulfillment of an undergraduate course requirement in educational psychology. Due to failure to meet an established performance criterion (see Results section), two participants were removed. Of the remaining sample of participants, 38 were female and 17 were male, and the mean age was 20.22 years (*SD* = 1.27; *range* 18-23 years).

Materials and Procedure

Participants were randomly assigned to either the expressive writing condition or the neutral condition that required math problem solving. Participants in the expressive writing condition were asked to write for five minutes about something negative that had happened to them since coming to college. In detail, the instructions were: "Please write about a negative experience you have had since you came to college. You will be given five minutes to complete this task. If you don't feel comfortable completing this writing assignment, please inform the researcher." No research participants discontinued this writing assignment. As a control, a neutral condition was used that did not involve writing but still required cognitive effort; a non-verbal task involving math calculations was chosen to ensure that negative emotions about a specific experience were not inadvertently evoked. Participants were given a series of complex multiplication problems (e.g., 778 X 175) to work on for five minutes. Their specific instructions were: "Please complete the following sheet of math problems. Do the best you can to correctly answer the problems. You will be given five minutes to work on the problems." In both tasks, participants were asked to stop working after five minutes had passed.

Participants then completed the fan effect task (e.g., Anderson, 1974). The fan effect task is thought to measure how well one may integrate a series of facts about a single subject into long-term memory (e.g., Anderson, 1974). Materials were constructed by the experimenters but were based on previously used materials (e.g., Cantor & Engle, 1993; Experiment 1). Targets consisted of subjects paired with either three or six locations that were presented in the learning phase as a sentence, "The subject was in the location." Foils consisted of the same subjects paired with additional locations (either three or six) that were not previously presented in the learning phase. Four subjects and 12 locations were counterbalanced across two versions of the experiment in which subject-location sentences served as either targets or foils. Set size was also counterbalanced, so that subjects of a particular set size in one version were assigned to the other set size in the second version (see Appendix for version one and version two materials).

We implemented a modified version of the fan effect task used by Conway and Engle (1994), which involved two phases: a learning phase and a verification phase (see Figure 1). The learning phase of the fan effect task involved learning a series of subject-location sentences, where each subject was paired with either three or six different locations, representing the "fan size". Participants learned two series of set size three (each set had one subject paired with three different locations) and two series of set size six (each set had one subject paired with six different locations). In the first cycle of the learning phase, participants were exposed to the groups of subject-location sentences for a total of x seconds, where $x = n (10) + 10$, and $n =$ fan size. Next, participants were presented with subjects and asked to verbally recall all of the locations associated with each subject. In this first cycle, the criterion was to recall all of the locations for each subject correctly exactly one time before the participant could move on to the next phase. If participants did not correctly recall all locations, they received an error message, the subject was returned to the to-be-recalled queue, and each subject-location pair was randomly presented again for participants to recall all of its locations. Once they met the recall criterion for all of the subjects, they were allowed to go on to the next phase of the task.

In the second cycle of the learning phase, participants were exposed again to the individual sentences, not in their groups, presented randomly for five seconds. After this period of exposure, each subject was presented three times in random order for recall of all corresponding locations. If participants did not recall all of the locations correctly, they received an error message, and that subject was returned to the to-be-recalled queue. Participants were not allowed to move on to the next phase of the experiment until they correctly recalled all of the locations associated with each subject three times in a row. Once the criterion was met for a specific subject, that subject was not tested again. In the final part of the learning phase, that is, after participants reached the criterion for the second cycle, participants were exposed to the sentences one last time in their groups for 40 or 70 seconds, respectively for sets of three and six, with no opportunity for recall. Upon reaching criterion successfully, the verification phase of the task began immediately.

In the verification phase of the fan effect task, participants saw both target and foil sentences one at a time and were asked to determine whether the sentence was old or new (e.g., whether or not they had studied it before) by pressing one key to indicate “new” and another key to indicate “old” on the computer keyboard. Both speed and accuracy were stressed. Each target and foil appeared three times in random order.

The entire experiment took approximately one hour to complete.

RESULTS

Separate mixed-factors univariate analyses of variance (ANOVAs) were used to test the effects of the cognitive activity tasks on the learning phase and the verification phase of the fan effect task. To score the learning phase, the average number of times it took participants to reach criterion on each of the two cycles (see section above for criterion) was determined. In regard to the verification phase, the accuracy and speed (in ms) for participants to decide whether sentences were old or new was calculated and averaged across participants. Participants who did not achieve at least a 60% accuracy level or who had 40% or more errors were excluded from the data set. This criterion level was established because it is the minimum thought to reflect an appropriate level of effort on behalf of the research participant (see Bunting et al., 2004). That resulted in the removal of two individuals from the neutral condition. Of the remaining 55 participants, 26 participants were in the neutral condition and 29 were in the expressive writing condition. All analyses used an alpha level of .05 as the significance criterion, but findings at the alpha level of .10 also are reported to provide a complete picture of general trends in the data set.

Learning phase

A mixed-factors ANOVA was conducted using Cognitive Activity Condition (Neutral or Expressive Writing), Set Size (three and six), and Cycle (First Cycle and Second Cycle) as independent variables. The average number of trials to reach criterion (with more trials representing increased difficulty) was the dependent variable (see means in Table 1). Cognitive Activity Condition was a between-subjects factor, whereas Set Size and Cycle were within-subjects factors.

The results showed a significant main effect of Cognitive Activity Condition, $F\,(1, 53) = 6.87$, $MSe = 4.66$, $p < .05$, where participants in the neutral condition took more trials to reach criterion than did participants in the expressive writing condition. The main effect of Set Size was also significant, F (1, 53) = 14.56, MSe = .79, $p < .001$, where participants required more trials to meet criterion for set sizes of 6 than for set sizes of 3. Lastly, the main effect of Cycle was significant, F (1, 53) = 43.16, MSe = 2.81, $p < .001$, as participants required more trials to meet criterion in the second cycle than in the first cycle, presumably because the second cycle had a more extensive criterion to reach. None of the interaction effects reached significance, Fs < 1.

Verification phase: Recognition times (in ms)

A mixed-factors ANOVA was conducted using Cognitive Activity Condition (Neutral or Expressive Writing), Set Size (three and six), and Target Type (Target and Foil) as independent variables and recognition time (in ms), averaged across three presentations, as the dependent variable (see means in Table 2). Only recognition times for correct responses were analyzed; 9.46% of responses were incorrect and were excluded from analyses. The factor of Cognitive Activity Condition served as a between-subjects factor; Set Size and Target Type served as within-subjects factors. Because recognition time data tend to be highly variable (e.g., Ratcliff, 1993), outliers were removed using 2.5 standard deviations above and below the mean of each cell of the independent variables. As a result, 3.4% of the data were removed from recognition time analyses.

The ANOVA showed a significant main effect of Target Type, F (1, 53) = 10.60, MSe = 141794, $p < .01$, such that participants were faster to accurately recognize target sentences as opposed to foil sentences. There was also a main effect of Set Size, F (1, 53) = 5.80, MSe = 141794, $p < .05$, which was qualified by a marginally significant interaction between Cognitive Activity Condition and Set Size, F (1, 53) = 3.61, MSe = 164076, $p < .06$. Follow-up tests on the interaction revealed that Cognitive Activity influenced recognition times for sentences from set sizes of three, which were marginally slower in the neutral condition than the expressive writing condition, $p < .09$. However, for sentences from set sizes of six, there were no differences in recognition times between the neutral and expressive writing conditions, $p > .54$. An alternative interpretation of the interaction is that the effect of set size was relevant only for participants in the neutral condition, where set sizes of six were more quickly recognized than set sizes of three, $p < .05$. In contrast, participants in the expressive writing condition had equivalent recognition times for set sizes of three and six, $p > .63$. No other effects were significant in this analysis, *F*s < 1.

V*erification phase: Accuracy (percentage of errors)*

A mixed-factors ANOVA was conducted using Cognitive Activity Condition (Neutral or Expressive Writing), Set Size (three and six), and Target Type (Target and Foil) as independent variables, and proportion of errors, averaged across three presentations, was the dependent variable (see means in Table 3).

The results of the ANOVA revealed a main effect of Cognitive Activity Condition, F (1, 53) = 4.65, $MSe = .02$, $p < .05$, which was moderated by a significant Cognitive Activity Condition x Target Type interaction, F (1, 53) = 4.61, $MSe = .004$, $p < .05$. Follow-up analyses of this interaction revealed that participants in the neutral condition and in the expressive writing condition made an equivalent amount of recognition errors on target items, $p > .19$. However, for foil items, participants in the neutral condition made more errors than participants in the expressive writing condition, $p < .05$. Alternatively, for participants in the neutral condition, the percentage of errors was marginally higher for foil items than for target items, $p < .08$. In contrast, participants in the expressive writing condition made equivalent recognition errors for the foil and target items, $p > .27$. No other effects in the ANOVA reached significance, $F\text{s} < 1$.

CONCLUSION

The primary question addressed in this study was whether the benefits of writing generalize to cognitive tasks other than working memory tasks, specifically tasks that last for longer-term intervals beyond the relatively short duration of working memory. The results showed several advantages in long-term memory performance following expressive writing relative to the neutral cognitive activity. First, expressive writing facilitated the initial learning of subject-location pairs; participants required fewer trials to reach criterion compared to the neutral condition. Second, participants in the expressive writing condition were marginally faster at recognizing subject-location sentences (in sets of 3). Third, expressive writing facilitated accuracy of recognizing foil items compared to the neutral condition. Although expressive writing did not increase speed and accuracy in all conditions, the specific benefits described above indicate that some long-term benefits in cognitive performance result following expressive writing. Verification of statements in the fan effect task is thought to involve the integration of facts in long-term memory (Anderson, 1974), so speeded recognition times and decreased errors following the expressive writing condition suggest that this integration process is being facilitated to some degree. Thus, the present research provides some evidence that expressive writing facilitates learning and long-term memory organization.[1]

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[1] To verify that the neutral condition, a series of multiplication problems, did not hinder performance (instead of expressive writing improving performance), we calculated the number of problems that participants completed as well as the number of problems that were accurately answered. We correlated both measures with number of learning cycles, recognition times, and accuracy rates on the fan effect task. There were no significant correlations, suggesting that performance on the math problem solving task was independent of every phase of the fan effect task, making it an appropriate control condition to contrast with the expressive writing condition.

Surprisingly, the fan effect did not emerge in our study for either cognitive activity condition, which would have been evidenced by slower response times and more errors for subjects with six locations than three locations. Interestingly, we did observe a "reverse" fan effect in recognition times for participants in the neutral condition, where set sizes of six were even faster than set sizes of three. One possible explanation for the lack of fan effects in our study may be that the learning phase criteria were so difficult and time-consuming to reach, especially for set sizes of 6, which required significantly more trials to meet criterion. In our study, participants were given two cycles to learn, and in one of those cycles, the criterion was to learn each set three times consecutively. This extended amount of time spent in the learning phase may have provided participants with the opportunity to develop strategies and to build strong mental representations called “situation models”. Previous research has shown that strategies, which are more elaborative in nature, such as determining the plausibility of subject-location pairs that one is trying to learn, can reverse the fan effect (Reder & Wible, 1984). In addition, recent research shows that making more retrieval mistakes, which is more likely when the learning criterion is harder as in the sets of six facts, actually strengthens memory and learning (e.g., Kornell, Hays, & Bjork, 2009) and makes situation model formation more likely. Using situation models has also been shown to eliminate the fan effect or reverse it (Radvansky, 2005). It is worth noting that more recent studies of fan effects (e.g., Radvansky, 2005; Sohn, Anderson, Reder, & Goode, 2004) have used less stringent and time-consuming learning phases than ours.

Although we did not set out to systematically test the mechanism responsible for expressive writing and its facilitation of long-term memory and learning, there are several possible explanations on which we can speculate. As has been proposed by other researchers, expressive writing may involve a mechanism that facilitates the purging of unwanted emotional material from working memory, which makes cognitive processing more efficient (Klein, 2002; Klein & Boals, 2001). A second mechanism could be that engaging in expressive writing is a form of language priming, which allows working memory to be more prepared for upcoming tasks using language (e.g., Branigan, Pickering, & McLean, 2005; Cleland & Pickering, 2006). This explanation is a possibility because the fan effect task is inherently verbal in nature and goes beyond individual words to the processing of sentences, as does expressive writing. To confirm priming as a mechanism, more must be known about why writing about positive life events is not a strong enough language manipulation compared to writing about negative life events to produce cognitive benefits since both types of expressive writing involve language (see Klein & Boals, 2001; Yogo & Fujihara, 2008). Perhaps there are some unique linguistic structures that emerge when writing about negative life events that must occur in order to show cognitive benefits.

A unique contribution of the present study is that cognitive benefits were found following expressive writing when there was only a short, 5-minute session of expressive writing. These results extend the findings of other studies where expressive writing occurred over several sessions, typically lasting several weeks (Klein & Boals, 2001; Yogo & Fujihara, 2008). Showing that cognitive benefits can be derived from just one short session of writing enhances the educational application of this strategy. For example, one short session of writing about anxious feelings or a negative experience is a task that students could be taught to do on their own, prior to engaging in an academic task, to heighten performance. Furthermore, the present experiment had participants write for a much shorter interval, and on topics that were considerably less traumatic, relative to Klein and Boals (2001). Whether our findings would extend beyond the immediate testing window, for example, for a week or longer, is unknown. Clearly, more needs to be known about the quality and the quantity (e.g., how many writing sessions and for how long) of expressive writing that is necessary to show improvements in cognitive performance.

In summary, the present experiment showed that expressive writing about a negative life event gives a boost to long-term memory performance. That is, expressive writing boosts cognitive functions other than simple working memory tasks (see Klein & Boals, 2001). Future research should determine other types of cognitive tasks that expressive writing benefits. If expressive writing does indeed facilitate processing in both working and long-term memory, then more complex cognitive tasks may also be facilitated by expressive writing. For example, reading comprehension and memory for text information are cognitive tasks that are dependent on working memory (e.g., Just & Carpenter, 1992; Linderholm & van den Broek, 2002; Linderholm, 2002). Thus, one future direction may be to determine if expressive writing tasks enhance reading comprehension and text memory by facilitating processing in working memory.

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Appendix

Subject-Location Stimuli for Experiment

Set Size	*Subject*	*Location*
		Version 1
Targets		
3	Lawyer	Boat, Park, Church
3	Artist	House, Store, Zoo
6	Teacher	Boat, Park, Church, Bank, Gym, Bar
6	Doctor	House, Store, Zoo, Train, Pier, Fair
Foils		
3	Artist	Boat, Park, Church
3	Lawyer	House, Store, Zoo
6	Doctor	Boat, Park, Church, Bank, Gym, Bar
6	Teacher	House, Store, Zoo, Train, Pier, Fair
		Version 2
Targets		
3	Teacher	Bank, Gym, Bar
3	Doctor	Train, Pier, Fair
6	Lawyer	Boat, Park, Church, Bank, Gym, Bar
6	Artist	House, Store, Zoo, Train, Pier, Fair
Foils		
3	Doctor	Bank, Gym, Bar
3	Teacher	Train, Pier, Fair
6	Artist	Boat, Park, Church, Bank, Gym, Bar
6	Lawyer	House, Store, Zoo, Train, Pier, Fair

Table 1

Means and Standard Errors (in parentheses) of the Number of Trials to Learn Subject-Location Sentences as a Function of Cognitive Activity Condition, Set, and Cycle

	Cycle 1		*Cycle 2*	
	Set 3	*Set 6*	*Set 3*	*Set 6*
Neutral	2.52 (.27)	3.33 (.30)	4.29 (.27)	4.60 (.32)
Expressive Writing	1.98 (.26)	2.40 (.29)	3.50 (.25)	3.79 (.30)

Table 2

Means and Standard Errors of the Recognition Times (in ms) to Verify Subject-Location Sentences as a Function of Cognitive Activity Condition, Target Type, and Set Size

	Target Items		*Foil Items*	
	Set 3	*Set 6*	*Set 3*	*Set 6*
Neutral	2534 (185)	2272 (145)	2906 (197)	2504 (178)
Expressive Writing	2254 (175)	2176 (137)	2336 (187)	2337 (168)

Table 3

Means and Standard Errors of Proportion of Errors to Verify Subject-Location Sentences as a Function of Cognitive Activity Condition, Target Type, and Set Size

	Target Items		*Foil Items*	
	Set 3	*Set 6*	*Set 3*	*Set 6*
Neutral	.08 (.02)	.09 (.01)	.12 (.02)	.10 (.02)
Expressive Writing	.07 (.02)	.05 (.01)	.06 (.02)	.04 (.02)

Figure 1. Flowchart of the general procedure used for the fan effect task with an example of set size 3.