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## **Emotional expression and modality: an analysis of affective arousal and linguistic output in a computer vs. paper paradigm**

William G. Sharp and David S. Hargrove

### **ABSTRACT**

The authors hypothesized that writing longhand and typing about a stressful experience are equivalent in terms of emotional arousal and essay content. 168 college students were randomly assigned to describe either a neutral or emotional topic by typing or writing longhand, in a 2x2 factorial design. Compared with students in the neutral conditions, students instructed to describe an emotional topic reported greater negative affect following the writing task and produced essays that contained significantly more personal and psychological content. Consistent with the hypothesis, participants writing longhand and typing were equivalent in the direction and degree of this difference. These findings suggest that at least a portion of the population (i.e. college students) is now comfortable and/or adept in expressing themselves emotionally on a computer.

## 1. INTRODUCTION

A growing number of studies have demonstrated that writing about an emotional experience has significant physical, behavioral, and mental health benefits; among these are an increase in immune functioning, decrease in absenteeism from work, and an increase in positive mood (Francis and Pennebaker, 1992, Pennebaker et al., 1988 and Pennebaker and Seagal, 1999). While most of the research regarding emotional writing has focused exclusively on demonstrating its effectiveness, there is comparatively little research devoted to determining if the modality of writing influences therapeutic self-disclosure. Given the widespread use of word-processing and electronic mail (e-mail) in today's society, determining if these therapeutic benefits translate to computers appears to be an important area for further research.

When the issue of modality has been addressed, two main theories have emerged. In one line of research, it was theorized that writing in longhand holds distinctive benefits over typing because people are more accustomed to writing about personal events in longhand and because typing may exert an additional load on one's cognitive capacities, reducing the capability for self-focus (Brewin & Lennard, 1999). Evidence to support this theory was based on measured levels of emotional arousal. Utilizing this dependent measure, it was reported that students who wrote about a stressful experience in longhand indicated greater levels of negative affect, rated the writing task as more beneficial, and reported a higher level of self-disclosure.

Alternatively, it has been argued that, with the advent of e-mail and word processing programs, individuals are becoming more adept at expressing personal experiences with the typewritten word. Working from this line of reasoning, Wood, Sharp, and Hargrove (2001) focused on the content of the emotional essays and reported that there were virtually no differences in terms of linguistic content (e.g. the percentage of words used in a variety of categories including positive emotion words, negative emotion words, sad words, and cognitive words). Based on these findings, it seemed that, although paper may have been the primary mode of personal expression in the past, people have become more adept and comfortable at expressing themselves on a computer.

It is evident that there are no firm conclusions regarding the impact of computerization on writing about emotion. This lack of consensus can be attributed to several factors. First, previous studies used different dependent measures, with dependent measures of interest including emotional arousal and linguistic content. Second, there are a limited numbers of studies focusing primarily on writing modality. To date, there are only two studies that specifically address writing modality. Finally, as could be expected with such a small number of studies, there is a lack of replication of the aforementioned research findings.

This study addressed these limitations by incorporating the dependent measures utilized in previous research. Participants in this study were randomly assigned to write longhand (Longhand condition) or type (Typing condition) a description of superficial topic (Neutral condition) or an emotional event that has influenced their lives (Emotional condition) in a 2x2 factorial design. Comparisons between these four cells were made in terms of affective arousal and linguistic content. The goal of this analysis was to determine if equivalent levels of

emotional arousal and linguistic output could be achieved on the computer in comparison to essays produced longhand.

## **1.1. Review of literature**

### **1.1.1. Brief history**

Virtually all forms of psychotherapy involve some degree of emotional disclosure. Whether based on psychodynamic, insight-oriented, or behavioral principles, therapy takes place in the context of an interpersonal relationship between the therapist and client during which problems are labeled and discussed in terms of causes and consequences (Donnelly & Murray, 1991). While the exact nature of therapeutic disclosure may vary depending on a particular theoretical orientation, the act of translating important psychological events into words remains at the core of psychotherapy. More importantly, research addressing the effectiveness of disclosure has demonstrated that it is a powerful therapeutic tool that accounts for a substantial percentage of the variance in the healing process (Pennebaker, 1997). Given the importance of disclosure, identifying the methods and mechanisms of effectiveness has been the focus of a growing body of literature.

Traditionally, self-disclosure is a verbal process in the context of the therapeutic relationship. In this relationship, the therapist is viewed as an essential element for therapeutic change, especially in discussing and dealing with powerful and maladaptive emotions (Donnelly & Murray, 1991). Several researchers have studied the verbal behavior of both therapists and patients to determine if there are process or outcome variables related to verbal output. For example, Scher (Garfield & Bergin, 1986) reported a nonsignificant relationship between therapist verbal output and improvement rates among counseling-center clients. Other studies have indicated that more disturbed, psychiatric patients may benefit more from lower levels of therapist verbal activity level. Based on these findings, researchers have hypothesized that some degree of congruency between patient and therapist verbal patterns is necessary in facilitating therapeutics change (Garfield & Bergin, 1986).

While traditional verbal therapy appears to involve some degree of verbal congruency (i.e. similar levels of verbal activity) between patient and therapist, there is a growing amount of work that utilizes the written statement of feelings and events, removing the verbal interaction that plays a role in psychotherapy. Pioneered by the work of James Pennebaker, several laboratories have demonstrated that writing about a stressful experience for brief periods of time over several days can have significant benefits. In the standard writing paradigm, participants write about an assigned topic for 3–5 consecutive days for 15–30 min each day. Participants are randomly assigned to one of two conditions. Individuals in the control group are instructed to write about a superficial topic, such as how they spend their time. In contrast, individuals in the experimental group are instructed to write about an emotional event that has impacted their lives.

Research conducted using this paradigm has indicated that it can bring about substantial therapeutic benefits for the writer. Measures assessing the short-term effects of writing show that participants experience increased levels of negative affect in the hours after writing about a traumatic event. However, when mood is assessed as little as 2 weeks following the writing assignment, these same participants report feeling equivalent (or elevated) levels of positive affect and a significant decrease in negative affect compared with those who wrote about neutral events (Pennebaker & Seagal, 1999). In addition to subjective changes in mood, a number of physiological changes are also associated with writing about emotional experiences. Lab reports indicate that narrative writing can benefit the immune system by improving t-helper cell counts, antibody response, and hormonal activity. Significant behavioral changes include improvement in work or school performance, reduced absenteeism, increases in subjective well being, and decreases in distress (Pennebaker, 1997 and Pennebaker and Graybeal, 2001). These effects have been demonstrated among various groups including college students, individuals suffering from chronic pain, maximum-security prisoners, crime victims, first-time mothers, and unemployed men. When tested in several industrialized nations, the benefits of narrative have also been found to transcend the boundaries of social class and ethnic identity (Pennebaker & Graybeal, 2001; Pennebaker & Seagal, 1999).

## **1.2. Talking vs. writing**

Given the demonstrated health benefits of writing about emotional event, a number of investigators began to question how written expression compared to traditional verbal self-disclosure. In this line of research, written expression has been compared to verbal self-disclosure operationalized as both talking to a tape recorder and talking to a therapist (Donnelly and Murray, 1991 and Esterling et al., 1994). In general, studies comparing writing and talking report comparable biological, mood, and cognitive effects and indicate that disclosing emotional experiences is superior to discussing superficial topics for both modalities (Pennebaker, 1997).

Although writing and talking have been found to have similar therapeutic benefits, there is evidence to suggest that they may do so in different ways. For example, Donnelly and Murray (1997) tested the hypothesis that, when required to focus on a traumatic event in written essays, participants might be able to generate cognitive, self-esteem, and adaptive behavioral changes similar to psychotherapy given a sufficient number of sessions. In this experiment, psychotherapy and written expression about a stressful or neutral event were compared over four successive days in a 2x2 factorial design. Donnelly and Murray reported that, when the number of sessions was increased to four, written expression produced improvements that were comparable with psychotherapy. Although participants in both modalities experienced comparable therapeutic outcomes, there were dramatic differences between the two experimental groups in terms of the mood aroused following each session. Participants in the written expression condition left with an increase in negative mood and a decrease in positive mood throughout the extent of the experiment, while subjects left each session of psychotherapy with no increase, and sometimes a decrease, in negative mood. In general, participants who wrote about a stressful experience continued to view the process of self-

disclosure as aversive, even though therapeutic progress was being accomplished. Based on these findings, Donnelley and Murray hypothesized that the therapist may ameliorate the aversiveness of emotional self-disclosure in some unknown way.

### **1.3. Writing vs. Typing**

While similar therapeutic benefits have been demonstrated for talking and writing, initial research addressing the impact of varying writing modalities has supported the notion that typing is less emotionally arousing than writing in longhand, leading to the idea that longhand held distinctive therapeutic benefits over typing. In a study conducted by Brewin and Lennard (1999), it was hypothesized that participants randomly assigned to write about a stressful experience in the longhand would report greater arousal of negative affect, greater disclosure, and greater perceived benefits based on the argument that adults are more accustomed to writing about personal experiences in longhand and that hand-writing represents a fully routinized activity, while typing may be an additional cognitive load. In order to test this hypothesis, eighty college students were randomly assigned to describe either a neutral or stressful topic by typing or writing in longhand in a 2x2 factorial design. Brewin and Lennard assessed pre- and post-mood using the Positive and Negative Affect Schedule, which involves endorsing 10 positive and 10 negative descriptors on a five-point likert scale. In addition, participants in the stressful condition were asked two additional questions focusing on perceived benefit and level of self-disclosure rated in a five-point Likert scale.

Utilizing these dependent measures, it was reported that when compared with typing, writing in longhand about a stressful experience produced significantly more negative affect [ $F(1, 76)=31.9, P<0.001$ ]. Those who wrote in longhand about a stressful event also reported revealing significantly more and found it more beneficial. These results supported the hypothesis that writing in longhand about a stressful event was associated with greater negative affect, greater disclosure, and greater perceived benefit. Based on these findings, Brewin and Lennard concluded previous research utilizing the Pennebaker writing paradigm may be contingent on the mode of emotional expression employed.

### **1.4. Further modality research**

While Brewin and Lennard's findings suggest that the benefits of the Pennebaker writing paradigm may be contingent on the task being completed in longhand, related areas of research tend to indicate the impact of computerization is, at most, minimal. For example, utilizing the Pennebaker writing paradigm, Wood et al. (2001) focused on the linguistic output of participants assigned to write about an emotional experience either in longhand or by typing on a computer. Wood et al. theorized that, due the widespread use of word processing and e-mail in today's society, a significant amount of the population is now adept in generative typing [e.g. typing in which "the typist formulates ideas and translates them directly to type without intervening spoken or written production of the material" (Cooper, 1983, p. 31)]. Based on this theory, Wood

et al. hypothesized that there would be no significant differences in the linguistic profile produced in the two modalities.

To test this hypothesis, 92 college undergraduates were assigned to either type or write about an emotional experience, removing the neutral or control group used in previous research. Using the Linguistic Inquiry and Word Count (LIWC) program to calculate the percentage of the total number of words used in each essay in a variety of categories including positive emotion words (e.g. happy, good), negative emotion words (e.g. hate, enemy), and cognitive words (e.g. cause, know), Wood et al. reported that there were no significant differences in linguistic profile produced in the two writing modalities. Participants within each writing mode utilized approximately the same number of positive emotion words, negative emotion words, anxiety words, sad words, pronouns, and cognitive words. The only significant difference reported was in the total number of words per essay across writing mode [ $t(91) = -3.27, P < 0.05$ ], such that typed essays contained significantly more words ( $M = 444$ ) than written essays ( $M = 372$ ).

Although this pattern of findings was taken as initial support for the convergent validity of the two modalities, Wood et al.'s study was limited in a number of respects. By removing the neutral group from the experimental design, Wood et al. were unable to demonstrate the same within modality effect that has been demonstrated in previous research [i.e. emotional disclosure leading to a consistent decrease in positive affect and a consistent increase in negative mood, with controls failing to show a similar pattern (Donnelly & Murray, 1997)]. If the two modalities are similar in terms of emotional disclosure, including a control group in the experimental design would allow for a more convincing argument to be made favoring the similarity between paper and computer emotional expression.

In spite of this limitation, other lines of research investigating the effects of computerization tend to converge with Wood et al.'s findings. For example, there are a number of studies that have utilized a paper vs. computer paradigm to determine if computerization influences the response patterns on traditionally paper-based surveys or assessment instruments (Beebe et al., 1998, Finegan and Allen, 1994, Kiesler and Sproul, 1986 and King and Miles, 1995). In general, the findings of these studies tend to suggest that computer surveys and assessments yield essentially equivalent results to paper-based instruments in terms of self-expression, impression management, and participant candor if the computers are not connected to a larger database and if the responses are anonymous (Beard, 1996). In two studies of particular note, Kiesler and Sproul (1986) found that subjects reported more socially undesirable responses in an electronic survey conducted via e-mail than in a paper survey and Rosenfeld, Giacalone, and Knouse (1991) demonstrated that there may be at least a subgroup of the population that responds more candidly via computer.

The purpose of the current study was to assess the impact of computerization on emotional expression. This was accomplished by combining the dependent measures used by Brewin and Lennard, 1999 and Wood et al., 2001 into one experimental design. Based on previous research, it was hypothesized that: (1) Those assigned to type or write about an emotional experience would experience significantly more negative affect after the writing task in comparison to their neutral counterparts. This difference would be reflected by a significant

within modality main effect, with the emotional groups reporting significantly more negative affect and producing significantly more emotional words in comparison to controls. (2) There would be no significant between-modality main effect in terms of affective arousal and linguistic content, supporting the theory that the majority of the population is now comfortable and adept at expressing themselves via computer due to the widespread use of email and word processing programs.

## **2. METHOD**

### **2.1. Participants**

The research sample included 168 college undergraduates from a public university in north Mississippi. Students were recruited from a pool of students seeking to fulfill undergraduate psychology course requirements. Students who volunteer to participate in the study were randomly assigned to one of four groups using a random number list: Emotional/Typing ( $n=43$ ), Emotional/Longhand ( $n=41$ ), Neutral/Typing ( $n=42$ ), and Neutral/Longhand ( $n=42$ ). Each cell was similar in terms of gender, age, and year in school (All  $F_s < 1$ ). Three essays that were typed were lost due to corrupted disks in the typing conditions (2 in the Emotional and 1 in the Neutral condition) reducing the number of essays analyzed by LIWC to 165.

### **2.2. Materials**

The Linguistic Inquiry and Word Count program, developed by Pennebaker and Francis (1999), was used to analyze the pattern of word usage among the writing samples gathered within each experimental condition. The LIWC program was designed to calculate the percentage of total words used that fall into a variety of language categories. Although the LIWC program has the capacity to evaluate text according to 82 different language dimensions, only 14 categories was analyzed for the purposes of this study. In accordance with previous research, the use of positive emotion words (e.g. happy, good), negative emotion words (e.g. hate, enemy), and cognitive words (e.g. cause, know) were compared across groups. In addition to these, word count, words per sentence, anxiety words, anger words, optimism, pronouns (i.e. I, we, self, you) and sad words were analyzed.

In addition to word usage, the Positive and Negative Affect Schedule (PANAS: Watson, Clark, & Tellegen, 1988) was used to assess current mood. The PANAS was designed by Watson et al. to provide a brief, reliable measure of positive and negative affect by having participants endorse 10 positive and 10 negative descriptors on a five-point likert scale. On the PANAS, high positive affect (PA) scores reflecting a state of high energy, full concentration, and pleasurable engagement, while low PA scores characterized by sadness and lethargy. In contrast, high negative affect (NA) scores are characterized with anger, contempt, disgust, guilt, and nervousness, while low NA scores are characterized as by a state of calmness and serenity.

### **2.3. Procedure**

Participants met in a computer laboratory and were given a brief explanation of the experiment. Each participant was then asked to review and sign a consent form. Once informed consent was obtained, students were directed to either a computer or desk based on their assigned writing mode. Those assigned to type their essays were seated at individual computer workstations with Microsoft Word open and a floppy disk in the disk drive in order to save their work. Participants in the handwriting condition were provided with a pad of paper and pens.

Prior to the writing task, participant completed the PANAS. They were then instructed to open the stapled instructions located at their desks. The Emotional group members were prompted with the following instructions based on the writing paradigm established by Pennebaker (1997):

I would like for you to write about your deepest thoughts and feelings about an extremely important emotional issue that has affected you and your life. In your writing, I'd like you to really let go and explore your deepest emotions and thoughts. You might tie in your topic to your relationships with others, including parents, lovers, friends, or relatives: to your past, your present, or your future; or to who you have been, who you would like to be, or who you are now. All of your writing will be completely confidential. Do not worry about spelling, sentence structure, or grammar. The only rule is once you begin writing, continue to do so until your time is up.

The Neutral group members were asked to write or type about the details of their closet, with an emphasis placed on being as detailed as possible in their description.

At the end of the 15-min writing period, participants again completed the PANAS. Participants in the Emotional groups were also be asked to answer the following two questions used by Brewin and Lennard (1999): "Do you think you have revealed more about the event than before in this particular writing task?" and "How beneficial is it for you to express yourself in this way?". Participants were asked to respond to these questions using a five-point likert scale anchored with 1 (not at all) to 5 (a lot) (Appendix D).

After completing these tasks, participants were instructed to submit all of their materials, either on a floppy disk or paper, to the researcher by placing them in an envelop. Before being dismissed, students were debriefed and provided with appropriate referrals if necessary. On their way out of the computer lab, participants placed their envelopes in a sealed box top ensure confidentiality.

### **3. RESULTS**

The results showed that those assigned to type or write about an emotional experience experienced significantly more negative affect after the writing task in comparison to their neutral counterparts. As hypothesized, this difference was reflected by a significant within modality main effect, with the emotional groups reporting significantly more negative affect and producing significantly more emotional words in comparison to controls. This pattern of results



suggests that the experimental manipulation was successful in eliciting negative affect. The results also supported the hypothesis that there is no significant difference between the two-modalities in terms of affective arousal and linguistic content. Participants in both modalities had similar levels of affective arousal, linguistic output, disclosure, and perceived benefit. Results from each dependent measure are presented below.

### 3.1. PANAS Negative Affect Scale

Mean scores for all four conditions are shown in Table 1. A 2 (Mode)×2 (Emotion) ANOVA on pre-writing scores showed that there were no significant main effects or interactions (all  $F < 1$ ), indicating that the four groups did not differ in terms of negative affect before the writing task. This similarity is presented visually in Fig. 1. Given that the groups did not differ on the pre-writing measure, a 2 (Mode)×2 (Emotion) ANCOVA was performed on post-writing scores with pre-writing scores serving as a covariate. This analysis revealed a significant main effect for Emotion,  $F(1, 163) = 44.6$ ,  $P < 0.0001$ ,  $\eta^2 = 0.215$ , but no significant main effect for mode of writing or any interaction. This pattern of results suggests that the experimental manipulation of writing condition (emotional vs. neutral instructions) was successful in inducing negative mood for the participants instructed to write about a stressful experience, while there was no significant difference in the reported level of negative affect between the two modalities. This pattern is presented in Fig. 2.

Table 1  
Mean affect scores as a function of mode and writing instructions

	Positive affect pre-writing task	Positive affect post-writing task	Negative affect pre-writing task	Negative affect post-writing task
<i>Emotional condition</i>				
Typing ( $n = 41$ )	27.5 (7.7)	26.5 (8.8)	14.4 (5.1)	19.9 (8.0)
Longhand ( $n = 41$ )	28.1 (7.5)	27.1 (10.4)	14.7 (4.1)	19.8 (9.9)
<i>Neutral condition</i>				
Typing ( $n = 41$ )	27.3 (7.8)	25.1 (8.8)	14.6 (4.8)	13.9 (4.5)
Longhand ( $n = 42$ )	26.8 (7.5)	25.3 (8.6)	14.2 (3.8)	13.1 (3.0)

Standard deviations appear in parentheses.

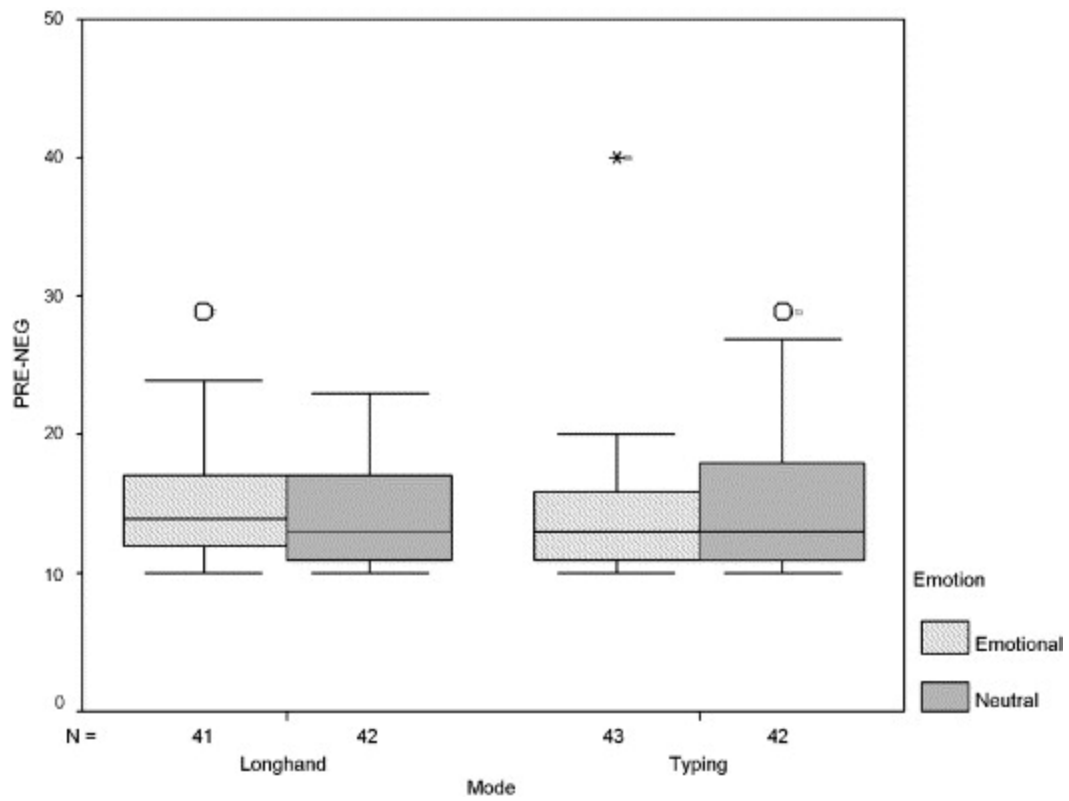


Fig. 1. A box plot of pre-negative PANAS scores by mode and emotion.

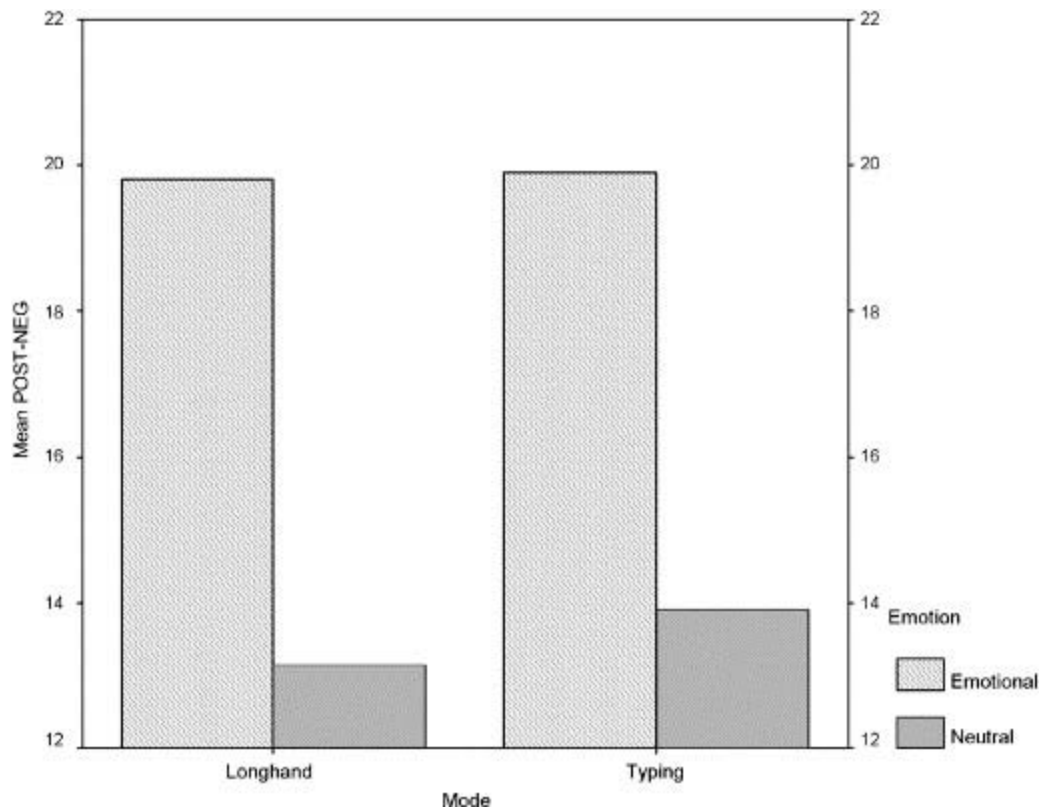


Fig. 2. Mean post-negative PANAS scores by mode and emotion.

### 3.2. PANAS Postive Affect Scale

A 2 (Mode) $\times$ 2 (Emotion) ANOVA on pre-writing scores failed to reveal any significant main effects or interactions (all  $F < 1$ ), indicating that the four groups did not differ in terms of positive affect before the writing task. This similarity is presented visually in Fig. 3. A 2 (Mode) $\times$ 2 (Emotion) ANCOVA on post-writing scores failed to reveal any significant main effects or interactions (all  $F < 1$ ) indicating that the four groups did not differ in terms of positive affect after the writing task. Looking at mean positive affect scores in Table 1, positive affect was down slightly following the writing task, but the lowering of affect appears to be unrelated to Emotion or Mode. A paired-sample  $t$ -test on pre- and post-positive affect scores revealed that positive affect was significantly lower after completing the writing task with mean post-writing positive affect scores ( $M=26$ ,  $S.D.=9.1$ ) significantly lower than pre-writing positive affect scores ( $M=27$ ,  $S.D.=7.5$ ),  $t(167)=2.4$ ,  $P < 0.05$ ,  $d=0.12$ .

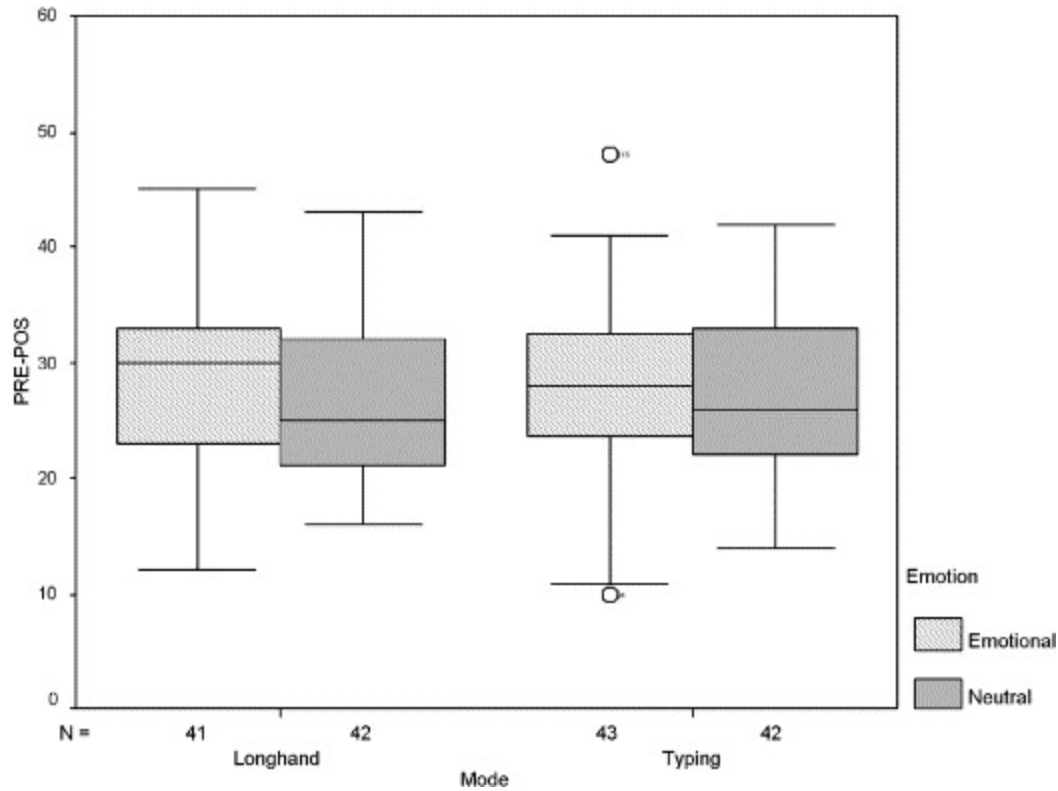


Fig. 3. A box plot of pre-positive PANAS scores by mode and emotion.

### 3.2.1. Linguistic inquiry and word count categories

Mean scores for the 14 LIWC categories are shown in Table 2. Except for Word Count and Words Per Sentence, all LIWC output data are presented as the percentage of total words used. For each LIWC category, a 2 (Mode: Longhand vs. Typing)  $\times$  2 (Emotion: Negative vs. Neutral) ANOVA was conducted. In general, this analysis indicated that participants in the emotional conditions tended to use more emotion words and pronouns in comparison to neutral counterparts. The two modalities tended to mirror one another in terms of the magnitude of this difference, with modality not playing a significant role in the linguistic output of the essays. Participants in the typing conditions did produce significantly more words than their longhand counterparts, with analysis of word count revealing a significant main effect for mode of writing,  $F(1, 164)=49.8$ ,  $P<0.0001$ ,  $\eta^2=0.23$ , but no significant main effect for emotion or any interaction. Although participants who typed produced more words, essay length was unrelated to other LIWC categories and analysis of word per sentence failed to reveal a significant main effect for mode, emotion, or any interaction, largest  $F(1, 164)=2.4$ ,  $P>0.10$ , indicating that the four groups did not differ in terms of number of words per sentence.

Table 2  
Mean LIWC scores as a function of mode and writing instructions

	Typing		Longhand	
	Emotional condition	Neutral condition	Emotional condition	Neutral condition
Word count	456 (115)	480 (125)	386 (69)	331 (77)
Words per sentence	17.9 (4.11)	16.9 (4.0)	16.7 (5.2)	16 (3.5)
Pos. emotion words	2.4 (1.0)	1.4 (0.71)	2.5 (1.5)	1.3 (1.0)
Neg. emotion words	2.3 (0.93)	0.54 (0.44)	2.3 (1.3)	0.51 (0.46)
Cognitive words	8.7 (2.1)	3.5 (1.5)	7.1 (2.7)	3.6 (1.6)
Anxiety words	62 (0.48)	02 (0.05)	62 (0.55)	0.03 (0.09)
Anger words	54 (0.67)	13 (0.23)	51 (0.67)	0.10 (0.15)
Optimism words	61 (0.50)	58 (0.36)	67 (0.66)	0.58 (0.45)
Sad words	61 (0.42)	20 (0.19)	70 (0.73)	0.20 (0.29)
Pronouns	17.8 (2.4)	11.9 (3.7)	17.6 (2.3)	11.9 (3.2)
I	10.7 (2.7)	8.4 (3.0)	10.1 (2.9)	9.0 (2.9)
We	73 (1.0)	05 (0.16)	1.31 (1.5)	0.07 (0.22)
Self	11.41 (2.3)	8.5 (3.0)	11.44 (2.8)	9.1 (2.9)
You	30 (0.47)	30 (0.34)	23 (0.48)	0.28 (0.55)

Standard deviations appear in parentheses.

Eight of the 14 LIWC categories (i.e. positive emotion words, negative emotion words, pronouns, anxiety words, anger words, sad words, I, and Self) analyzed revealed significant main effects for emotion, but no significant main effect for mode or any interaction. Participants instructed to write about a stressful experience in both the Emotional/Longhand and Emotional/Typing conditions produced significantly more words in each of these LIWC categories in comparison to their Neutral/Longhand and Neutral/Typing counterparts. *F* values and effect size estimates for the main effect of emotion in these 10 categories are presented in Table 3.

Table 3  
LIWC main effect  $F(1, 164)$  and effect size estimates for Emotion

LIWC category	<i>F</i> *	$\eta^2$
Positive emotion words	35.8	0.18
Negative emotion words	173.7	0.52
Anxiety words	144	0.4
Anger words	31.4	0.16
Sad words	40	0.2
Pronouns	157	0.5
I	13.3	0.08
Self	36.6	0.19

\*  $P < 0.0001$ .

Two other LIWC categories, Cognitive Words and We, revealed significant main effects for emotion, as well as additional interactions. Analysis of Cognitive Words revealed a significant main effect for emotion,  $F(1, 164)=194.9, P<0.0001, \eta^2=0.5$ , and mode,  $F(1, 164)=5.7, P<0.05, \eta^2=0.03$ , as well as an interaction between emotion and mode,  $F(1, 164)=6.6, P<0.05, \eta^2=0.04$ . Compared with those in the Neutral/Longhand ( $M=3.6, S.D.=1.6$ ) and Neutral/Typing ( $M=3.5, S.D.=1.5$ ) conditions, participants instructed to write about a stressful experience in both the Emotional/Longhand ( $M=7.1, S.D.=2.7$ ) and Emotional/Typing ( $M=8.7, S.D.=2.1$ ) condition produced significantly more cognitive words. The interaction suggests that participants in the Emotional/Typing condition producing significantly more cognitive words than their longhand counterparts, but the size of the effect for mode and the interaction is substantially smaller than the main effect for emotion. Analysis of we revealed a significant main effect for emotion,  $F(1, 164)=43, P<0.0001, \eta^2=0.21$ , and as well as an interaction between emotion and mode,  $F(1, 164)=4.2, P<0.05, \eta^2=0.03$ . Compared with those in the Neutral/Longhand ( $M=0.05, S.D.=0.16$ ) and Neutral/Typing ( $M=0.07, S.D.=0.22$ ) conditions, participants instructed to write about a stressful experience in both the Emotional/Longhand ( $M=1.31, S.D.=1.5$ ) and Emotional/Typing ( $M=0.73, S.D.=1$ ) condition produced significantly more cognitive words. The interaction suggests that participants in the Emotional/Longhand condition use we significantly more than their typing counterparts, but as with Cognitive words the size of this interaction is dwarfed by the effect size for emotion. Finally, analysis of two LIWC categories, You and Optimism, failed to reveal any significant main effects for or any interaction (all  $F < 1$ ), indicating that the four conditions did not differ in their use of you or optimism words.

### **3.2.2. Amount and benefit of disclosure questions**

There was no significant difference between participants who wrote about an emotional event in longhand ( $M=3.46, S.D.=1.19$ ) and those who typed their essays ( $M=3.30, S.D.=0.96$ ),  $t(82)=0.68, P>0.10$ , in terms of reported level of self-disclosure during the writing exercise. Participants in the longhand condition ( $M=3.95, S.D.=1.04$ ) and those in the typing condition ( $M=4.12, S.D.=0.87$ ) also reported similar levels of perceived benefit from writing about an emotional,  $t(82)=0.78, P>0.10$ . These results indicate that participants in both modalities reported revealing approximately the same amount about their stressful event and found the writing task equally beneficial.

## **4. DISCUSSION**

The results of this study indicate that writing and typing about a stressful event are similar on dependent measures including negative affect, perceived benefit, and level of disclosure. In general, there was a significant main effect in both modalities, with the emotional conditions reporting significantly more negative affect and producing significantly more emotional words and pronouns in comparison to their respective controls. Furthermore, the two modalities were similar in terms of the degree and direction of this difference (with a few exceptions, most notable word count), indicating that there was not a significant between-modality effect.

Participants in the typing condition did produce significantly more words than their longhand counterparts, but the two modalities were similar in terms of sentence length and the results were unaffected when word count was controlled for.

These findings support the theory that at least a portion of the population (i.e. college students) is now comfortable and/or adept in expressing themselves on the computer. This support is reflected in the fact that typing on a computer yielded similar levels of emotional arousal as well as similar linguistic content in comparison to the traditional longhand conditions. The convergent validity of the two modalities has implications for future applications of the emotional writing paradigm. Applied to future laboratory research, scientists interested in utilizing the writing paradigm as a means to experimentally manipulate participant mood may be able to induce similar levels of negative affect by having participants type on a computer. This may be particularly useful in experimental designs incorporating other computerized tasks or instruments, thus eliminating the need for participants to switch modalities during the course of an experiment.

There are a number of limitations to the current study. First, these results contrast sharply with the findings of Brewin and Lennard (1999), who reported that the results of emotional writing studies may be dependent on the mode of self expression. One possible explanation for the conflicting findings could be that Brewin and Lennard did not control for the variable of time, which may have inadvertently introduced a confound into their design. In addition, Brewin and Lennard screened all of their participants for the ability to type continuously on a keyboard, which may have excluded less skilled typists who were still adept in expressing themselves through a hunt and peck method. Second, future research needs to address issues of external validity. Although college students may report similar levels of emotional arousal and linguistic output in the two modalities, this subgroup of the population may have more experience with computers and other forms of technology. Determining if similar patterns of results can be obtained with other subgroups of the population, such as individuals of low socio-economic status or in the elderly population, will help establish the scope of the current findings.

Future research focusing on the impact of modality on emotional writing may want to extend the number of writing sessions and include more long term dependent measures (e.g. physiological and behavioral outcomes used by Pennebaker and others) to determine if the similarity of outcomes extend beyond the initial session. Furthermore, it may also be fruitful to determine if significant therapeutic benefits can be achieved through email or other forms of electronic communication when direct contact with patients is not possible. The results from the current study suggest that it may be possible for clinicians to achieve similar positive health outcomes for patients who prefer or are more comfortable with journaling on the computer.

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