Motivating Expressive Writing with a Text-to-Sound Application

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ABSTRACT
Writing about emotional experiences has been shown to have long-term physical and mental health benefits, but it also creates short-term discomfort. We designed a system to motivate expressive writing by enhancing enjoyment and pleasure. Using automated language analysis, we designed a system that maps sound onto categories of language resulting in a musical interpretation of expressive writing texts. An experimental design compared the experience of 126 participants across musical and non-musical writing platforms Participants found the musical system to be more pleasurable.

Author Keywords
Music system, text analysis, creative tool, self-expression, expressive writing.

ACM Classification Keywords
H5.1 Multimedia Information Systems H5.5 Sound and Music Computing

General Terms
Design, Experimentation, Human Factors, Measurement

INTRODUCTION
A history of research in psychology has supported the notion that expressive writing has marked positive effects on mental and physical well-being [5, 7, 8]. For example, when individuals write about personal issues for just a few minutes a day consistently for several days, there are drastic improvements in rates of sickness, use of medicines, and number of doctor visits. Because of its non-invasive design, the expressive writing paradigm is a viable, cost-effective way to promote positive health [6]. But despite its long-term benefits, expressive writing can often bring up negative emotional memories or experiences that lead to acute physical (e.g. heart racing, anxiety) and emotional discomfort (e.g. negative affect) [7]. For this reason, people may not be compelled to participate in an expressive writing exercise. Our goal was to design a system that was more enjoyable to writers and thus would encourage the practice of expressive writing.

The textual nature of the expressive writing technique makes it well suited for application in digital technologies. We found a web-based platform designed specifically for expressive writing to be an excellent mode of incorporating positive health practices into ubiquitous computing tools that already rely on text-based communication.

In building the system, we relied on a automated language analysis program to translate language into sound. The Language Inquiry and Word Count system (LIWC) [9] is based on 72 different linguistic and psychological categories. Using a previously established language-to-music taxonomy [9], LIWC enabled us to turn psychological categories of language (e.g. *affective words, analytical words*) into dimensions of sound (e.g. *pitch, note frequency*) in real time, which could then be played back to the author at the end of the exercise. We could then examine whether language-to-music feedback promoted greater pleasure and more enjoyment in the system.

To test this system, we designed an experimental study that compared participants' reactions to an expressive writing interface without musical feedback with a system that provided musical feedback based on writing. The experiment also included a control condition in which participants were told to write their weekly schedules. This was done in order to assess overall user satisfaction and emotionality of a web-based expressive writing system in its basic state, which could then be accurately compared to the same system with a musical component.

DESIGNING FOR SELF-EXPRESSION IN HCI
Technological tools available for individual self-expression have flourished in recent years. Previous systems have included visual and audio approaches to self-expression, including animated characters and facial expressions representing specific emotions and attitudes [3], expression-based movie generation systems [12], as well as numerous personal music recommendation systems that try to generate playlists based on a predetermined mood [4]. Each of these systems reflects a trend in encouraging self-expression with technology. However, to our knowledge, no system yet has translated expressive writing text into music and focused its emotional feedback for encouraging self-reflection.

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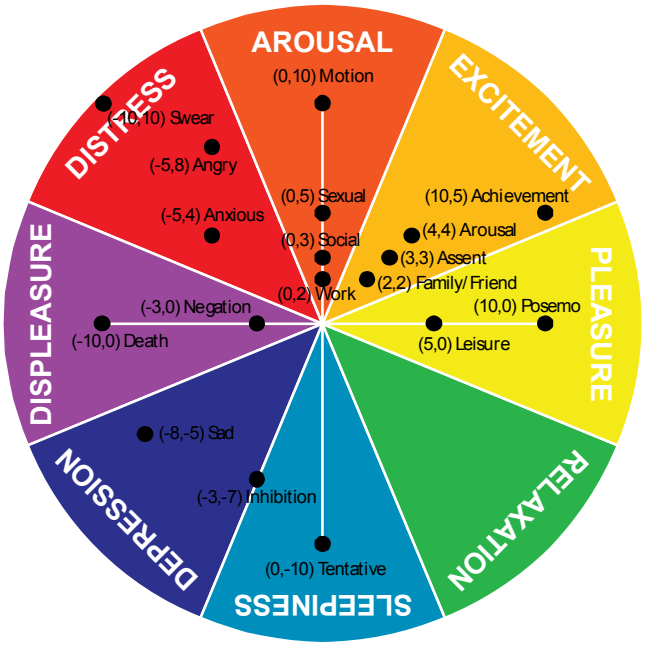

Figure 1: Mapping of LIWC text categories to emotion with Russell's two-dimensional (valence/activity) circumplex model of affect [10].

SYSTEM DESIGN

Our system, *Expresso* was designed to attain text input from the user, analyze the user's language, and generate corresponding music that reflected the input. The system was deployed online with JavaServer Pages Technology and a Java applet for sound playback and made available to participants remotely from any computer. *Expresso* performed a statistical analysis of the user's language and extracted emotive and non-emotive qualities in the writing. The system then translated this affective characterization into corresponding musical parameters and generated music in the form of a song, played through the user's web browser. This process is described below.

Text analysis

Text analysis of the user's writing began with the tallying of words that belonged to each word category (e.g. sad, social, negative emotion), as defined by the Linguistic Inquiry and Word Count (LIWC) dictionary [9]. The system computed the percentage of language from each category relative to the overall text to create a set of weighted parameters uniquely representative of each user's text. The system used primarily emotive language categories in translating text to music, and thus divided language categories into affective (e.g. positive emotion, anger, etc.) and non-affective (e.g. word count and words per sentence) groups.

Emotive mapping

There has been previous work in mapping emotion to music [11], so we expanded upon this by mapping 18 LIWC text categories to the eight emotions represented by Russell's valence/activity circumplex model of affect (Figure 1). This created a comprehensive model of affective categories to which we mapped the musical parameters of mode, harmony, tempo, rhythm, and loudness, each weighted individually to reflect the user's writing given the parameters determined in the previous text analysis. In addition, we included parameters such as chord progression, complexity, and note frequency using non-affective categories (e.g. high word count gives longer song length) to further manipulate the variability of the music. As a simple example, if the text happened to have mostly "achievement" emotion words (at coordinate (10,5) in Figure 1), the system may plot overall affect in the "excitement" octant, translating to high tempo, major tonality, etc. The music generation component then used these parameters to construct a short song, using a knowledge-based algorithmic music system utilizing Western music theory-based rules and probability theory.

STUDY DESIGN

A one-way experimental design was used to measure the experience of participants across three conditions: expressive writing-musical feedback, traditional expressive writing and writing about one's weekly schedule (control).

There are three research questions of interest in this study: Will people enjoy the writing system with music feedback more than that of traditional writing methods (RQ1)? Will users of this system find it more pleasurable, by providing a greater sense of *creation, fantasy, discovery, exploration, captivation* (RQ2)*?* And finally, will users who receive music feedback report greater levels of positive and negative affect, as an indicator of enhanced effects of expressive writing (Pennebaker & Beall, 1986) (RQ3)? A description of each of these measures is provided in the results section.

Participants

One hundred twenty-six people from a large northeastern university took part in the evaluation experiment for course credit.

Methods

In the traditional writing condition, participants were sent a webpage link that described the study as an opportunity to "get in touch with your creative self through self-expression in a digital space." After reading and completing a consent form, participants were given a prompt and instructions to write for five minutes in a stream-of-consciousness style. The prompt was a version of the prompt used by Pennebaker and colleagues in a standard expressive writing exercise [8]. After at least five minutes of writing, participants submitted their entry and were given a summary of the type of language used based on LIWC analysis, (e.g. "25% of your language used sad emotion words"). At that point, participants completed the study with a link to a follow-up survey.

In the writing-musical feedback condition, participants were given the same introduction, consent form, writing prompt, and language summary. Following this, participants were told that they would be able to "hear a musical translation of [their] thoughts and emotions." The next page generated a song based on the language analysis of the personal expressive writing entries, which the participants could hear by pressing a "Play" button. After listening to the song, participants were directed to a follow-up survey.

In the control condition, participants were told to spend five minutes providing "a detailed list of what [their] weekly schedule looks like." The intention was to spend the same amount of time writing about something that was not creative or expressive. After five minutes, these participants were given a summary of the language they had used during the exercise and directed to follow-up survey questions.

RESULTS

Quantitative

Enjoyment was measured with 3 items (*enjoy system, willingness to recommend, willingness to use again*, α = .78). Consistent with our expectations (RQ1), an analysis of variance revealed a significant effect of the use of different systems on enjoyment ($F(2, 121) = 14.86$, $p<.001$). A post hoc analysis of the Least Significant Difference between the means (LSD) revealed that individuals in the traditional writing condition enjoyed the music more than individuals in the control condition (Mean Difference = .61, $p < .01$), and individuals in the musical feedback condition enjoyed the system more than individuals in the condition without musical feedback (Mean Difference = .44, $p < .05$) (See Table 1).

An additional analysis of system satisfaction comes from previous work in HCI evaluation [2]. We used five items from a larger tool designed to assess pleasure at play with mediated artworks (RQ2). The items included impressions of *creation, fantasy, discovery, exploration,* and *captivation.* Participants responded to the statement, "This self-expression tool gave me a sense of [concept] (*1=Not At All, 9=Extremely*).

Analyses of variance revealed that the system influenced ratings on each of these measures (*Creation,* $F(2, 122) = 8.0$, $p<.001$; *Fantasy,* $F(2, 122) = 9.5$, $p<.001$; *Discovery,* $F(2, 122) = 9.2$, $p<.001$; *Exploration,* $F(2, 122) = 15.20$, $p<.001$; *Captivation,* $F(2, 122) = 13.41$, $p<.001$). A post hoc test with LSD (Table 1) revealed that perceptions of all five constructs were enhanced in the expressive writing conditions compared to the control condition. Perceptions of *fantasy* (Mean Difference = 781, $p < .05$) and *captivation* (Mean Difference = .72, $p < .09$) were also greater in the music condition compared to the condition without music, at significant and marginally significant *p*-values, respectively.

Finally, a measure of positive and negative affect (PANAS) [13], was used to examine effects of each writing experience on emotional state. Previous work has concluded that because expressive writing usually leads to acute negative affect, followed by positive health, that higher levels of negative affect may suggest a more effective design [1,5]. The PANAS is an orthogonal measure of ten negative and positive states (range *5-50*). An analysis of variance revealed a significant effect of the system ($F(2, 120) = 5.5$, $p<.01$) on positive affect and on negative affect ($F(2, 121) = 7.5$, $p<.01$). An LSD test of positive affect effects revealed no difference of being in the traditional writing ($M=23.1$, $SD=9.1$) versus musical feedback condition ($M=24.2$, $SD=8.7$), although each writing system produced more positive affect than the control condition ($M=18.5$, $SD=7.6$, $p<.09$). Alternatively, in testing effects of negative affect, the LSD revealed no significant difference between the writing ($M=16.3$, $SD=5.0$) and control conditions ($M=15.4$, $SD=4.5$), though there is significantly more negative affect in the music condition ($M=20.1$, $SD=7.4$ $p<.01$).

	Control	Traditional Writing	Musical Feedback
Use Again	2.1 (1.1)	2.7 [a] (1.3)	3.5 [a b] (1.1)
Recommend	2.4 (1.1)	2.9 [a] (1.1)	3.1 [a] (1.2)
Enjoy	2.4 (.79)	3.1[a] (1.1)	3.5[a] (1.1)
Pleasurable			
Creation	2.8 (2.0)	4.0[a] (1.9)	4.5[a] (2.0)
Fantasy	1.6 (1.3)	2.5[a] (2.1)	3.3 [a b] (1.8)
Discovery	3.1 (2.0)	4.5[a] (1.9)	4.8[a] (1.9)
Exploration	3.3 (2.1)	5.2[a] (1.8)	5.4[a] (2.0)
Captivation	1.8 (1.3)	3.2[a] (2.0)	4.0 [a b] (2.3)

Table 1. Mean level of Enjoyment (*1-5 range*) and Pleasurable Experience (*1-9 range*) in each system condition. Standard deviation in parentheses. [a]Significantly different from Control group, $p < .01$; [b]Significantly different from Writing group, $p < .05$.

Qualitative

A review of the free response data suggested that individuals did indeed find the writing with music condition more intriguing than the condition without music. In the latter condition, participants' comments ranged from somewhat flat (*It was like writing in a journal. I feel the same because I have expressed these feelings before elsewhere*) to pleasantly surprised (*This was a good exercise in gaining personal insight while writing. I did not think I would enjoy this experiment, but I did*). Others seemed moved (*A little sad, and a little relieved*). However, in the writing with music condition, comments showed greater enthusiasm (*This was very cool. The musical part was unlike anything I had seen before and I found it very intriguing*) and an interest in using the system again (I *think that the musical component should be longer... and downloadable, for sure!*). Some individuals also suggested that the music highlighted new insights that the writing

system alone did not provide (*The quick tempo surprisingly brought into light a slightly anxious edge that I wasn't aware I gave off. It was also a kind of sad melody, which reflects my story really well*).

SUMMARY

Overall, the qualitative data seems to support the quantitative data in suggesting that participants enjoyed the music system more than the other two systems. The mean level of pleasure was higher on all dimensions in the musical feedback condition, particularly in the areas of captivation and fantasy. In assessing enjoyment, participants reported more overall enjoyment in the traditional writing condition than in the control condition, and more enjoyment in the musical feedback condition than either of the other conditions. In particular, participants reported being more likely to use the system again if they received musical feedback. These findings support the notion that an expressive writing program that provides musical feedback based on text may encourage users to write more often, thus promoting positive health.

One of the most interesting results came from the enhanced negative affect in the musical feedback condition. Participants were given the same instructions in both expressive writing conditions. Thus, any difference in feedback was due to musical feedback. At first, we suspected that this must have come from participants responding negatively to the music. However, not one participant in the music condition reported disliking the music, according to open-ended feedback. Moreover, the average score for enjoyment of the music was 3.4 on a scale of 1-5, and the correlation between negative affect and enjoyment of music was non-significant, $r(40)=.16$, $p=.34$.

These findings suggest that the negative affect was not simply a negative reaction to the music, but rather a reflection of having a musical interpretation of one's text-based, emotional expression. Based on some of the comments from participants, it seems that the music enhanced the emotional outcomes associated with expressive writing, in addition to making the experience more compelling. Future work is necessary, however, to further support this conclusion. If supported, this conclusion would have impressive implications for the benefits of a system that added a musical feedback component to the traditional expressive writing process.

CONCLUSION

This study is an important first step in designing an accessible, web-based platform that encourages the positive mental and physical health benefits associated with expressive writing. According to these findings, adding a musical interpretation of an expressive writing text enhances user enjoyment, as well as user perception that they would use the system again. There is also some indication that the health effects of the writing may be enhanced, according to elevated negative affect following musical feedback. Given the important health implications of expressive writing and the ease of implementing an accessible writing system with existing technologies, these findings demonstrate exciting potential for continued research in this area.

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