



## Linguistically-tailored video feedback increases total and positive emotional expression in a structured writing task

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### ABSTRACT

A strength of computer-based interventions is the capacity to tailor to individual differences, but most studies have tailored to self-report, rather than linguistic, data. The purpose of the present study was to develop and evaluate the effects of linguistically-tailored feedback on an Internet-based expressive writing intervention. Two hundred eighty-one participants were asked to engage in 3 days of expressive writing and were randomly assigned to one of 3 feedback conditions: control (no feedback), simple (feedback about levels of emotional expression), and directive (simple feedback + suggestions for emotional processing). A Perl-based implementation of Linguistic Inquiry and Word Count (LIWC) was developed in order to provide dynamic feedback to participants based on levels of emotional expression identified in their writing. This implementation provided near-perfect correlations with standard LIWC output,  $r$ 's = .98–1.00. Positive and total, but not negative, emotional expression increased over time for those who received simple or directive feedback. These findings suggest that linguistically-tailored feedback has the potential to alter patterns of engagement in computer-based interventions. However, additional research is needed to identify the most effective types of feedback in order to enhance immediate effects on writing and longitudinal effects on relevant outcomes.

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### 1. Introduction

Computer-delivered and self-guided treatment interventions for those with mild to moderate mental health needs have been shown to have promise as an adjunct to more traditional forms of treatment or for those who would otherwise be unable or unwilling to use traditional treatments (Graham et al., 2000; Proudfoot et al., 2004). In the United Kingdom, computer-based interventions are a recommended component of a stepped-care approach to managing depression and anxiety (NICE, 2006). By virtue of the fact that such therapies are typically patient-directed with minimal or no direct consultation with a mental health professional, these treatments have generally used static or only minimally-tailored content that is not necessarily specific to important individual differences that might influence the efficacy of the treatment (e.g., degree of engagement/adherence to the treatment, etc.; Andersson et al., 2005; Cukrowicz et al., 2009; Newman et al., 1997). In other areas of literature, notably health behaviors, tailored interventions have been shown to markedly improve

health-related outcomes, including smoking cessation (Lancaster et al., 2000), fruit and vegetable consumption (Campbell et al., 2009; Neville, O'Hara, & Milat, 2009), and physical activity (van Stralen et al., 2009). Because no previous studies have attempted to use tailoring to improve self-guided treatments, we sought to test the effects of real-time, linguistically-tailored emotional feedback on subsequent emotional processing using a longitudinal expressive-writing paradigm. If effective, linguistically-tailored feedback has the potential to improve the efficacy of computer-based treatments for mental health needs.

One unique advantage to using computer-based treatments is that they provide rich behavioral data to supplement self-report surveys (Owen et al., 2005). Chief among these are linguistic data, which have been widely used to identify markers of psychological processing of specific events or stimuli (e.g., Chung & Pennebaker, 2007; Cohn, Mehl, & Pennebaker, 2004; Pennebaker, Mayne, & Francis, 1997). Psychological studies of linguistic data have primarily emerged from the literature on expressive writing. In studies that have employed a standard expressive-writing paradigm, beneficial emotional and physical health outcomes have been linked with specific linguistic markers of emotional processing (Pennebaker & Francis, 1996; Pennebaker et al., 1997), and Linguistic Inquiry and Word Count (LIWC) has been shown to be a valid instrument for identifying emotional expression in linguistic data

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(Bantum & Owen, 2009). LIWC operates by comparing each word of a text file to several dozen categories of psychologically-relevant words (e.g., affect, cognitive processes, social processes, etc.). Other text analysis programs, such as Psychiatric Content Analysis and Diagnosis (PCAD) are available, but LIWC has been shown to have superior signal detection indices, at least for the identification of emotional expression in text (Bantum & Owen, 2009). However, a limitation of LIWC is that it requires manual processing of text files and interpretation of the resulting output. As a result, LIWC is typically used only after study procedures have been completed, during the data analysis phase of a research study. The Perl (Wall & Loukides, 2000) programming language, which can be used in the development and delivery of websites, is also extremely well-suited for text manipulation and linguistic analyses similar to those used by LIWC. Thus, a major benefit of implementing LIWC procedures using a programming language such as Perl is that participants who engage in online expressive writing could be provided with feedback derived from LIWC while a study is still ongoing. We hypothesized that the provision of near real-time, linguistically-tailored feedback would enhance emotional processing in otherwise self-directed expressive writing.

A number of studies have suggested that expressing thoughts and feelings surrounding a traumatic event is valuable (e.g., Everly & Mitchell, 1999; Frattaroli, 2006; Wortman & Boerner, 2007). Putative mechanisms of action for the positive benefits of emotional approach coping include the clarification of personally-relevant concerns and goals, habituation to negative emotions, and facilitation of social support (Stanton et al., 2000). Emotional processing theory (Foa & Kozak, 1986) has contributed to the development of several clinically-effective treatments. This theory suggests that successful interventions to reduce trauma symptoms need to focus on two inaccurate ways of looking at a given experience: the world is extremely dangerous and the belief that the individual experiencing trauma symptoms is incompetent. In attempting to impact both of these dysfunctional thoughts, prolonged exposure, involves asking a participant to repeatedly, yet gradually, recount a traumatic experience in as much vivid detail as possible (Foa & Rothbaum, 1998); this is thought to activate cognitive representations of the trauma, including emotional responses to the trauma, and to then modify these cognitive representations by helping the client incorporate information that helps reframe either trauma or reaction to trauma (e.g., empowerment, sense of security and safety, etc.; Foa & Kozak, 1986). Emotion-focused treatments have also been successfully applied to cancer survivors (Giese-Davis et al., 2002) and treatment of depression (Ellison et al., 2009; Pos, Greenberg, & Warwar, 2009).

A body of evidence now suggests that expressive writing and emotional processing of stressful events in particular, may be associated with improvements in mental and physical health outcomes (Greenberg, 2008; Low, Stanton, & Bower, 2008; Pennebaker, 1997). The expressive-writing paradigm has been tested in over 250 studies (per comprehensive meta-analysis; Frattaroli, 2006), and nearly all of these studies deliver at least three expressive writing sessions spread out over time (e.g., Low, Stanton, & Danoff-Burg, 2006; Pennebaker, 1997; Pennebaker, 2004). While the mechanisms of action have not been fully identified, use of emotion words has been linked with positive outcomes (Pennebaker & Francis, 1996; Pennebaker et al., 1997). It is important to note that emotional expression can be thought of as one of the aspects that can help lead to emotional processing of a given experience. However, it is worth noting that no known studies have evaluated tailored approaches to expressive writing procedures (e.g., modifying subsequent instructions based on the content of what was previously written) in order to modify or enhance the effects of the intervention. Recent successes in using computers to identify emotional expression in text is now possible and provide a platform to

use linguistic data as a way of delivering tailored instructions and perhaps increasing the efficacy of this procedure.

Use of computer-tailored treatment recommendations and interventions have been successfully used with other treatment paradigms (Porter, 2009). In nearly all studies that employ computer-based tailoring, tailoring is determined based on self-report responses from a survey. Such tailoring works by either scoring a standardized instrument to provide a participant with information about how they compare to others or by directing participants to specific types of information based on their responses to the survey. Depending on the level of sophistication, the computerized feedback can be delivered in a number of ways, from personalized letters to direct feedback via the computer screen (Brug, Campbell, & van Assema, 1999). The aim of tailoring is to increase the effectiveness of the information given to the individual (Dijkstra & De Vries, 1999).

Computer-tailored feedback has been most heavily studied with respect to changing health behaviors. Basic computer tailoring interventions have been successfully implemented for alcohol abuse treatment (e.g., Matano et al., 2007), smoking cessation (e.g., Buller et al., 2008), as well as improving nutrition, diet, and exercise (e.g., Frenn et al., 2005). Furthermore, it allows for custom health messages, customized assessments, and provides an individual with additional tools for improving their health (Lustria et al., 2009). While tailored messages have repeatedly been shown in the literature to be superior to no message, only a small number of studies have actually compared them against generic messages. These studies have generally found tailored messages to be preferable over a generic or general message (Noar, Benac, & Harris, 2007).

In a systematic review, Kroeze, Werkman, and Brug (2006) identified three of 11 published studies on computer-tailoring for physical activity and 20 of 26 dietary changes that resulted in significant improvements. In those studies that showed tailoring to be efficacious, computer-tailoring was provided immediately after completion of a battery of self-report instruments (e.g., Marcus et al., 1998; Vandelanotte et al., 2005). Those interventions that have provided some degree of interactivity primarily did so by providing profile results generated from completion of self-report surveys on the study website (e.g., Christensen, Griffiths, & Jorm, 2004; Clarke et al., 2002; Osgood-Hynes et al., 1998), and this type of interactivity does not generally change the way the remainder of the intervention is delivered. Self-report responses can be easily categorized by a computer (e.g., check boxes, likert-type ratings, etc.), but short answer or essay formats are not easily deciphered by computers. As a result, existing tailored interventions are unable to encourage participants to engage in exercises that require generative self-disclosure (e.g., expressive writing). However, tools such as LIWC allow investigators to process linguistic data and therefore have the potential to be used to inform linguistically-derived tailoring strategies.

Given our previous efforts to validate LIWC for the identification of emotional expression in text (Bantum & Owen, 2009; Owen et al., 2005; Owen et al., 2006), the present study sought to evaluate whether linguistically-tailored feedback related to emotional expression could be used to modify emotional processing in the context of an expressive-writing paradigm. There were two primary aims of the study. The first aim was to create a valid implementation of LIWC using Perl, an open source computer language adaptable for linguistic analysis and manipulation of text files. By implementing LIWC via Perl, it would then be possible to provide dynamic, linguistically-tailored feedback in real time. The second aim of the study was to experimentally test whether linguistically-tailored feedback could alter emotional processing during expressive writing. We hypothesized that participants who received tailored feedback would engage in greater levels of

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