FEATURE

Biofeedback and Expressive Writing: Emotional Disclosure and Its Effects on Health

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The purpose of this study was to evaluate the combined effects of biofeedback training and expressive writing on emotional disclosure and health. Our results indicate that combining these two modalities can facilitate emotional disclosure. It appears that electroencephalogram (EEG) biofeedback and expressive writing can mutually enhance each other's effect on stress responses through subcortical and cortical integration and subsequently produce a reduction in blood pressure. More solid studies with stronger research design are needed to address the theoretical and methodological issues involved, as well as the clinical implications.

Introduction

Going to college represents a major lifestyle change for many students, who frequently move away from their families to meet their emotional, relational, financial, and other needs by themselves while facing new challenges in their budding and yet challenging academic pursuit. This transition often leads to stress-related problems that occur when the students' previously successful coping strategies fail in the new social environment. Not surprisingly many colleges and universities are constantly searching for new and effective ways to help students adjust to the realities of college life. We have tried to explore the efficacy of one such approach in our project by combining well-established biofeedback techniques with expressive writing as an adjunctive modality.

Empirically, research has shown that expressive writing can generate new understanding of the past event, and this new understanding has been associated with improvements in physical and psychological health (Pennebaker, 1989). Over the course of writing, the students are constructing a coherent life story or narrative, and in so doing they create psychological distance between the events concerning them and themselves (or their egos) on the spatio-temporal dimension. Relying on this safe distance, students can rationally reflect on what happens and how they should approach it, rather than being overwhelmed by the stressful events. Second, in the process of writing, which requires the organization of their thoughts, students are more likely to develop their thinking process and come up with an effective strategy to deal with the stressful situation. Third, writing produces a transformation of the emotional experience, which leads to a new and probably more sensible meaning, possibly easing the accompanying tensions (e.g., Lepore & Smyth, 2002; Pennebaker, 2002; Pennebaker & Graybeal, 2001).

Clinically, Lepore and Smyth (2002) argued that combining writing with other treatments could facilitate the effects of expressive writing. In addition, from our previous research experiences that separately involved expressive writing and biofeedback, we felt that both therapeutic modalities could effectively regulate emotion and attention, as well as blood pressure (Lepore & Smyth, 2002; Norris, Lee, Burshteyn, & Cea, 1998; Norris, Lee, Burshteyn, & Cea-Aravena, 2001). As such, it would be of great interest to investigate whether biofeedback and expressive writing can complement each other in the same population.

As far as biofeedback is concerned, some people still look at it as a simple conditioning technique, and although conditioning without conscious awareness is possible and can lead to the desirable behavioral changes, it is probably misleading to look at biofeedback as a mere series of conditioning trials. Biofeedback represents conscious self-regulation, and most biofeedback practitioners realized that a long time ago. Parks (1997) demonstrated that alpha-increase training enables participants to develop psychophysiological control by using self-regulatory attentional processes. In other words, participants can learn to become conscious of the relaxed and alert state of mind that corresponds to high alpha levels through alpha-increase training. They can also be trained to enter and exit this state at will so that they would be able to regulate levels of arousal, increase

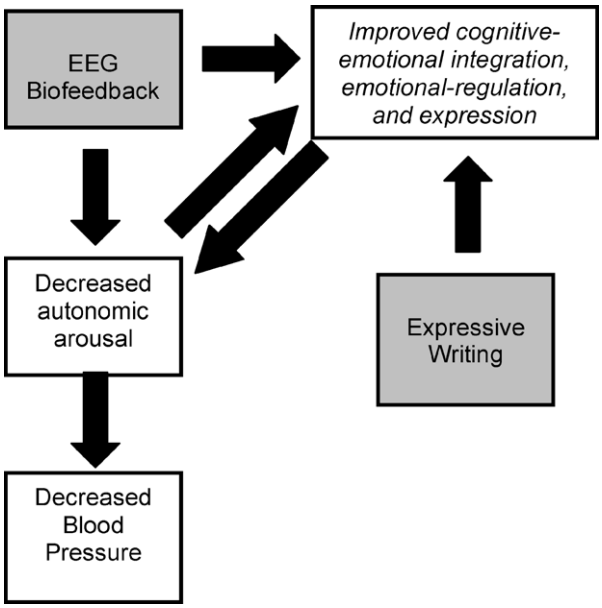

Figure 1. Proposed mechanism of facilitative effects of expressive writing and *electroencephalogram* (EEG) biofeedback on blood pressure.

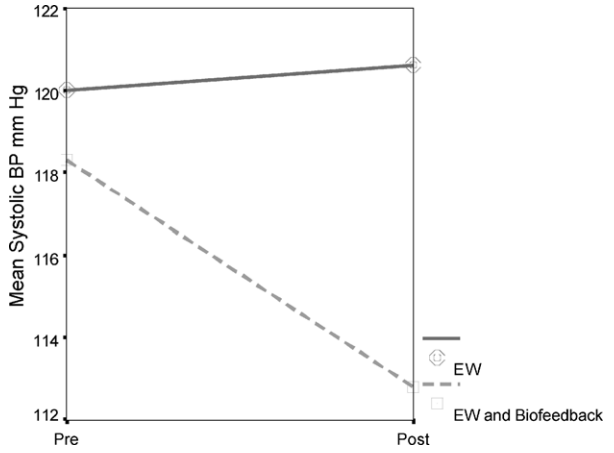

Figure 2. Mean comparisons of systolic blood pressure scores recorded from the expressive writing (EW) and expressive writing and biofeedback (BF+EW) group at pre- and posttest.

attention capacity, and sustain attention longer. In terms of attention, it is central to emotional regulation because people must become aware of emotional responses and antecedent stimuli before they learn to control them (Lepore & Smyth, 2002). Related to this thesis is our hypothesis, which states that both expressive writing and biofeedback direct attention to sources of stress and facilitate emotion regulation processes. Furthermore, this self-regulation of attention may lead to improved impulse control, enhanced cognitive-emotional integration, greater emotional balance, and positive changes in physiological variables, of which one quintessential example is blood pressure. There is evidence in the research literature that electroencephalogram (EEG) biofeedback can produce a decrease in blood pressure levels (Norris et al., 2001).

With regard to expressive writing, there is an increasing body of evidences showing that expressive writing can decrease blood pressure levels. Furthermore, according to Davidson et al. (2002), cognitive processes, particularly those operating on stressful experiences, can influence blood pressure. Other researchers have also held that cognitive processes, such as the persistence of trauma-related thoughts/memories/images and attempts to avoid such thoughts/memories/images, can result in the elevated blood pressure. Along the same line, lack of cognitive integration could increase anger and associated arousal, and eventually blood pressure. On the other hand, successful cognitive-emotional integration and its subsequent expression should decrease blood pressure (Davidson et al., 2002). With these theoretical statements about the cognitive-emotional processes involved in responses to stress and with the earlier statements about the biological mechanisms that underlie stress responses, we would like to widen the theory and argue that both EEG biofeedback and expressive writing can mutually enhance each other's effect on stress responses through subcortical and cortical mediation and integration. The enhanced effect should be reflected in the decrease of blood pressure. Our theoretical hypothesis is illustrated in Figure 1.

In order to examine some of the cognitive-emotional aspects of both expressive writing and biofeedback, we attempted to focus on the content of the essays written by the participants (Pennebaker, 1989); measures of frontal cortical activation (for evaluating the cortical involvement in cognitive-emotional reintegration); and a measure of blood pressure (for assessing the physiological impact of both therapeutic modalities' combined effect). Specifically regarding the content of EW, the analysis was conducted in terms of cognitive and emotional categories, among others. The cognitive and emotional categories are very important because they reveal the causes and reasons for the events and the emotions involved. The importance can be seen in Niederhoffer and Pennebacker's (2002) finding, which indicated that the more that people used positive-emotion words the more their health improved, whereas individuals who used a moderate number of negative-emotion words evidenced the greatest drops in physician visits.

Method

Participants

Twenty Siena College freshmen participated in this study. Informed consent was obtained from each of the participants, and extra credit was given for their participation.

Materials

The Deymed Diagnostic TrueScan was used for EEG acquisition, a Thought Technology Biograph was used for alpha-training, and a Gen-Med blood pressure device was used to record blood pressure readings.

Procedure

Participants were randomly assigned to each of two matched groups (matched on gender, GPA, and age); one involved expressive writing (EW) only, and the other included expressive writing as well as biofeedback (BF+EW). Both biofeedback and expressive writing sessions were held in the same research laboratory in order to rule out the setting effect. Each individual was invited to come to the laboratory for a total of five visits. The first and the last visits were used as pre- and posttest sessions, whereas the treatments were performed in sessions 2, 3, and 4. Participants' blood pressure and frontal EEG activity were recorded during pre- and posttests. Blood pressure was recorded three consecutive times during each pre- and postsession, and the means of the three were used for data analysis (see Figure 2). Alpha baseline levels at PZ were also recorded at that time. Each participant in the BF+EW group was asked to come to the laboratory once per week for about 40 minutes per session for the total of three training sessions. A quasi-crossover design was employed to rule out the order effect. That means half of the students in the BF+EW group spent the first 20 minutes for biofeedback training (alpha-increase at PZ), whereas the other half of the same group took the same kind of training during their last 20 minutes of each session. Students in the EW group were seen for the same length of time and with the same crossover design governing the sequence of their training.

During the biofeedback training students were told to observe their breathing and keep their eyes slightly out of focus as they looked at the computer display. Students in the EW group were given identical instructions and were asked to look at the screen saver on the computer screen for the first 20 minutes of the session as a sham control (vs. the real biofeedback training) before writing. During the expressive writing portion of the session, both groups were asked to write about their deepest thoughts and feelings associated with making the transition to college life. They were given a standard 8.5 × 11 inch pad of paper and asked to write as much as they could until told to stop.

Upon the completion of the study, pre- and postsession blood pressure and frontal EEG measures were analyzed along with essays that were content analyzed independently by two raters blind to the conditions of the experiment. The two raters were trained and given instructions to count the number of positive, negative, and cognitive restructuring words.

For content analysis, we used a procedure that is somewhat more subjective than the linguistic word count program, although both follow the same strategies. The interrater reliability for our content analysis ranged from .64 to .75. The emotional categories used for content analyses included negative-emotion words such as miserable and distressing, positive-emotion words such as happy and enjoy, cognitive categories consisting of causal words such as cause and reason, and insight words such as understand and realize.

Results

The effect of group × pre/post interaction on systolic blood pressure was statistically significant, with $F(1, 18) = 5.96$ and $p < .025$. The simple effect for the BF+EW group yielded an $F(1, 9) = 13.75$, $p < .005$, indicating a statistically significant decrease in systolic blood pressure for the BF+EW group (see Figure 2). No significant changes were observed in the EW group. Our alpha increase training enabled all of our BF+EW participants to successfully raise their alpha amplitudes compared with the baseline. Among the 10 BF+EW participants, eight were able to raise their alpha amplitude by 15% from their baseline levels.

Frontal activity measure showed no significant interaction between groups and no significant changes in frontal activation from pre- to posttests at either the F3 or F4 electrode sites.

Content analysis on the essays was performed by two raters who were blind to the conditions of the experiment. One-way analysis of variance (ANOVA) revealed a marginally significant difference of cognitive restructuring words (specifically on the total number of content and insight words) between the two groups, with $F(1, 19) = 3.25$ and $p < .09$ (see Figures 3 and 4).

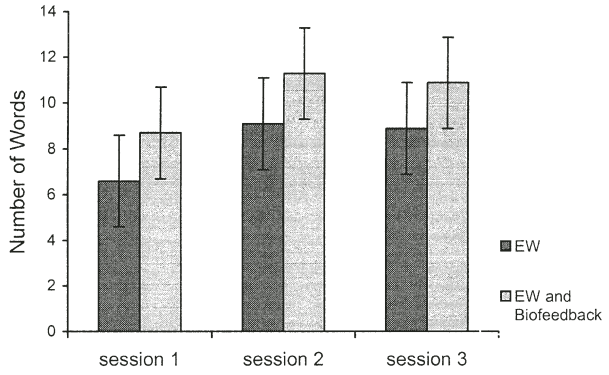

Figure 3. Mean number of causal and insight words reported by the expressive writing (EW) and expressive writing and biofeedback (BF+EW) group at each of the three expressive writing sessions.

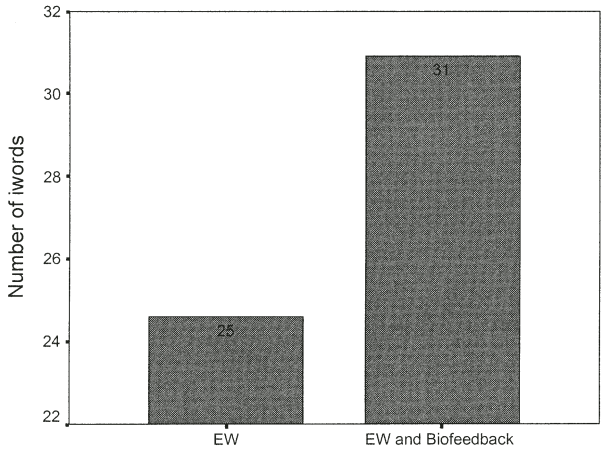

Figure 4. Combined group means for the total number of causal and insight words reported by the expressive writing (EW) and expressive writing and biofeedback (BF+EW) group during all of the experimental sessions.

Discussion

The results of our study seem to be promising, although some theoretical and methodological issues need to be addressed. The first question is whether EEG biofeedback facilitates expressive writing by assisting its emotion regulation and expression. Our content analysis yielded slightly significant result for one out of three major categories, and these results should not be taken lightly considering the small size of our sample (Typically, the smaller the sample size, the more difficult it is to generate a significant result).

We did not observe any significant differences in negative and positive words; however, the significant changes in cognitive categories deserve our special attention because the cognitive categories account for the most variance in predicting health improvements. Some empirical studies show that people whose health improves the most tend to use increasing amounts of causal and insight words (Niederhoffer & Pennebaker, 2002).

Provided the prevalence of respiratory illnesses (e.g., stress-induced asthma) on college campuses and given the potential of our participants to improve their health, convenient and economical health interventions such as expressive writing seem worthy of further trials. A study by Smyth, Stone, and Hurewitz (1999) showed positive effects of journaling for respiratory illnesses.

As readers may agree, the ultimate goal of many psychologists and biofeedback practitioners is to help individuals reconstruct a story about themselves and from its reflection to derive a new direction for their lives. In this rational reconstruction process, the cognitive-emotional reorganization involved is probably facilitated by biofeedback, which helps participants to self-regulate and reach a new level of mind-body integration. For some, biofeedback facilitates a conscious "aha" stage (Wilson, Peper, & Gibney, 2004).

Secondly, this study did not include an EEG biofeedback alone condition, so that we have not measured whether EEG training alone would have produced as much change as EEG training with expressive writing. Further research will be necessary to document how much effect expressive writing adds to neurofeedback training.

The third issue we wish to address is in regard to the clinical significance of our empirical findings, especially the effect of the combination of biofeedback and expressive writing on reducing systolic blood pressure. Our research participants were recruited from a normatively healthy college student pool. Their blood pressure did not decrease from abnormal to normal, but rather changed within the normal range. Further research will be needed to assess whether we can generalize our finding to clinical hypertensive populations.

The fourth issue refers to our failure to find changes in frontal activation and frontal asymmetry. Following Davidson's (1995) frontal activation model, we had expected a change in frontal asymmetry scores caused by a decrease in right frontal activation as individuals re-evaluated and resolved some of the emotional conflicts. Two possible reasons may account for the failure. One is that a 5-week period from pre- to postsession may have not been sufficient for a long-lasting cognitive integration. Another possibility is that the changes in cognitive processing brought about by these interventions were insufficient to reshape the global EEG picture.

One of our purposes in reporting on this project is to encourage biofeedback practitioners to explore the efficacy of combining biofeedback and expressive writing in clinical

settings. We recommend that practitioners utilize expressive writing at least as a homework assignment for their patients, so that the patients can stay better focused on the problems they are trying to resolve. In this regard, the fourth issue we would like to address concerns the clinical efficacy of expressive writing. In spite of the systolic reduction effect reported in previous studies (e.g., Davidson et al., 2000), our study does not indicate such an effect, as can be seen in Figure 2. To investigate this discrepancy will require a randomized controlled crossover study with a larger sample size, as determined by statistical power.

In addition, more studies are needed to identify the characteristics of individuals who are more or less likely to benefit from both expressive writing and biofeedback. The other important purpose of this article, of particular interest to our team, is the application of these complementary modalities to the college student population as introduced at the beginning of this article. For this purpose, the authors of this article are pursuing a joint project to compare the effects of future interventions in diverse college populations. For example, at the City University of New York (the largest urban university in the United States), the majority of students come from middle or lower SES, instead of upper or upper-middle SES. They are relatively older than the liberal arts college students as represented by Siena College students, and they play multiple roles, including full-time or part-time workers and parents. As such, the sources of their stress are quite different from those of Siena College students. It would therefore be theoretically meaningful and empirically valuable to find out whether the same kind of techniques can be generalized to other college settings.

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