Biofeedback-Assisted Relaxation as Part of Preincident Stress-Management Training within a Model of Comprehensive Crisis Intervention: A Pilot Study

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The purpose of this study was to explore the potential applicability of biofeedback-assisted relaxation training using frontalis EMG as it might be applied as part of a preincident stress-management training program within a model of comprehensive crisis intervention. For 4 consecutive weeks, 37 treatment participants were taught a different relaxation technique followed by six weekly sessions of frontalis EMG biofeedback. The 25 control participants did not receive the relaxation training, but they did attend six weekly sessions of yoked biofeedback training. Compared to the control group, the treatment group evidenced significant reductions in frontalis EMG readings and individual standard-deviation measures from baseline pretest to baseline posttest. These preliminary data support the use of preincident stress-management training as it might be applied to a systematic, multicomponent approach to crisis management. [Brief Treatment and Crisis Intervention 3:437–443 (2003)]

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Stress, a concept first introduced into the allied health sciences in 1936 by Hans Selye, is considered an endemic part of the human condition. Despite the purported benefits of modern technology to alleviate some of life’s current stress, there are those who contend that our present era entails more stress than ever (Jones, 1997). Given the profound psychological unrest engendered by chronic psychosocial stressors—such as massive domestic downsizing of public and private companies, recurrent economic unpredictability, changes in traditional family roles, and a divorce rate of approximately 50% (Granvold, 2000)—it is difficult to argue with these conclusions. According to the U.S. Surgeon General (U.S.
Department of Health and Human Services, 1999), stress-related diseases and anxiety serve as the major contributors to mental illness in the United States for persons 18 to 54 years old, with more than twice the prevalence (16.4%) of mood disorders (7.1%). Given the apparently epidemic impact of human stress on health and disease, it seems reasonable to conclude that stress may be considered a significant public health challenge.

In addition to the chronic psychosocial stressors noted here, a proliferation of professional and public interest in crisis intervention services has occurred in the past decade (Roberts, 2000). Considering that the lifetime prevalence of exposure to any form of trauma is 90% (Breslau et al., 1998)—especially with the impact of events such as September 11, domestic sniper attacks and bombings, and recurrent natural and man-made disasters—it is not surprising that these services have flourished. Recognizing the need for crisis management has led to the development, facilitation, and mobilization of response teams that provide a variety of interventions on an as-needed basis. In 1990, the British Psychological Society (1990) recommended that crisis intervention consist of multicomponent interventions.

A successful model of crisis management is predicated on the notion that managing stress reactions in the aftermath of a critical incident requires a comprehensive, systematic, and multicomponent approach (Everly & Mitchell, 1999). Early intervention programs are considered comprehensive because they consist of techniques that functionally span the temporal spectrum of a crisis. A recent report by the National Institute of Mental Health (NIMH; 2002) endorses early psychological intervention that utilizes an integrated, multicomponent evidence-based intervention system. Stress management is mentioned within that report as being of potential value in the wake of mass violence and disasters. Preincident preparation or training, which is an integral part of a comprehensive system, is sometimes overshadowed by interventions that take place following a critical incident. However, preincident preparation may be the most important tool in assisting individuals to become resistant to debilitating stress in the wake of a mass disaster or a well-circumscribed critical incident (Everly & Mitchell, 1999). Preincident training is designed to enhance stress resistance by providing information about general stress, the human stress response, formal techniques to help alleviate stress, and cognitive techniques to enhance perception of control as well as challenge irrational beliefs.

A notable propagation of stress-management techniques have been designed specifically to mitigate physiological arousal and increase one’s perception of control (Lazarus & Folkman, 1984). Included among these techniques are diaphragmatic breathing, active and passive neuromuscular relaxation, and meditation. The efficacy of these stress-management interventions, either programmatically or with a specific disease cohort, has often relied on self-report measures (Henry, Wilson, Bruce, Chisholm, & Rawling, 1997; Kushnir, Malkinson, & Ribak, 1998). While certainly essential in assessing responses to these interventions, the utility of psychophysiological data provides an additional, important piece of multivariate quantification to augment self-report information.

The human psychophysiological response to stress has been well documented (Guyton & Hall, 2000), and it includes autonomic changes in the peripheral nervous system, such as increased heart rate, blood pressure, sweat-
gland activity, breathing rate, and muscle tension. The psychophysiological assessment of stress has typically involved the noninvasive quantification of electrophysiological events as they relate to distinctive psychological variables (Kallman & Feuerstein, 1986). Cardiovascular measures, such as heart rate and blood pressure, as well as various forms of biofeedback provide meaningful measures to these covert autonomic events. Electromyographic (EMG) biofeedback, for example, has been used successfully to assess and treat muscle tension by having individuals become aware of small increments of change, thus allowing them to learn to relax the muscles involved. Frontalis muscle biofeedback, often used with some combination of relaxation techniques, has traditionally been used for low-arousal or general relaxation training (Stoyva & Budzynski, 1993). However, the effectiveness of frontalis placement as “key muscles” for generalized relaxation has been questioned because of its purported lack of discrimination of gross muscle tension occurring in other parts of the body (Graham et al., 1986; Jones & Evans, 1981). Moreover, other data suggest that multiple and reactive-site EMG biofeedback may be as effective as frontalis biofeedback in reducing arousal (Mariela, Matt, & Burish, 1992). Despite these purported reservations, the need to assess psychophysiological stress responses reliably, accurately, and with minimal invasiveness remains pertinent.

Given the amount and impact of current stress we face in our lives and the inherent susceptibility we all face to critical incidents, learning ways to understand and control the stress response—more specifically, the regulation of autonomic nervous system arousal—may help to inoculate us from the impact of critical incident stress. Furthermore, Bandura (1997) posits that physiological self-regulation serves as one of the four principal influences guiding an individual’s personal belief in self-efficacy. The purpose of this pilot study was to determine if biofeedback-assisted relaxation training using frontalis EMG could reduce baseline stress levels. The participants of the study were enrolled in a course designed to help control stress and tension through the use of formal relaxation techniques. The success of such a program provides impetus for the use of ample preincident preparation and training in comprehensive critical incident stress management.

**Method**

**Participants**

The participants were 66 healthy undergraduate students (16 men, 50 women) whose ages ranged from 19 to 22 years (mean age, 20.53 years). Of those participants, 40 (12 men, 28 women) were in the biofeedback-assisted relaxation-training group, which means that they were completing an elective course on controlling stress and tension in which the procedures described here were part of the class requirements. The other 26 participants (4 men, 22 women) served as a control group; they had volunteered for the study as part of course credit for a health psychology class. None of the participants in the control group had taken the course in controlling stress and tension.

**Biofeedback Instrumentation**

The EMG feedback instruments used in this study were the Autogenic System’s Advanced Technology AT33. A narrow bandpass filter of 32 to 220 Hz provided rejection of physiological artifact, such as cardiovascular signals and environmental noise. Standard disposable silver/silver-chloride sensors on a foam strip were gelled and then placed horizontally 1 inch above the eyebrows. Two active sensors and
one ground reference sensor were placed on the frontalis muscles and then connected to the EMG machine with shielded lead wires. Summary statistics of mean, maximum, minimum, and standard deviation were recorded from a digital display of integrated absolute levels of microvolts per minute.

**Procedure**

All feedback sessions took place in a laboratory setting that had 10 cubicles, each containing an Autogenic System’s Advanced Technology AT33 EMG instrument. During the second week of class, all participants underwent a baseline pretest that began with a thorough explanation of the EMG biofeedback equipment. After cleaning their foreheads with 70% isopropyl alcohol solution and having the sensors and leads attached, participants underwent a 3-min adaptation period followed by a 5-min recorded baseline period. During this baseline pretest, participants were asked to simply sit quietly.

For the following 4 weeks, the biofeedback-assisted relaxation group received training by Lating for the following relaxation techniques: Week 1, diaphragmatic breathing; Week 2, active neuromuscular relaxation; Week 3, passive neuromuscular relaxation; and Week 4, meditation. The training consisted of a thorough description of the technique followed by in-class practice (see Everly and Lating, 2002, for a complete description of each of the relaxation techniques). The participants were asked to practice each technique for 15 to 20 min, twice per day (except for diaphragmatic breathing, which they were instructed to practice for 7 to 9 repetitions, 10 to 15 times per day). These participants then practiced the newly taught technique for 1 week and recorded their activities on daily log forms, which were reviewed in class the following week. The week after being taught meditation, these participants began six weekly 20-min individual sessions of biofeedback-assisted relaxation training using an EMG. These sessions consisted of 3 min of adaptation, 5 min of baseline, and 12 min of formal feedback. Participants continued to practice the relaxation techniques during these next 6 weeks and kept the daily log forms, which were collected when they arrived in the lab for their weekly session.

The control group did not receive training in any of the relaxation techniques. They did, however, undergo the 6 weeks of 20-min individual sessions in which they had sensors and leads attached. The EMG machine was not turned on. Participants were told that the purpose of the study was to assess the utility of the biofeedback instrumentation. After having the sensors attached, they were asked to sit quietly and relax.

During the last week of class, all participants underwent a 5-min baseline posttest that was identical to the pretest. The effectiveness of the biofeedback-assisted relaxation training was determined by comparing the baseline scores.

**Results**

Eliminated from analyses were data from 3 participants from the biofeedback-assisted relaxation-training group and 1 participant from the control group. This decision was made as a result of one of two scenarios: one, their baseline pretest EMG readings and their baseline pretest individual standard-deviation readings were each two standard deviations above the mean for their respective groups; two, the same scenario as the first, but with regard to their baseline posttest EMG readings and baseline posttest individual standard-deviation readings. These participants’ readings were considered spurious due to equipment error (e.g., defective sensor, a poor connection), participant error (e.g., excessive movement), or some combination of the two. Also, a pretest
individual standard-deviation score was missing for a participant in the stress-management group. Therefore, data were analyzed for 37 participants in the stress-management group (12 men, 25 women) and 25 participants in the control group (4 men, 21 women).

A comparison between the biofeedback-assisted relaxation group and the control group, using separate variance $t$ tests, revealed no significant differences between the two groups on mean pretest baseline EMG readings $t(59.7) = .45, p = .655$; or mean pretest individual standard-deviation scores $t(55.8) = .301, p = .764$ (see Table 1).

In assessing the efficacy of relaxation training, it was assumed that a preponderance of participants in the biofeedback-assisted relaxation-training condition would lower their mean baseline EMG score from pretest to posttest. In fact, 35 participants (94.6%) lowered their score. Conversely, since the control condition did not receive formal relaxation training, we assumed that their scores had an equal chance of either increasing or decreasing. The data revealed that 13 participants (52%) lowered their scores. Moreover, the biofeedback-assisted relaxation-training group reduced their baseline EMG readings $t(29.6) = 4.95, p < .01$; and their individual standard-deviation readings $t(27.1) = 4.37, p < .01$; from pretest to posttest significantly more than the control group (see Table 1). The effect sizes for EMG readings and individual standard-deviation scores were $d = 1.05$ and $d = .90$, respectively. As shown in Table 1, the control group’s EMG readings, $t(24) = .665, p = .512$, and individual standard-deviation readings, $t(24) = 1.62, p = .118$, actually increased from pretest to posttest, albeit not significantly.

### Discussion

The results of this pilot study evidence that biofeedback-assisted relaxation training using frontalis EMG was effective in reducing physiological arousal in a group of undergraduate students. These preliminary data also support the efficacy of incorporating formalized stress management as part of preincident training within a comprehensive, systematic crisis intervention program. Given the inherent stressors facing people today, as well as the potential for exposure to crisis events, it may be prudent to teach lifelong, effective coping strategies to inoculate people against the adverse impact of stress.

Particularly impressive about these initial results is that a healthy sample of participants was able to reduce their EMG levels by more than 2 microvolts on average after learning and practicing various relaxation techniques. Also,
the lowering of mean individual standard-deviation scores reflects a homogenizing of the treatment effect for the biofeedback-assisted relaxation-training group. The lowered standard-deviation posttest baseline readings for the stress-management participants further suggest that they were likely not attempting to utilize active relaxation strategies during this assessment period. One would imagine that attempts at an active form of relaxation, such as inhalation during diaphragmatic breathing, would result in increased lability of standard-deviation readings, in addition to possibly elevated EMG scores because of increased psychological pressure and arousal. Moreover, even with the inherent expectancy effect of being attached to a biofeedback machine for six sessions, the control group did not demonstrate an overall empirical reduction in EMG readings from pretest to posttest.

Despite these impressive initial results, the study does have limitations. Although the participants were healthy undergraduate students with a limited age range, they were not randomly assigned to their respective groups. Also, men and women were not equally represented in this convenience sample, and since the purpose was to assess the effects of multiple stress-management techniques, the data do not provide information on any specific technique. We believe, however, the lack of a specific components’ analysis does not diminish the utility of the present findings as relaxation training needs to be ego-syntonic and therefore individually suited to be of greatest benefit (Girdano, Everly, & Dusek, 2001). Thus, subjects were exposed to an array of interventions.

Additional limitations to this study include the lack of follow-up data and the lack of subjective stress and/or anxiety measures to support the EMG results. We realize that these limitations restrict the interpretations that can be made about the amount of perceived relaxation experienced by the participants.

**Conclusion**

The findings of this pilot study demonstrate the potential applicability of biofeedback-assisted relaxation training as part of a stress-management program to be applied within a model of comprehensive crisis intervention. As these current data suggest, healthy college-aged participants were able to lower their physiological arousal after practicing various relaxation techniques. We hoped that the enhanced sense of physical control they experienced by receiving objective EMG frontalis data is augmented by an equally relevant enhanced sense of perceived personal control (i.e., self-efficacy) in which they feel that they possess an internal mechanism to cope with excessive stress. Given the tenets of comprehensive crisis intervention, particularly preincident training, providing the foundation of an enhanced sense of physical and personal control over stress may be invaluable in the aftermath of a critical incident.

Although preliminary, the findings of this pilot study may provide the impetus for researchers to employ randomized controlled studies, incorporate participants’ subjective data, generalize these results to older and more clinically relevant populations, enhance gender equality of the samples, and assess whether these results persist longitudinally. Additionally, if researchers can determine specific outcome differences among diverse techniques, it will be particularly advantageous to the overall study. What these pilot data do suggest, however, is that inclusive preincident education that includes stress management and is part of a comprehensive crisis management system appears viable and warrants further applied investigation.
References


