Research Article

The Salivary Biochemical Changes Associated with a Mood Induction Writing Task

Jason E. Warnick and Chelsea D. Liddell

Arkansas Tech University

Address correspondence to Jason E. Warnick, Ph.D, Department of Behavioral Sciences, Arkansas Tech University, 407 West Q St., Russellville, AR 72801 USA, e-mail: jwarnick@atu.edu

ABSTRACT: *Writing about emotionally salient topics to influence a participant's mood is a common experimental technique in emotion research. This study attempted to begin the biological characterization of this research paradigm. Thirty-eight participants were: 1) administered the Positive and Negative Affect Schedule (PANAS) and asked to provide a saliva sample, 2) assigned to either an emotionally positive or negative writing task, and 3) re-administered the PANAS and asked to provide another saliva sample. Saliva samples were analyzed using ELISA for concentration of a stress hormone (cortisol), an immunological marker (secretory immunoglobulin A), and a sex steroid (dehydroepiandrosterone). Both writing tasks were found to influence mood in the appropriate manner. That is, the positive writing task increased positive mood and the negative writing task increased negative mood. The negative writing task was found to lower salivary cortisol concentration. The ability for the negative writing task to attenuate stress hormone levels is discussed in the context of this research paradigm's potential similarity to expressive written therapy.*

The study of emotion commonly relies on techniques that can produce mood alterations in a laboratory setting. One frequently utilized technique has been the mood induction writing task. In this task, participants are asked to write about an emotionally arousing subject (e.g., the saddest time in their life) while control-group participants are asked to write about a neutral topic (e.g., the contents of a geography article; Baker & Guttfreund, 1993). This experimental technique has the benefits of requiring a short amount of time (approximately 20-30 minutes), necessitating few resources, produces a fairly large effect, and possesses few risks for the experimental subject (Baker & Guttfreund, 1993).

While the mood induction writing task has been used in many psychological experiments, no research has focused on the biological changes that accompany this technique. In studies using a naturalistic setting, positive and negative moods have been associated with certain biological characteristics. For example, positive affect is associated with decreased release of the stress hormone cortisol (Lai, Evans, Ng, Chong, Siu, Chan, Ho, Ho, Chan, & Chan, 2005), exacerbated androgen release (Booth, Shelley, Mazur, & Tharp, 1989) and increased immune system function (Stone, Cox, Valdimarsdottir, Jandorf, & Neale, 1987). Conversely, negative affect is associated with increased cortisol release (Smyth, Ockenfels, Porter, Kirschbaum, Hellhammer, & Stone, 1998), decreased androgen release (van Niekerk, Huppert, & Herbert, 2001) and decreased immune system function (Stone et al., 1987). Based on the similarity between one's self-reported mood in the writing task and a naturalistic setting, it could be argued that similar biological changes would occur in the mood induction writing task. However, the writing task mimics many aspects of a therapeutic practice that has produced physical changes incongruent with this hypothesis.

The therapeutic practice of self-disclosure has been studied extensively by James Pennebaker (for reviews see: Pennebaker, 1997; Pennebaker & Chung, 2007). In this paradigm, a person repeatedly writes about a

topic that has been negatively affecting his or her life over an extended period of time (i.e., days to months). This paradigm has shown positive therapeutic outcomes for a wide range of issues, including depressive symptomology (Gortner, Rude, & Pennebaker, 2006), insomnia (Harvey & Farrell, 2003), smoking cessation (Ames, Patten, Offord, Pennebaker, Croghan, Tri, Stevens, & Hurt, 2005; Ames, Patten, Werch, Schroeder, Stevens, Fredrickson, Echols, Pennebaker, & Hurt, 2007), stress due to job loss (Spera, Buhrfeind, & Pennebaker, 1994), and work absenteeism (Francis & Pennebaker, 1992). Interestingly, positive changes to participants' health have been a consistent outcome in this paradigm in spite of the maintenance of a negative mood. For example, in one study, adults suffering from fibromyalgia were assigned into either a disclosure group, which wrote for four consecutive days about life stress, or a control group, which wrote for four consecutive days about a neutral topic (Gillis, Lumley, Mosley-Williams, Leisen, & Roehrs, 2006). At a one-month follow-up, the disclosure group, relative to the control group, showed signs of improvement in sleep quality, fatigue, pain, and physical disability. However, the disclosure group also experienced a significant worsening of mood and perceived social support. At the 3-month follow-up point, the previously mentioned biological factors of the disease continued to show improvement relative to the control group but the negative effects on mood and perceived social support were no longer evident. This mismatch between health improvement and negative mood leads one to question whether the operationally-similar mood induction writing task could produce biological changes that are diametrically-opposed to those caused by moods induced in a naturalistic setting.

In this experiment, the effects of a mood induction writing task on the release of the stress hormone cortisol, the immune system marker secretory immunoglobulin A (SIgA) and the sex steroid dehydroepiandrosterone (DHEA) were investigated. Participants were assigned to one of two writing task groups: the positive writing task group wrote for 30 min about someone they love and the negative writing task group wrote for 30 min about someone they hate. Participants completed a self-report mood survey both before and after the writing task to assess any change in mood. Also, participants provided a saliva sample both before and after the writing task for the assessment of any biological changes. The saliva was analyzed via Enzyme-Linked ImmunoAssorbent Assay (ELISA) for changes in cortisol, SIgA, and DHEA.

METHOD

Participants

Thirty-eight participants were recruited from undergraduate psychology courses at Arkansas Tech University. Students were provided extra credit for their participation.

Procedure

When students volunteered to participate in the study, they were explicitly told not to smoke, eat or drink at least two hours prior to their scheduled time. Prior to starting the experiment, students were asked if they had followed this instruction before being allowed to participate in the study. At this time, the study was explained and each participant was asked to read and sign an informed consent agreement. Participants were then asked to complete the Positive and Negative Affect Schedule (PANAS) in order to assess the general mood of the individual. Each participant was provided a bottle of water and asked to rinse their mouth. A piece of gum (Trident; Cadbury Schweppes, Parsippany, NJ, USA) was given to each person to increase saliva production and participants were asked to provide a saliva sample in a supplied test tube (e.g., Chatterton, Vogelsong, Lu, & Hudgens, 1997). At this point, participants were randomly placed into one of two mood induction tasks. In the positive mood induction task, participants were asked to write for 30 minutes about someone they love and describe why they love that person. In the negative mood induction task, participants were asked to write for 30 minutes about someone they hate and describe why they hate that person. When the mood induction task was finished, participants were provided a new copy of the PANAS to assess their current mood and another saliva sample was also requested in the same manner.

Biochemical Analyses

Saliva samples were immediately placed on ice after collection and then taken to a freezer for storage. On the day of analysis, the samples were thawed and centrifuged for 15 min at 3000 rpm prior to use. Salivary concentrations of cortisol, SIgA, and DHEA were determined by ELISA (ER HS Cortisol Research, SIgA and DHEA; Salimetrics, LLC, State College, PA, USA). The assays were conducted according to the manufacturer's instructions. The intra-assay coefficients for each assay ranged from 2.11% to 4.45%.

Ethical Considerations

This experiment was approved by the Arkansas Tech University Human Subjects Research Committee and conducted under the ethical guidelines of the American Psychological Association.

RESULTS

The effect of the negative writing task on participants' self-reported mood is summarized in Figures 1A and B. Participants in this group had a robust decrease in their positive affect scale scores and a robust increase in their negative affect scale scores. Consistent with this description, one-tailed paired-subjects t-tests revealed significant differences between pre- and post-tests for the positive affect scale scores, $t(17) = 2.71$, $p < 0.05$ and the negative affect scale scores, $t(17) = -3.52$, $p < 0.005$. The effect of the positive writing task on participants' self-reported mood is summarized in Figures 2A and B. Participants in this group had a robust increase in their positive affect scale scores and a decrease in their negative affect scale scores. Consistent with this description, one-tailed paired-subjects t-tests revealed a significant difference between pre- and post-tests for the positive affect scale scores, $t(19) = -2.96$, $p < 0.001$ and a significant difference between pre- and post-tests for the negative affect scale scores, $t(19) = 2.01$, $p < 0.05$. Two tailed paired-subjects t-tests were used to assess biological changes in saliva. Participants in the negative writing task had a robust decrease in their salivary cortisol concentration (see Figure 3). Consistent with this description, a paired-subjects t-test revealed a significant difference between pre- and post-test salivary cortisol concentration, $t(16) = 2.61$, $p < 0.025$. Participants in the positive writing task had a no change in their salivary cortisol concentration. Consistent with this description, a paired-subjects t-test revealed a non-significant difference between pre- and post-test salivary cortisol concentration, $t(18) = 0.43$, $p = 0.675$.

Participants in the negative writing task had no change in their salivary SIgA concentration. Consistent with this description, a paired-subjects t-test revealed a non-significant difference between pre- and post-test salivary SIgA concentration, $t(13) = 1.39$, $p = 0.187$. Similarly, participants in the positive writing task had a no change in their salivary SIgA concentration. Consistent with this description, a paired-subjects t-test revealed a non-significant difference between pre- and post-test salivary SIgA concentration, $t(13) = -0.58$, $p = 0.575$.

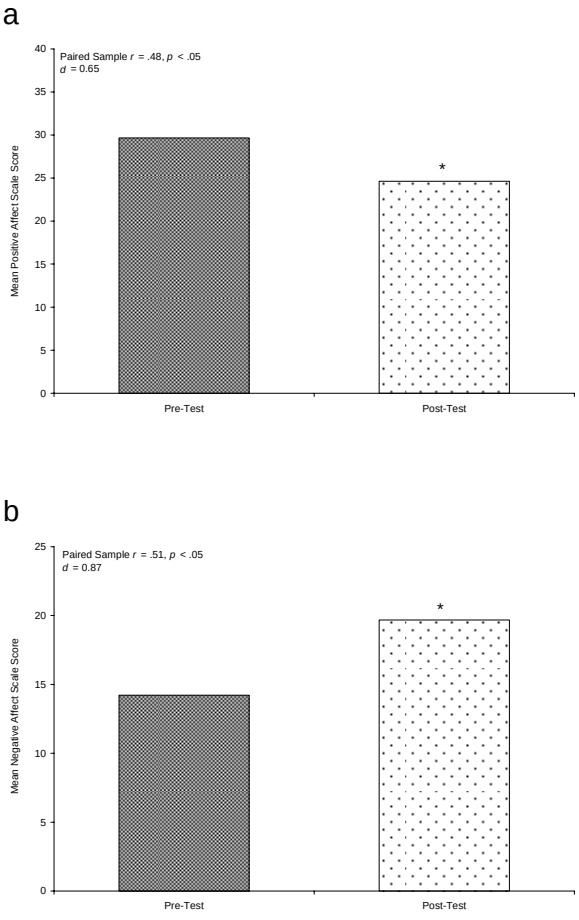
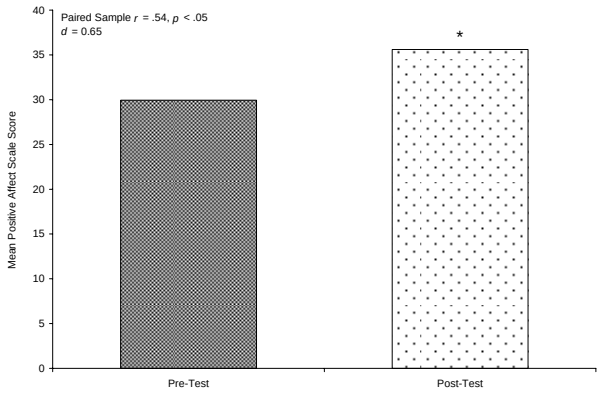


Fig. 1. The effects of the negative writing task on mean PANAS positive affect scale scores (panel A) and mean negative affect scale scores (panel B). * indicates a significant change compared to the pre-test mean score. All $p^s < .05$.

Participants in the negative writing task had no change in their salivary DHEA concentration. Consistent with this description, a paired-subjects t-test revealed a non-significant difference between pre- and post-test salivary DHEA concentration, $t(16) = 0.74$, $p = 0.47$. Similarly, participants in the positive writing task had a no change in their salivary DHEA concentration. Consistent with this description, a paired-subjects t-test revealed a non-significant difference between pre- and post-test salivary DHEA concentration, $t(18) = 0.05$, $p = 0.958$.

a



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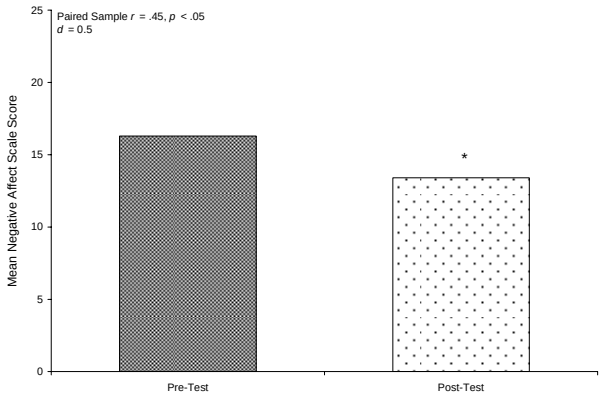

Fig. 2. The effects of the positive writing task on mean PANAS positive affect scale scores (panel A) and mean negative affect scale scores (panel B). * indicates a significant change compared to the pre-test mean score. All $p^s < .05$.

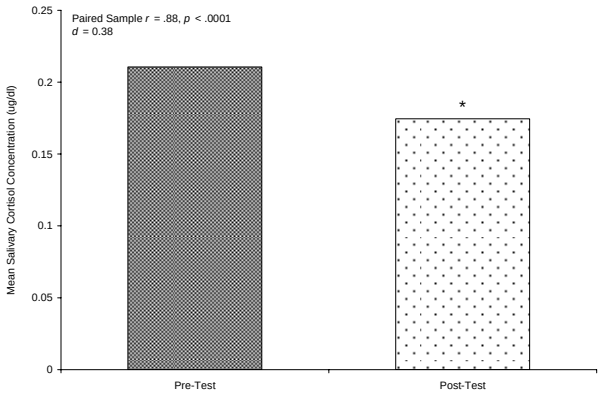

Fig. 3. The effects of the negative writing task on mean salivary cortisol concentration. * indicates a significant change compared to the pre-test mean score ($p < .025$).

DISCUSSION

The purpose of this experiment was to examine the biochemical profiles associated with changes in emotional states when using a mood induction writing task. Participants were assigned to one of two writing task groups (i.e., a positive group and a negative group) and changes in mood and salivary concentrations of cortisol, SIgA and DHEA were measured. Both writing task groups had robust changes in their mood. Specifically, participants in the negative mood induction task had a more negative mood at post-test and the participants in the positive mood induction task had a more positive mood at post-test. Measurement of salivary biochemicals revealed that the level of cortisol had decreased at post-test in the negative writing task group. None of the other analyses of interest showed any changes in either group.

These findings provide preliminary evidence that the mood induction writing task is biologically dissimilar from other more natural mood induction techniques. Instead, the mood induction writing task appears to more closely resemble expressive written therapy. Pennebaker and colleagues have repeatedly demonstrated that expressive written therapy produces positive health outcomes, including stress relief (Pennebaker, 1997), while often producing short-term negative effects on mood (e.g., Marlo & Wagner, 1999).

While most of the previous studies on writing therapy have investigated long-term therapeutic effects, one study directly investigated the effects of this therapeutic exercise on immediate physical arousal (Sloan & Marx, 2004). In that study, participants who wrote about a personal traumatic event showed an increased concentration of salivary cortisol following the first writing exercise. The difference between that finding and those of this study may point to key differences between expressive written therapy and the mood induction writing task. Most notably, writing therapy appears to use topics that are more specific and traumatic than the mood induction task. Thus, writing therapy may produce more immediate physiological arousal than the mood induction task, which could lead to differences in cortisol release. Participants in a mood induction writing task could potentially be less aroused and show immediate therapuetic-like effects. However, a direct comparison between the studies is difficult as differences in the saliva collection procedure could account for dissimilar outcomes.

While the current study provides an interesting biochemical profile of an experimental technique, future research will be necessary to further characterize its similarities and differences with expressive written therapy. In particular, it would be interesting to determine whether the physiological arousal that occurs after the initial writing therapy session declines over multiple sessions to resemble the findings of the current study. Further, future studies will need to further describe the biochemical profiles of the mood induction writing task at multiple time points. This would also allow for further comparisons to be made between this experimental task and writing therapy.

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REFERENCES

Ames, S. C., Patten, C. A., Offord, K. P., Pennebaker, J. W., Croghan, I. T., Tri, D. M., Stevens, S. R., & Hurt, R. D. (2005). Expressive writing intervention for young adult cigarette smokers. *Journal of Clinical Psychology, 61*, 1555-1570.

Ames, S. C., Patten, C. A., Werch, C. E., Schroeder, D. R., Stevens, S. R., Fredrickson, P. A., Echols, J. D., Pennebaker, J. W., & Hurt, R. D. (2007). Expressive writing as a smoking cessation treatment adjunct for young adult smokers. *Nicotine & Tobacco Research, 9*, 185-194.

Booth, A., Shelley, G., Mazur, A., Tharp, G., & Kittok, R. (1989). Testosterone, and winning and losing in human competition. *Hormones and Behavior, 23*, 556-571.

Baker, R. C., & Guttfreund, D. G. (1993). The effects of written autobiographical recollection induction procedures on mood. *Journal of Clinical Psychology, 49*, 563-568.

Chatterton, R. T., Vogelsong, K. M., Lu, Y. C., & Hudgens, G. A. (1997). Hormonal responses to psychological stress in men preparing for skydiving. *Journal of Clinical Endocrinology and Metabolism, 82*, 2503-2509.

Francis, M. E., & Pennebaker, J. W. (1992). Putting stress into words: The impact of writing on physiological, absentee, and self-reported emotional well-being measures. *American Journal of Health Promotion, 6*, 280-287.

Gillis, M. E., Lumley, M. A., Mosley-Williams, A., Leisen, J. C. C., & Roehrs, T. (2006). The health effects of at-home written emotional disclosure in fibromyalgia: A randomized trial. *Annals of Behavioral Medicine, 32*, 135-146.

Gortner, E., Rude, S. S., & Pennebaker, J. W. (2006). Benefits of expressive writing in lowering rumination and depressive symptoms. *Behavior Therapy, 37*, 292-303.

Harvey, A. G., & Farrell, C. (2003). The efficacy of a Pennebaker-like writing intervention for poor sleepers. *Behavioral Sleep Medicine, 1*, 115-124.

Lai, J. C. L., Evans, P. D., Ng, S. H., Chong, A. M. L., Siu, O. T., Chan, C. L. W., Ho, S. M. Y., Ho, R. T. H., Chan, P., & Chan, C. C. (2005). Optimism, positive affectivity, and salivary cortisol. *British Journal of Health Psychology, 10*, 467-484.

Marlo, H., & Wagner, M. K. (1999). Expression of negative and positive events through writing: Implications for psychotherapy and health. *Psychology & Health, 14*, 193-215.

Pennebaker, J. W. (1997). *Opening up: The healing power of expressing emotions* (revised edition). New York: Guilford Press.

Pennebaker, J.W. & Chung, C.K. (2007). Expressive writing, emotional upheavals, and health. In H. Friedman and R. Silver (Eds.), *Handbook of Health Psychology* (pp 263-284). New York: Oxford University Press.

Sloan, D. M., & Marx, B. P. (2004). A closer examination of the structured written disclosure procedure. *Journal of Consulting & Clinical Psychology, 72*, 165-175.

Smyth, J., Ockenfels, M. C., Porter, L., Kirschbaum, C., Hellhammer, D. H., & Stone, A. A. (1998). Stressors and mood measured on a momentary basis are associated with salivary cortisol secretion. *Psychoneuroendocrinology, 23*, 353-370.

Spera, S. P., Buhrfeind, E. D., & Pennebaker, J. W. (1994). Expressive writing and coping with job loss. *Academy of Management Journal, 37*, 722-733.

Stone, A. A., Cox, D. S., Valdimarsdottir, H., Jandorf, L., & Neale, J. M. (1987). Evidence that secretory IgA antibody is associated with daily mood. *Journal of Personality and Social Psychology, 52*, 988-993.

van Niekerk, J. K., Huppert, F. A., & Herbert, J. (2001). Salivary cortisol and DHEA: Association with measures of cognition and well-being in normal older men, and effects of three months of DHEA supplementation. *Psychoneuroendocrinology, 26*, 591-612.