Feel Free to Write This Down:

Writing About a Stressful Experience Does Not Impair Change Detection Task Performance

Supplemental Method

Complete Essay Prompts by Condition

Stressful writing. What follows is the entire essay prompt given to participants in the stressful writing condition:

> Please write an essay in the space provided below. Please remember, relive, and vividly recall a negative event that makes you feel extremely stressed out. Choose an event that has not been resolved and is still a source of stress for you. Please give as much detail as necessary to vividly describe the situation and why it stresses you out. You will have ten minutes to complete this task. You must write for the full ten minutes. The study will automatically continue when the ten minutes is over. Please begin.

Neutral writing. What follows is the entire essay prompt given to participants in the neutral writing condition:

> Please write an essay in the space provided below. Please remember, relive, and vividly recall all of the events that happened to you yesterday. Please describe any and all events regardless of whether they were routine or unusual. Please give as much detail as necessary to vividly describe the situation. You will have ten minutes to complete this task. You must write for the full ten minutes. The study will automatically continue when the ten minutes is over. Please begin.

Additional Analytic Method

Essay sentiment analysis. Essay sentiment (i.e., the how positive or negative the valence of the sentences used in the essay were) was calculated using the `sentimentr` package, version 2.2.3. This package accounts for negators and amplifiers in speech to ensure that valenced words modified by qualifiers are treated as such (e.g., “I’m not feeling good” is scored as negative in sentiment rather than positive). A random sample of ten essays from each condition—twenty

total—were manually inspected and used to modify sentiment analysis parameters to most accurately capture the sentiment of the selected essays.

Supplemental Results and Discussion

Change Detection Task Parameter Reliability

To assess reliability of the change detection parameter estimates, we examined split-half reliability. This analysis is somewhat problematic, because reliability of working memory estimates improves substantially from 90 trials (i.e., the number per half in these split-half analyses) to 180 trials (i.e., the total number of trials in the entire task) (Xu, Adam, Fang, & Vogel, 2018). Nonetheless, because participants did not complete the change detection task twice, these split-half reliability analyses were the best analyses to determine parameter estimate reliability. In these analyses, we found that Spearman-Brown corrected reliability estimates for capacity, attention, and guessing were, $r = .56$, $r = .63$, and, $r = .76$, respectively.

Manipulation Check: Essay Sentiment

We examined essay sentiment (i.e., the valence of the written words) to determine if participants in the stressful writing condition did, indeed, recount experiences more negative in valence than participants in the control condition. We found that participants in the stressful writing induction condition ($M = -0.11$, $SD = 0.01$) had essays with sentiment that was significantly more negative in valence than participants in the neutral writing condition ($M = 0.04$, $SD = 0.01$), $p < .0001$, $d = -1.33$. Therefore, participants in the stressful writing condition did, indeed, describe an event that was significantly more negative in valence than participants in the control condition.

Correlations Between Essay Sentiment, Changes in Negative Affect, and Working Memory

We also examined whether individual differences in essay sentiment predicted changes in negative affect, as well as whether essay sentiment or changes in negative affect predicted working memory performance. we found that essay sentiment was inversely associated with changes in negative affect, r = -.20, p = .009, such that as participants' essay sentiments became more negative, they showed a greater increase in negative affect from pre- to post-essay.

Importantly, individual differences in essay sentiment were unrelated to overall working memory performance, r = .06, p = .423, BF_{01} = 4.13, capacity, r = .12, p = .111, BF_{01} = 1.65 (note that this became r = .09, p = .240, BF_{01} = 2.87, when the two capacity outliers were excluded), attention, r = -.08, p = .318, BF_{01} = 3.48, or guessing, r = -.09, p = .252, BF_{01} = 2.99. Similarly, changes in negative affect from pre- to post-essay were unrelated to overall working memory performance, r = .04, p = .610, BF_{01} = 4.97, capacity, r = -0.01, p = .854, BF_{01} = 5.55 (note that this became r = .005, p = .949, BF_{01} = 5.59, when the two capacity outliers were excluded), attention, r = .08, p = .280, BF_{01} = 3.20, or guessing, r = .006, p = .943, BF_{01} = 5.62. Thus, individual differences in both the valence of the recalled experience and changes in negative affect from pre- to post-essay were unrelated to working memory.

Analyses Considering Computer Privacy

Due to seating differences between the four testing rooms used for this study, 39 out of the 85 participants in the stressful writing condition and 32 out of the 86 participants in the neutral writing condition were seated at computers that were not or may not have felt private (i.e., another participant could have seen the screen if the other participant looked around). Notably, however, the condition by computer privacy interactions for changes in negative affect (p = .711), essay sentiment (p = .400), and all working memory measures and parameter estimates (ps > .590).

To further ensure the privacy of the computer was not contributing to our results, we also re-ran all analyses using only participants who were seated at private computers. We found that, relative to participants in the neutral writing induction condition, participants in the stressful writing induction group continued to show significantly greater changes in negative affect, $p < .001$, $d = 0.86$, and significantly lower essay sentiment, $p < .001$, $d = -1.12$, but no differences in overall working memory performance (i.e., total hits – false alarms), capacity, attention, or guessing bias, ps > .744, ds < 0.07, BF_{01}s > 4.51. Therefore, these results were not affected by the privacy of the participants' computers.

Strength of the Manipulation

Astute readers will notice that scores on the PANAS negative affect scale only increased from approximately 1.66 to 2.07, which may seem like a small increase. It may be surprising to learn, however, that the gold-standard acute stress induction—the Trier Social Stress Test—usually produces an increase of between 0.1 and 0.5 (and most often, around 0.3) on the PANAS negative affect scale, and, notably, the stress group usually reports a negative affect score of around 1.9 immediately post-stressor (e.g., Brown, Weinstein, & Creswell, 2012; Schoofs, Preuß, & Wolf, 2008; Schoofs & Wolf, 2011; Smeets et al., 2012; Villada, Hidalgo, Almela, & Salvador, 2016; Wiemers, Schoofs, & Wolf, 2013). Note that Smeets et al. (2012) and Villada et al. (2016) used a sum rather than a mean, so their scores need to be divided by 10 (the number of negative affect items) to be comparable to our and these other studies' data. Therefore, our increase of 0.41, with a score of ~2.1 immediately post stressor, is certainly within the range of effects induced by the gold standard laboratory induction of stress. Therefore, our manipulation was strong enough to test our hypothesis.

Analyses Considering the Delay Between Manipulation and Change Detection

We conducted two analyses to determine if time played a role in our results. First, we examined change detection performance from the only first half of the task as a function of stress. Although 90 trials is not enough to reliably estimate parameters for capacity, attention, or guessing, analyses of overall task performance from the first 90 trials showed the virtually identical results to the main analyses. Namely, participants in the stressful writing condition (M = 26.25, SD = 0.90) did not differ in working memory performance from participants in the control condition (M = 26.97, SD = 0.74), $t(169) = -0.62$, $p = .538$, $d = -0.09$, with substantial evidence in favor of the null, $BF_{01} = 5.06$.

Second, we examined whether the association between trial number and the likelihood of making a correct response differed between the stressful writing and control conditions. This analysis can therefore show if participants in the stressful writing condition had poorer accuracy at the beginning of the task and normalized by the end of the task. We found that the slopes predicting the likelihood of making a correct response from trial number did not differ between the stressful writing (M_B = -0.0009, SD = 0.004) and control conditions (M_B = -0.0008, SD = 0.005), $t(169) = -0.04$, $p = .964$, $d = -0.007$, $BF_{01} = 6.04$. Therefore, performance over the task did not differ between the stressful writing and control conditions.

Supplemental References

Brown, K. W., Weinstein, N., & Creswell, J. D. (2012). Trait mindfulness modulates neuroendocrine and affective responses to social evaluative threat. *Psychoneuroendocrinology, 37,* 2037-2041.

Pabst, S., Brand, M., & Wolf, O. T. (2013). Stress and decision making: A few minutes make all the difference. *Behavioural Brain Research, 250,* 39-45.

Schoofs, D., Preuß, D., & Wolf, O. T. (2008). Psychosocial stress induces working memory impairments in an *n*-back paradigm. *Psychoneuroendocrinology, 33,* 643-653.

Schoofs, D., & Wolf, O. T. (2011). Are salivary gonadal steroid concentrations influenced by acute psychosocial stress? A study using the Trier Social Stress Test (TSST). *International Journal of Psychophysiology, 80,* 36-43.

Smeets, T., Cornelisse, S., Quaedflieg, C. W., Meyer, T., Jelicic, M., & Merckelbach, H. (2012). Introducing the Maastricht Acute Stress Test (MAST): A quick and non-invasive approach to elicit robust autonomic and glucocorticoid stress responses. *Psychoneuroendocrinology, 37,* 1998-2008.

Villada, C., Hidalgo, V., Almela, M., & Salvador, A. (2016). Individual differences in the psychobiological response to psychosocial stress (Trier Social Stress Test): The relevance of trait anxiety and coping styles. *Stress and Health, 32,* 90-99.

Wiemers, U. S., Schoofs, D., & Wolf, O. T. (2013). A friendly version of the Trier Social Stress Test does not activate the HPA axis in healthy men and women. *Stress, 16,* 254-260.

Xu, Z., Adam, K. C. S., Fang, X., & Vogel, E. K. (2018). The reliability and stability of visual working memory capacity. *Behavior Research Methods, 50,* 576-588.