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The Immunological Effects of Thought Suppression

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ABSTRACT

Individuals often suppress emotional thoughts, particularly thoughts that arouse negative emotions, as a way of regulating mood and reducing distress. However, recent work has highlighted the complexities and unexpected cognitive and physiological effects of thought suppression. In a study designed to examine the short-term immunological effects of thought suppression, participants wrote about either emotional or nonemotional topics with or without thought suppression. Blood was drawn before and after each experimental session on 3 consecutive days. Results showed a significant increase in circulating total lymphocytes and CD4 (helper) T lymphocyte levels in the emotional writing groups. Thought suppression resulted in a significant decrease in CD3 T lymphocyte levels. The implications of the results for the role of the expression and suppression of emotion in health are discussed.

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Suppression of emotional thoughts, particularly those thoughts that arouse negative emotions, is often invoked as a way of regulating mood and reducing distress. Emotional suppression has played an important role in psychosomatic models of disease, in which the active suppression of strong emotions has been proposed to increase susceptibility to illness (Schwartz, 1990). Reports from clinicians working with cancer patients and research studies suggest that a personal coping style that suppresses negative emotion may increase the risk of cancer (e.g., Gross, 1989 ; Kune, Kune, Watson, & Bahnson, 1991 ; Shaffer, Graves, Swank, & Pearson, 1987). The mechanisms by which suppression is associated with disease are far from clear, but a likely mechanism is via the immune system (Petrie, Booth, & Davison, 1995).

To date, there has been little experimental work examining the effect of suppression on immunity, but a number of recent studies have highlighted the complexities and unexpected physiological and cognitive effects of thought suppression. Research suggests that suppression of emotional thoughts magnifies the emotionality and accompanying physiological reaction of the suppressed thoughts (Wegner & Zanakos, 1994). Wegner, Shortt, Blake, and Page (1990) found that the suppression of exciting thoughts, specifically thoughts about sex, resulted in short-term increases in levels of sympathetic system arousal as measured by skin conductance. It seems that the process of suppression, perhaps because of the accompanying cognitive monitoring process, heightens the impact of any emotion attached to the thought.

Previous studies have also found that efforts to suppress target thoughts often result in a "rebound effect" in which the suppressed thought increases in frequency after the suppression period (e.g., Clark, Ball, & Pape, 1991 ; Wegner, Schneider, Carter, & White, 1987 ; Zeitlin, Netten, & Hodder, 1995). Moreover, when the target thought has emotional significance (e.g., a thought about a still-desired ex-lover), the rebound effect has been linked with increased physiological activity (Wegner & Gold, 1995).

In a study examining the physiological effects of suppressing emotions during emotional arousal, Gross and Levenson (1993) found reliable physiological differences between participants asked to suppress their emotional response to a disgust-inducing film and controls. Although suppression did not affect subjective emotional reports, it produced a mixed physiological state distinguished by increased skin conductance and decreased heart rate. In a more recent study, Gross and Levenson (1997) examined the responses of participants inhibiting emotions while watching sad, neutral, and amusing films and the responses of control participants who watched the films without suppressing. They found no physiological changes between the groups while watching the neutral film. However, suppression of both positive and negative emotions produced increased sympathetic activation of the cardiovascular system and other effects specific to the emotion being suppressed. Participants suppressing emotions while watching an amusing film exhibited less somatic activity and slower heart rates but no difference in skin conductance or respiratory activation; those watching the sad film also exhibited less somatic activity, but they evidenced higher levels of skin conductance and respiratory activation. Both of these studies raise the possibility that suppression, as well as affecting sympathetic and parasympathetic activity, may influence other areas of physiological functioning such as the immune system. This possibility was investigated in the present study.

To date, there is little direct experimental evidence on this issue, although there is some indication that circumstances or personality styles that inhibit the disclosure of stressful or traumatic experiences are associated with changes in immune function and an increased risk of poor health. After major stressful events, the vast majority of individuals experience intrusive thoughts about the episode (Tait & Silver, 1989) and feel a need to talk to others about their experience (Ersland, Weisaeth, & Sund, 1989 ; Rimé, 1995). A number of studies have found that poorer immunological function after stressful experiences is associated with lower levels of social or spousal support and, thus, restricted opportunities to talk with others (Glaser et al., 1993 ; Kennedy, Kiecolt-Glaser, & Glaser, 1988 ; Kiecolt-Glaser, Dura, Speicher, Trask, & Glaser, 1991). Furthermore, studies of victims of major life events that are difficult to confide to others, such as rape and sexual abuse, suggest that such individuals may be at greater risk of poor health (Golding, Stein, Siegel, Burnam, & Sorenson, 1988 ; Kimerling & Calhoun, 1994 ; Pennebaker & Susman, 1988).

As well as suppressing emotional thoughts because of the nature of the traumatic experience, individuals may also do so because of their usual coping style or personality. Here there is also some evidence to suggest that a personality style that consistently represses negative emotion is associated with differences in immune function consistent with poorer health outcomes. Studies have found individuals classified as repressors to have lower cell-mediated immune responses (Shea, Burton, & Girgis, 1993), decreased numbers of blood monocytes, and elevated eosinophil counts, serum glucose levels, and self-reported reactions to medication (Jamner, Schwartz, & Leigh, 1988). In two studies examining antibody titers in individuals with latent Epstein—Barr virus (EBV) infection, Esterling, Antoni, Kumar, and Schneiderman (1990, 1993) found repression of negative affect and defensiveness to be associated with higher serum EBV antibody titers, indicating poorer immunological control of the virus. Repression of negative emotion has also been associated with poorer natural killer (NK) cell activity (Levy, Herberman, Maluish, Schlien, & Lippman, 1985).

Although there is evidence that suppression of emotions and emotional thoughts leads to physiological and immunological changes, there are now a number of studies showing that the expression of emotions leads to immune changes associated with positive health outcomes. Emotional expression has been associated with reliable decreases in autonomic system activity (Pennebaker, 1993), elevations in NK cell activity (Futterman, Kemeny, Shapiro, Polonsky, & Fahey, 1992), and changes in blood lymphocyte reactivity to mitogens (Knapp et al., 1992).

Experimental studies have also assessed immunological changes in individuals randomly assigned to write or talk about emotional issues. Investigations have shown that, in comparison with controls, those in emotional disclosure groups have lower titers to EBV (Esterling, Antoni, Fletcher, Margulies, & Schneiderman, 1994), increased proliferative response capacity of blood T lymphocytes to phytohemagglutinin (PHA; Pennebaker, Kiecolt-Glaser, & Glaser, 1988), and greater development of antibodies to hepatitis B after vaccination (Petrie, Booth, Pennebaker, Davison, & Thomas, 1995). The limited data available on this issue suggest that emotional expression may have important links with the functioning of the immune system.

Evidence in this area to data points to the possibility of two different processes affecting immune functioning. The first is that simply attempting to suppress one's thoughts could be construed as a stressful activity, and acute stressors have been found to affect circulating lymphocyte numbers (Marsland et al., 1997) and activities (Herbert et al., 1994). The second possibility is that suppression of emotional and nonemotional thoughts, perhaps through differential effects on autonomic activity, could alter immune variables in different ways.

Recently, attention has been given to how the nature of an individual's writing may be related to health outcomes. A text analysis of six previous writing studies that included health outcomes as dependent variables showed that the use of more self-reflective and causal thinking from the first to the last day of writing was associated with greater health improvements, as assessed by lower symptom reports and fewer doctor visits (Pennebaker, Mayne, & Francis, 1997). It has been proposed that these changes may reflect more efficient cognitive processing of a trauma or may come about as the person integrates and makes a more coherent construction of the emotional components of the event.

In the present study, we sought to identify whether any short-term immunological effects are associated

with the suppression of emotional or control thoughts. In our previous work, we found changes in numbers of circulating lymphocytes but not other blood cells after emotional writing (Booth, Petrie, & Pennebaker, 1997). Circulating leukocyte populations change in response to acute stressors, characteristically with increases in total white blood cells, CD8 cells (cytotoxic—suppressor T lymphocytes), and CD56 cells (NK lymphocytes) but not CD4 (helper T lymphocytes) cells (Brosschot et al., 1994 ; Cacioppo et al., 1995 ; Herbert et al., 1994 ; Marsland et al., 1997). Interestingly, the changes we observed to be associated with emotional expression were typical of those associated with acute stressors, suggesting that aspects of emotional expression may have overridden acute stressor effects. Because of this, we were particularly interested in the influence of emotional expression and thought suppression on circulating lymphocyte populations. The experimental design of the study involved participants writing about emotional or control topics and, immediately after this writing period, suppressing or thinking about their topic. In this way, we were able to examine the effects of both emotional disclosure and thought suppression.

Method

Participants

Sixty-five 1st-year medical school students from the University of Auckland volunteered for the study. The sample comprised 47 women and 18 men with an average age of 19.66 years (*SD* = 2.67). There were 37 Caucasians, 24 Asians, and 4 Maori in the sample. The study was completed during winter in the middle of the medical school year, and participants received NZ$30 for taking part.

Procedure

Participants were randomly assigned to one of four experimental groups: emotional writing with or without thought suppression and control writing with or without thought suppression. After arrival at the lab, participants completed brief questionnaires and had blood (10 ml) collected by a trained hospital phlebotomist immediately before the 20-min experimental session. Directly after the session, another blood sample was taken. Blood was collected into ethylenediaminetetraacetic acid (EDTA; anticoagulant) tubes for immunological analysis. All participants completed the study writing at a personal computer in a private computer laboratory carrel. All writing was anonymous, and participants identified themselves by a four-digit alphanumeric code. This code was used as an identifier on all writing, blood tests, and questionnaires.

A computer program was written that gave participants instructions for their particular experimental group. Participants in the two emotional writing conditions were given instructions based on those outlined in previous writing studies (e.g., Pennebaker et al., 1988):

> For each of the three days of the study we want you to write about an emotional issue that is personally meaningful for you. The topic may be a traumatic experience in your life, a difficult or tragic emotional event, or an issue related to close interpersonal relationships, sex, death and so on. Ideally, this topic should be something you haven't talked about very much or at all with other people. The topic should be one that still bothers you at some level and that you still think about from time to time. The most important aspect is that the topic is personally meaningful for you.

Participants in the control writing conditions were instructed to write on their use of time over the

previous 24 hr. Their instructions included the following:

> The topic you will write about is what you did in the past 24 hours. In your writing we want you to write in a purely descriptive way about your day without the use of emotions. So you might describe what you did at lunchtime yesterday, then what you did in the afternoon and so forth. The most important aspect is that you write in a purely descriptive way without the use of emotions.

Participants in all groups wrote for 15 min at the same time of day for 3 consecutive days. At the end of the writing period, participants in the emotional and control thought-suppression groups were instructed as follows:

> For the next 5 minutes we want you to concentrate on putting any thoughts about what you have been writing completely out of your mind. What we want you to do is to concentrate on suppressing those thoughts and pushing them completely out of your mind. Try and do this without looking around the room but by closing your eyes and focusing totally on controlling these thoughts. Sometimes people find it difficult to block out thoughts. If at any time you think of any of the things you have been writing about, please press the space bar then carry on suppressing the thoughts and trying to put them out of your mind.

In the 5 min after the writing, participants in the no-suppression groups were asked to think about what they had just written:

> For the next 5 minutes we want you to sit and just allow your mind to think over the things that you've been writing about. You need do nothing else but sit and think about your writing. Try and do this without looking around the room but by closing your eyes and focusing on what you've written about.

Questionnaires.

Before beginning the study, participants completed a demographic and health behavior questionnaire asking them how often they had restricted their activity as a result of their health in the previous 2 months, their current alcohol consumption, hours of sleep per night, and how often they had engaged in strenuous exercise each week.

Participants completed the Profile of Mood States (McNair, Lorr, & Droppleman, 1971) before the experimental session each day. Participants were asked to describe their mood "right now" using 65 descriptors on 5-point Likert scales ranging from *not at all* (0) to *very much* (4). Items were summed to form six mood scales: tension, depression, anger, vigor, fatigue, and confusion.

Eight weeks after completion of the study, participants were sent a follow-up questionnaire. This questionnaire, completed and returned by 61 of the 65 participants (94%), contained the same health behavior questions as the initial questionnaire. It also asked participants to rate the following item on a 7-point scale ranging from *not at all* (1) to *a great deal* (7): "Since completing the study how much have you thought about what you wrote and how much have you talked to other people about what you wrote?" Participants also rated the degree to which the study had positive effects and negative effects, as well as how happy and sad they had felt since the study finished and how valuable or meaningful the study had been for them.

Content analysis of writing.

Text analysis was carried out with the second version of Linguistic Inquiry and Word Count (LIWC; Pennebaker & Francis, 1996), a text analysis program. As with the first version of LIWC, the program analyzes text on a word-by-word basis and categorizes words into multiple psychologically relevant high-level categories (Pennebaker & Francis, 1996 ; Pennebaker et al., 1997). Although the more than 2,100 words and word stems in the dictionaries are able to measure 72 different linguistic dimensions, we focus here on 4 that have been discussed in previous writing studies: positive emotions (e.g., happy, good, and love), negative emotions (e.g., guilt, sad, and hate), insight (e.g., realize, understand, and know), and causation (e.g., cause, because, and reason). In addition, we examined self-discrepancy word use (e.g., would, could, and ought), which has recently been implicated in health outcomes (Higgins, Vookles, & Tykocinski, 1992), as well as a general cognitive process category made up of words from each of the insight, cause, and self-discrepancy subcategories together with other general cognitive words that connote thinking (see Pennebaker & Francis, 1996 , for details).

Blood samples and hematological and lymphocyte surface markers.

Blood (10 ml) was drawn into heparinized tubes immediately before and immediately after each writing session. Standard hematological markers relating to white blood cells, red blood cells, and platelets, together with white blood cell differential counts, were determined with a Bayer Technicon H1 hematology analyzer (Bayer Corporation, Pittsburgh, PA). Proportions of mononuclear cells in the blood bearing the markers CD3 (T lymphocytes), CD4 (T helper lymphocytes), CD8 (T cytotoxic—suppressor lymphocytes), and CD16/56 (NK cells) were determined using flow cytometry in a Becton Dickinson FACScan cell analyzer with Becton Dickinson Simultest fluorescent antibody reagents (Becton Dickinson and Company, Franklin Lakes, NJ). Absolute numbers of CD3, CD4, CD8, and NK cells were calculated by means of these proportions and lymphocyte concentrations from the hematological screen.

Results

The results fall into four broad categories. The first focuses on the nature of the writing and suppression task itself. The second deals with the impact of the manipulations on the primary immune outcome measures. The third class of results includes long-term measures of health and adjustment. Finally, we focus on possible psychological processes implicated in the links among emotion, suppression, and immunity.

Nature of Writing and Suppression

Individuals were randomly assigned to write about either traumatic or control topics for 3 consecutive days. As in previous studies, the participants in the trauma conditions wrote about a wide range of objectively distressing events. Overall, 34% wrote about problems in close personal relationships, 16% wrote about family difficulties, 12% wrote about sexual issues, 11% wrote about the death of someone close, and 17% wrote about other miscellaneous topics. The Profile of Mood States was administered to participants daily before they began writing. A series of 2 (emotion vs. nonemotion writing) × 2 (suppression vs. no suppression) × 3 (day) between-subjects—within-subject repeated measures analyses of variance (ANOVAs) were computed on the subscales. The only scale to yield significant effects was self-ratings of tension. Specifically, those in the emotion writing conditions reported higher levels of tension than those in the control cells, F (1, 57) = 3.75, p = .058 (emotion group mean: 8.43; control mean: 6.17). In addition, there was a significant Suppression × Day interaction, F (2, 114) = 4.75, p = .01, such that those in the suppression cells maintained stable levels of tension across the 3 days

(suppression means: 7.20, 6.61, and 6.97), whereas those in the no-suppression conditions showed drops in self-reported tension across the 3 writing days (no suppression means: 10.21, 5.86, and 7.09).

Each writing sample was separately analyzed using the LIWC text analysis program. On the basis of previous writing studies, only five text dimensions were examined in the present experiment: percentage of total words categorized as (a) negative emotion, (b) positive emotion, (c) overall cognitive processes, (d) insight, and (e) causal. Note that the cognitive processes dimension was a general cognitive category attempting to assess the degree to which participants were actively thinking. This dimension included words in both the insight and causal word categories as well as words that tapped self-discrepancies (e.g., would, should, and could), markers of tentative thinking (perhaps and guess), and certainty (unquestionably and always). Averaging across the 3 days of writing, individuals in the emotion conditions used significantly more negative, F (1, 61) = 111.24, $p < .01$, and positive, F (1, 61) = 55.68, $p < .01$, emotion words than those in the control conditions (see Table 1). No interactions with day or the suppression manipulation emerged for the negative or positive emotion words. Cognitive word analyses indicated that emotion participants, in comparison with control participants, used more cognitive process words in general, F (1, 61) = 204.74, $p < .01$, as well as more insight, F (1, 61) = 123.99, $p < .01$; causal, F (1, 61) = 41.3, $p < .01$; and self-discrepancy words, F (1, 61) = 142.8, $p < .01$. Three intriguing interactions also emerged. First, as can be seen in Table 1 , a marginal Emotion × Suppression interaction was obtained for the use of insight words, F (1, 61) = 3.37, $p = .07$. In addition, significant Emotion × Suppression × Day interactions emerged for self-discrepancy words, F (2, 122) = 3.87, $p = .02$, and overall cognitive processes, F (2, 122) = 2.76, $p = .06$. Although not significant, similar interactions emerged in the same direction for causal words ($p = .10$) and insight words ($p = .18$). The patterns of these effects were all in the same direction, and they are depicted in Figure 1 using the overall cognitive processes dimension. As can be seen, no-suppression participants writing about emotional topics demonstrated an overall drop in cognitive processes over time, whereas those in the suppression cells were increasing in terms of their use of these words over time.

Recall that participants in the suppression conditions were asked to press the space bar on their keyboards during the suppression phase whenever they became aware of the target thoughts related to their writing. As can be seen in Figure 2 , the pattern of thought suppression failure differed as a function of condition. Overall, participants in the emotion condition had more difficulty suppressing thoughts than those in the control cells, F (1, 32) = 4.28, $p = .047$. Interestingly, a trend emerged suggesting that control participants improved in their abilities to suppress over the course of the study in comparison with the emotion participants, F (2, 64) = 2.66, $p = .078$.

Immunological Markers

Immunological measures were assayed from the blood samples drawn before and again after the writing and suppression—no suppression sessions each day. Preliminary analyses on each of the assays indicated no significant interactions between day and condition. Consequently, scores for each measure were averaged across days, yielding mean presession and postsession values. To simplify the data, we ran multiple regressions on each assay using the postmeasure as the criterion and the premeasure as the predictor. The residual adjusted scores, then, served as the dependent measures for the immunological markers. An initial overall 2 (emotion) × 2 (suppression) multivariate analysis of variance was computed on the eight adjusted immune markers collected for the study. A significant marker effect emerged, F (7, 427) = 4,616.32, $p < .01$, as well as significant Emotion × Marker, F (7, 427) = 1.98, $p = .055$, and Suppression × Marker, F (7, 427) = 4.14, $p < .01$, interactions. To evaluate these patterns, we conducted

separate ANOVAs on each marker.

Recall that the primary focus of the study centered around changes in circulating lymphocyte counts following the writing sessions, after control for prewriting levels. Whereas total lymphocytes refers to the general count of circulating white blood cells, the most commonly studied subpopulations of lymphocytes include CD3 (a general lymphocyte measure), CD4 (T helper cells), CD8 (T suppressor), and CD16 (NK cells). As shown in Table 2 , a 2 (emotion) × 2 (suppression) ANOVA on the adjusted lymphocyte measures yielded a significant emotion effect, F (1, 61) = 4.77, p = .03, and a marginal suppression condition effect, F (1, 61) = 3.21, p = .078. Thus, writing about emotional topics and not having to suppress the writing topic were associated with higher total lymphocyte counts.

The counts of each class of lymphocyte were affected by the manipulations, albeit in somewhat different ways (see Table 2). Consistent with the T suppressor pattern, analyses of CD3 lymphocytes revealed a significant main effect for the suppression condition, F (1, 61) = 5.11, p = .027, but no emotion main effect (p = .16). CD4 levels after the manipulations were elevated in the two emotion conditions relative to the controls, F (1, 61) = 3.77, p = .057. No other CD4 effects approached significance. CD8 levels, on the other hand, tended to be lower in the suppression conditions, as evidenced by a marginal suppression main effect, F (1, 61) = 3.65, p = .10. The emotion main effect did not attain significance (p = .17). Finally, analyses of CD16 levels indicated that the patterns of means were in the same directions as for the total lymphocytes, although neither the emotion (p = .16) nor suppression (p = .19) main effect attained significance. In none of the preceding analyses did the Emotion × Suppression interaction approach significance. In addition, we explored sex differences by adding this variable separately. Although the cell sizes were uneven, no consistent sex effects or interactions emerged for immune, language, or self-report data.

Longer Term Study Effects

Participants completed a postexperimental questionnaire 8 weeks after the writing phase of the study and before debriefing. Using a 7-point scale ranging from *not at all* (1) to *a great deal* (7), individuals responded to a series of questions about the long-term effects of the study. As can be seen in Table 1 , participants in the emotion condition reported that the experiment was more valuable and meaningful than did control participants, F (1, 57) = 6.80, p = .01. Emotion-group participants also reported that they had thought about, F (1, 57) = 33.72, p < .01, and talked about, F (1, 57) = 4.91, p = .03, the experiment more than the control group. In addition, the emotion participants were more likely to endorse the item "Looking back on the study, to what degree do you feel it has had positive effects on you?" than controls, F (1, 57) = 14.63, p < .01. Somewhat unexpectedly, an Emotion × Suppression interaction emerged on the responses to the item assessing the degree to which participants had felt happy since the study, F (1, 57) = 5.67, p = .01, such that emotion—no-suppression and control—suppression participants reported greater happiness. No main effects or interactions attained significance in terms of questions assessing negative effects of the study or feelings of sadness or depression since the study.

Other Relevant Data

As noted earlier, previous studies have found a particular "linguistic fingerprint" to be associated with long-term improved health among people writing about emotional topics. Specifically, Pennebaker et al. (1997) reported that an increasing use of cognitive words over 3 days of writing (specifically, insight and causal words) and a relatively high rate of positive emotion words to negative emotion words were optimally linked to long-term health. Through the algorithm from the Pennebaker et al. study, changes in

insight and causal words from the first to last day of writing were standardized within condition and then summed, yielding an overall cognitive change measure. Similarly, the mean rates of positive and emotion words across the 3 days of writing were standardized and then subtracted (positive minus negative emotion word use). These two word use scores, cognitive change and relative positive emotion word use, were then correlated with mean standardized lymphocyte counts as well as long-term self-reports separately by condition. As can be seen in Table 3 , strikingly different patterns emerged.

Consistent with effects reported by both Pennebaker et al. (1997) and Pennebaker and Francis (1996) , an increasing rate in the use of cognitive words and higher rates of positive emotion words were generally positively correlated with the various measures of lymphocyte counts as well as selected long-term self-reports. In contrast, participants in the emotional suppression condition generally showed opposite patterns. That is, higher positive emotion words and increased cognitive words tended to be linked to poorer long-term measures. Although less clear cut, similar effects appeared to be at work in the two control conditions.

Discussion

The results of this study suggest that the act of thought suppression produced measurable effects on circulating immune variables independent of whether the thoughts suppressed were of an emotional or control nature. Suppression caused a significant decrease in circulating T lymphocytes (CD3) as well as marginal decreases in CD8 (T suppressor) cells and total lymphocyte numbers. Emotional writing, on the other hand, increased the levels of circulating CD4 (T helper) cells and the number of total lymphocytes. No significant differences were observed in CD16 NK cells or other blood markers.

We found that difficulty in suppressing thoughts differed by condition, with participants in the emotion condition having more difficulty suppressing thoughts related to personal emotional issues than participants suppressing thoughts about what they had done over the previous 24 hr. This finding is similar to that of Wegner and Gold (1995) but contrasts with the findings of Kelly and Kahn (1994) . Consistent with this result, subjective reports after the experiment indicated that participants in the emotional writing groups thought about and talked to others about what they had written more than controls. These participants also saw the study as more meaningful and having more positive effects than did those in the control groups. These aspects are consistent with results from previous writing studies (e.g., Booth et al., 1997 ; Petrie et al., 1995).

The finding that suppression of thoughts leads to a reduction in certain circulating lymphocyte populations is intriguing and worthy of further investigation. It is consistent with earlier work showing that suppression is associated with a significant increase in sympathetic nervous system activation (Gross & Levenson, 1993, 1997 ; Wegner et al., 1990). The circulating pool of lymphocytes constitutes approximately 10% of the total number of lymphocytes in the body. Mobilization of lymphocytes into and out of the peripheral circulation can be quite rapid and is affected by a variety of physiological factors, such as blood pressure, vascular endothelial changes, hemoconcentration, neuroendocrine hormones, and autonomic nervous system activity. The effects of acute stressors on circulating lymphocyte populations have been well studied, and the accumulated evidence suggests that total white blood cells, CD8 T cells, and CD56 (NK) cells increase in response to acute stress (Brosschot et al., 1994 ; Cacioppo et al., 1995 ; Herbert et al., 1994 ; Marsland et al., 1997), whereas CD4 T cells and B cells remain unchanged (Marsland et al., 1997) or decrease (Mills, Dimsdale, Nelesen, & Dillon, 1996

). These effects have been attributed in part to elevated catecholamine levels (Cacioppo et al., 1995), cardiovascular changes (Herbert et al., 1994), changes in plasma concentration (Marsland et al., 1997), and sympathetic activation (Cacioppo et al., 1995 ; Herbert et al., 1994). Although we did not include measurements of neuroendocrine, autonomic, or hemodynamic stress reactivity in this investigation, our circulating lymphocyte measurements indicate that the short-term effects of emotional expression and of thought suppression cannot be attributed solely to classical stress reactivity effects. Moreover, they raise the possibility that suppression over a longer term may cause changes in immune function that could compromise health. This issue is clearly worthy of exploration in future studies.

In this study, the immune effects of suppression were independent of whether the participants were suppressing emotional or control thoughts. However, the distinction between emotional and neutral topics may have less relevance than might be first thought. In day-to-day experience, the goal of thought suppression is usually to regulate emotional responses so that upsetting thoughts do not dominate and interfere with everyday function and activity. Normally, one seldom needs to suppress thoughts that do not arouse strong emotional reactions, because such thoughts do not typically return or demand further attention. Individuals can be required to suppress daily events in an experimental setting, but this artificially constructed situation would not occur normally. The fact that thought suppression has immune consequences is most relevant to emotional thoughts, because it is this activity that thought suppression is used most frequently to regulate.

Data from this study point to the fact that the processes of emotional disclosure and suppression do not appear to have directly opposing effects on immune measures over the short term but, rather, may affect aspects of the circulating lymphoid pool. In this study, emotional disclosure, as opposed to control writing, influenced total circulating lymphocyte numbers (mostly T and B lymphocytes), whereas suppression mostly affected T lymphocyte counts. As discussed earlier, these effects cannot be explained solely in terms of stress reactivity. Although it is difficult to relate short-term changes, in terms of minutes, to longer term effects over weeks or months, we have consistently found the CD4 and CD8 circulating T lymphocyte populations to be most often affected by emotional disclosure (Booth et al., 1997 ; Petrie et al., 1995). Clearly, measures of T lymphocyte functional activity warrant further investigation in terms of the capacity to produce both helper and cytotoxic immune activities in response to an antigenic stimulus.

Previous writing studies have found the increased use of causal and insight words to be associated with markers of improved health (Pennebaker & Francis, 1996 ; Pennebaker et al., 1997). It has been proposed that changes in these word categories reflect greater cognitive integration of the emotional issue as the person processing the event gains perspective on the experience through his or her writing. The correlations between cognitive word use and both the immune measures and the long-term self-reports bolster this argument. Specifically, those individuals in the emotion—no-suppression condition replicated previous studies, suggesting that constructing a story over time with an increasing rate of cognitive words within an overall positive emotional state may be associated with improved health outcomes. Interestingly, the suppression manipulation brought about very different cognitive and, perhaps, emotional dynamics. For participants in the emotional suppression condition, the suppression period resulted in an increased use of cognitive words over the course of the study. This may indicate that the suppression period interfered with the natural processing of the issue participants were writing about after the session. Moreover, the pattern of correlations in Table 3 suggests that the suppression period disrupted the relationship between cognitive writing and immune changes and thus may have

interfered with changes brought about naturally when emotional topics are aired and processed.

Previous research has demonstrated that thought suppression, particularly of emotional topics, has a number of accompanying effects. These effects include physiological changes while the individual is suppressing the emotional thought (Gross & Levenson, 1997 ; Wegner et al., 1990) and thought rebound after the suppression period (Wegner et al., 1987). The current study extends these findings and suggests that thought suppression also may have distinctive effects on the immune system. Our results indicate the need for further work to examine the cumulative effects of suppression on immunity over longer time periods and the effect of suppression on functional immune activity.

References

Booth, R. J., Petrie, K. J. & Pennebaker, J. W. (1997). Changes in circulating lymphocyte numbers following emotional disclosure: Evidence of buffering?(*Stress Medicine, 13,* 23—29.)

Brosschot, J. F., Benschop, R. J., Godaert, G. L., Olff, M., De Smet, M., Heijnen, C. J. & Ballieux, R. E. (1994). Influence of life stress on immunological reactivity to mild psychological stress.(*Psychosomatic Medicine, 56,* 216—224.)

Cacioppo, J. T., Malarkey, W. B., Kiecolt-Glaser, J. K., Uchino, B. N., Sgoutas Emch, S. A., Sheridan, J. F., Berntson, G. G. & Glaser, R. (1995). Heterogeneity in neuroendocrine and immune responses to brief psychological stressors as a function of autonomic cardiac activation.(*Psychosomatic Medicine, 57,* 154—164.)

Clark, D. M., Ball, S. & Pape, D. (1991). An experimental investigation of thought suppression.(*Behaviour Research and Therapy, 29,* 253—257.)

Ersland, S., Weisaeth, L. & Sund, A. (1989). The stress upon rescuers involved in an oil rig disaster: "Alexander Kielland"–1980.(*Acta Psychiatrica Scandinavica, 80,* 38—49.)

Esterling, B. A., Antoni, M. H., Fletcher, M. A., Margulies, S. & Schneiderman, N. (1994). Emotional disclosure through writing or speaking modulates latent Epstein-Barr virus antibody titers.(*Journal of Consulting and Clinical Psychology, 62,* 130—140.)

Esterling, B. A., Antoni, M. H., Kumar, M. & Schneiderman, N. (1990). Emotional depression, stress disclosure responses, and Epstein-Barr viral capsid antigen titers.(*Psychosomatic Medicine, 52,* 397—410.)

Esterling, B. A., Antoni, M. H., Kumar, M. & Schneiderman, N. (1993). Defensiveness, trait anxiety, and Epstein-Barr viral capsid antigen antibody titers in healthy college students.(*Health Psychology, 12,* 132—139.)

Futterman, A. D., Kemeny, M. E., Shapiro, D., Polonsky, W. & Fahey, J. L. (1992). Immunological variability associated with experimentally-induced positive and negative affective states.(*Psychological Medicine, 22,* 231—238.)

Glaser, R., Pearson, G. R., Bonneau, R. H., Esterling, B. A., Atkinson, C. & Kiecolt-Glaser, J. K. (1993). Stress and the memory T-cell response to the Epstein-Barr virus in healthy medical students.(*Health Psychology, 12,* 435—442.)

Golding, J. M., Stein, J. A., Siegel, J. M., Burnam, M. A. & Sorenson, S. B. (1988). Sexual assault history and the use of health and mental health services.(*American Journal of Community Psychology, 16,* 625—644.)

Gross, J. (1989). Emotional expression in cancer onset and progression.(*Social Science and Medicine, 28,* 1239—1248.)

Gross, J. & Levenson, R. W. (1993). Emotional suppression: Physiology, self-report, and expressive behavior.(*Journal of Personality and Social Psychology, 64,* 970—986.)
Gross, J. & Levenson, R. W. (1997). Hiding feelings: The acute effects of inhibiting negative and positive emotion.(*Journal of Abnormal Psychology, 106,* 95—103.)
Herbert, T. B., Cohen, S., Marsland, A. L., Bachen, E. A., Rabin, B. S., Muldoon, M. F. & Manuck, S. B. (1994). Cardiovascular reactivity and the course of immune response to an acute psychological stressor.(*Psychosomatic Medicine, 56,* 337—344.)
Higgins, E. T., Vookles, J. & Tykocinski, O. (1992). Self and health: How "patterns" of self-beliefs predict types of emotional and physical problems.(*Social Cognition, 10,* 125—150.)
Jamner, L. D., Schwartz, G. E. & Leigh, H. (1988). The relationship between repressive and defensive coping styles and monocyte, eosinophile, and serum glucose levels: Support for the opioid peptide hypothesis of repression.(*Psychosomatic Medicine, 50,* 567—575.)
Kelly, A. E. & Kahn, J. H. (1994). Effects of suppression of personal intrusive thoughts.(*Journal of Personality and Social Psychology, 66,* 998—1006.)
Kennedy, S., Kiecolt-Glaser, J. K. & Glaser, R. (1988). Immunological consequences of acute and chronic stressors: Mediating role of interpersonal relationships.(*British Journal of Medical Psychology, 61,* 77—85.)
Kiecolt-Glaser, J. K., Dura, J. R., Speicher, C. E., Trask, O. J. & Glaser, R. (1991). Spousal caregivers of dementia victims: Longitudinal changes in immunity and health.(*Psychosomatic Medicine, 55,* 395—409.)
Kimerling, R. & Calhoun, K. S. (1994). Somatic symptoms, social support and treatment seeking among sexual assault victims.(*Journal of Consulting and Clinical Psychology, 63,* 333—340.)
Knapp, P. H., Levy, E. M., Giorgi, R. G., Black, P. H., Fox, B. H. & Heeren, T. C. (1992). Short-term immunological effects of induced emotion.(*Psychosomatic Medicine, 54,* 133—148.)
Kune, G. A., Kune, S., Watson, L. F. & Bahnson, C. B. (1991). Personality as a risk factor in large bowel cancer: Data from the Melbourne Colorectal Cancer Study.(*Psychological Medicine, 21,* 29—41.)
Levy, S. M., Herberman, R. B., Maluish, A. M., Schlien, B. & Lippman, M. (1985). Prognostic risk assessment in primary breast cancer by behavioral and immunological parameters.(*Health Psychology, 4,* 99—113.)
Marsland, A. L., Herbert, T. B., Muldoon, M. F., Bachen, E. A., Patterson, S., Cohen, S., Rabin, B. & Manuck, S. B. (1997). Lymphocyte subset redistribution during acute laboratory stress in young adults–Mediating effects of hemoconcentration.(*Health Psychology, 16,* 341—348.)
McNair, D., Lorr, M. & Droppleman, L. (1971). *Profile of mood states.* (San Diego, CA: EDITS)
Mills, P. J., Dimsdale, J. E., Nelesen, R. A. & Dillon, E. (1996). Psychologic characteristics associated with acute stressor-induced leukocyte subset redistribution.(*Journal of Psychosomatic Research, 40,* 417—423.)
Pennebaker, J. W. (1993). Social mechanisms of constraint.(In D. M. Wegner & J. W. Pennebaker (Eds.), *Handbook of mental control* (pp. 200—219). Englewood Cliffs, NJ: Prentice Hall.)
Pennebaker, J. W. & Francis, M. E. (1996). Cognitive, emotional, and language processes in disclosure.(*Cognition and Emotion, 10,* 601—626.)
Pennebaker, J. W., Kiecolt-Glaser, J. K. & Glaser, R. (1988). Disclosure of trauma and immune function: Health implications for psychotherapy.(*Journal of Consulting and Clinical Psychology, 56,* 239—245.)
Pennebaker, J. W., Mayne, T. J. & Francis, M. E. (1997). Linguistic predictors of adaptive bereavement.(*Journal of Personality and Social Psychology, 72,* 863—871.)
Pennebaker, J. W. & Susman, J. R. (1988). Disclosure of trauma and psychosomatic processes.(*Social Science and Medicine, 26,* 327—332.)

Petrie, K. J., Booth, R. J. & Davison, K. P. (1995). Repression, disclosure, and immune function: Recent findings and methodological issues.(In J. W. Pennebaker (Ed.), *Emotion, disclosure, and health* (pp. 223—237). Washington, DC: American Psychological Association.)
Petrie, K. J., Booth, R. J., Pennebaker, J. W., Davison, K. P. & Thomas, M. G. (1995). Disclosure of trauma and immune response to a hepatitis vaccination program.(*Journal of Consulting and Clinical Psychology, 63,* 787—792.)
Rimé, B. (1995). Mental rumination, social sharing and recovery from emotional exposure.(In J. W. Pennebaker (Ed.), *Emotion, disclosure, and health* (pp. 271—291). Washington, DC: American Psychological Association.)
Schwartz, G. E. (1990). Psychobiology of repression and health: A systems approach.(In J. L. Singer (Ed.), *Repression and dissociation* (pp. 405—434). Chicago: University of Chicago Press.)
Shaffer, J. W., Graves, P. L., Swank, R. T. & Pearson, T. A. (1987). Clustering of personality in youth and the subsequent development of cancer among physicians.(*Journal of Behavioral Medicine, 10,* 441—447.)
Shea, J. D., Burton, R. & Girgis, A. (1993). Negative affect, absorption, and immunity.(*Physiological Behavior, 53,* 449—457.)
Tait, R. & Silver, R. C. (1989). Coming to terms with major negative life events.(In J. S. Uleman & J. A. Bargh (Eds.), *Unintended thoughts* (pp. 351—382). New York: Guilford Press.)
Wegner, D. M. & Gold, D. B. (1995). Fanning old flames: Emotional and cognitive effects of suppressing thoughts of a past relationship.(*Journal of Personality and Social Psychology, 68,* 782—792.)
Wegner, D. M., Schneider, D. J., Carter, S. R. & White, T. L. (1987). Paradoxical effects of thought suppression.(*Journal of Personality and Social Psychology, 53,* 5—13.)
Wegner, D. M., Shortt, J. W., Blake, A. W. & Page, M. S. (1990). The suppression of exciting thoughts.(*Journal of Personality and Social Psychology, 58,* 409—418.)
Wegner, D. M. & Zanakos, S. (1994). Chronic thought suppression.(*Journal of Personality, 62,* 615—640.)
Zeitlin, S. B., Netten, K. A. & Hodder, S. L. (1995). Thought suppression: An experimental investigation of spider phobics.(*Behaviour Research and Therapy, 33,* 407—413.)

Figure 1. Mean Linguistic Inquiry and Word Count (LIWC) cognitive words across days by experimental group.

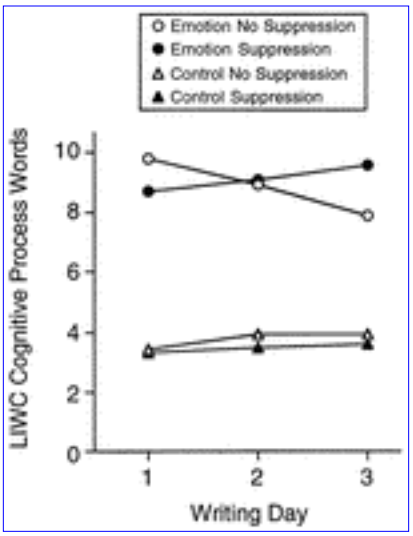


Figure 2. Failures in the suppression phase in emotional and control suppression groups.

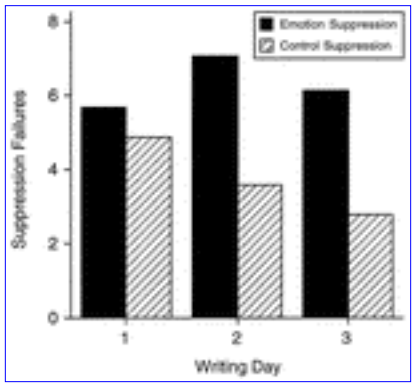
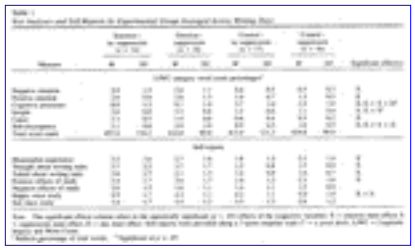


Table 1.



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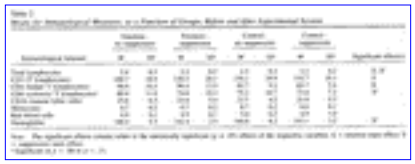
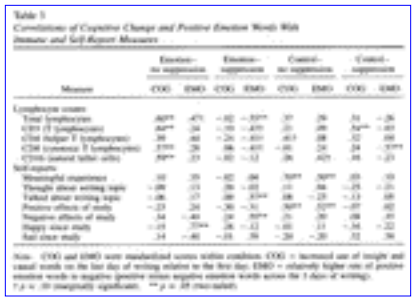
Table 3.