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CHANGES IN COGNITIVE COPING STRATEGIES PREDICT EBV-ANTIBODY TITRE CHANGE FOLLOWING A STRESSOR DISCLOSURE INDUCTION

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Abstract—Previous research has shown that emotional disclosure of traumatic or stressful events is associated with facilitating insight into the experience, improving mood, and modulating some aspects of the immune system. The current study examined how cognitive changes and experiential involvement during an emotional disclosure induction protocol relate to immune functioning, as measured by IgG antibody titres to the Epstein-Barr virus viral capsid antigen (EBV-VCA). Seventy-six college undergraduates were randomly assigned to either a disclosure induction or an assessment-only control condition. Experimental subjects met with an experimenter for three weekly 20-min individual sessions during which time they were asked to discuss a stressful or traumatic topic which they had previously discussed only minimally with others. Blood was drawn a week prior to the first session and at one week following the third session. Subjects completed the Impact of Event Scale (IES) after session 1 and at followup, and the extent of experiential involvement in disclosure during each session was assessed by means of the Experiencing Scale. Mood was assessed before and after each disclosure using the Nowlis Mood Adjective Checklist. Although the disclosure induction did not directly affect EBV-VCA antibody titres, individual differences in subjects' ability to involve themselves in the disclosure process and abandon their avoidance of the stressful topic during the course of the 3-wk period were predictive of antibody decrements. These associations were more pronounced for individuals who disclosed older and more troublesome events.

INTRODUCTION

How INDIVIDUALS cope with traumatic and highly stressful experiences has been shown to be an important factor in their subsequent psychological and physical well-being [1–4]. A number of recent studies showed that failure to express one's thoughts and feelings surrounding deeply stressful childhood experiences such as sexual abuse, death of a parent, etc. is associated with increased incidence of health problems later in life, which is compounded for individuals who had not confided in others about the event [4, 5]. Experimentally manipulated disclosure—having college undergraduates write about traumas or other stressful situations—in some studies has led to a significant drop in health center visits for illness over a subsequent 4–6 month period [6, 7]. Extent of disclosure among thirty-three Holocaust survivors concerning their experiences during the Second World War was related to less physician visits for health problems over a year later, even after controlling for pre-interview health problems [8].

Failure to express one's thoughts and feelings about a stressful situation can be

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viewed as a form of inhibition which is putatively related to some physiological changes. Physiological 'arousal' markers thought to be implicated in a connection between emotional inhibition and health variables include increased skin conductance, respiration rate, and heart rate, all of which have also been associated with behavioral inhibition [9–11]. Not only emotions, but stressor-associated cognitions as well, have been associated with changes in heart rate, blood pressure, galvanic skin response, respiration, eye movement, and muscle tone [12–26]. Unresolved stressful events and grieving are associated with a resurgence of traumatic imagery [2], physiological arousal and/or health problems years after the event [13, 17–19]. Thus incomplete cognitive assimilation as well as behavioral inhibition are implicated in the long-term physiological problems associated with trauma and lack of its disclosure to others [4, 17, 20].

Written or verbal expression of feelings regarding a traumatic experience has been shown to allow an individual to ventilate discomfort and articulate thoughts about the event, leading to both affective change and cognitive reorganization [4, 5, 21, 22]. Regarding physiological changes, Schwartz has proposed that teaching individuals to attend to previously ignored feeling states may be important in re-establishing proper regulation of bodily systems [23, 24]. If increases in inwardly focused attention can lead to both cognitive reappraisal and tension release, then structuring an intervention to utilize such attending might facilitate reappraisal, tension reduction, and perhaps might lead to more efficient physiological regulation.

The connection between emotional expression, immune changes, and health status is just beginning to be examined [25]. To explore mechanisms linking disclosure and health, Pennebaker *et al.* [26] tested the effects of an analogue trauma disclosure protocol on immune functioning. Four consecutive days of written disclosure of traumatic events by healthy college undergraduates was not only associated with a significant drop in health center visits, but with significantly increased T-cell proliferative responses to phytohemagglutinin (PHA), and these changes were maintained 6 weeks later. Using a one-session written stressor disclosure protocol with eighty-five undergraduates, Esterling and colleagues [27] found that personality style interacted with degree of stressor disclosure in predicting IgG antibody titres to the Epstein-Barr virus viral capsid antigen (EBV-VCA). Individuals characterized as emotionally expressive (sensitizers) on the Millon Behavioral Health Inventory had lower antibody titres to EBV-VCA than those individuals classified as emotionally non-expressive (repressors). Moreover, among sensitizers, those displaying greater disclosure on a behavioral task showed lower EBV-VCA antibody values than their low-disclosing counterparts. Thus dispositional factors appear to contribute to some immunologic changes observed in stressor disclosure paradigms.

Antibody titre to EBV-VCA has previously been proposed as an important marker of the immune system's ability to control latent herpesviruses [28]. EBV is widespread in the general population, which is at least 90% seropositive [29]. Decrements in the host's control over EBV are believed to be reflected in higher circulating IgG antibodies specific to EBV-VCA [30, 31]. Thus, such antibody levels may provide an *in-vivo* marker of immunologic surveillance over this particular virus. Elevated EBV antibody titres have been related to acute psychosocial stressors such as examinations [28, 30] as well as to chronic burdens such as marital discord [32].

The present study examined the nature of the psychological mechanisms involved

in emotional disclosure and their relationship to EBV-VCA antibody titres. We experimentally manipulated emotional disclosure and assessed changes in immune functioning and stressor-associated moods and cognitions in a sample of healthy EBV seropositive college students. The experimental manipulation was designed to both increase the subject's level of experiential involvement in the disclosure process as well as to maximize their opportunity for cognitive change. We hypothesized that greater experiential involvement and cognitive changes during the 3-week course of experimental period would predict subsequent decreases in EBV-VCA antibody titres.

METHOD

Subjects

Subjects were largely first year undergraduate psychology majors with an average age of 19.11 yr (SD = 3.8) who volunteered for a study on 'emotions and immune function' as part of a research requirement for an introductory psychology course. This study was approved by the University of Miami Institutional Review Board. Of an original pool of ninety-six male and female undergraduates who initially volunteered to participate in this study, 11 were eliminated because they did not meet the eligibility requirements for physical or psychological reasons and six changed their minds about participating. Three subjects were eliminated from the study post-hoc because they reported having experienced intense traumas during or immediately preceding the study.

Exclusion criteria used to minimize immunological confounds [33] included: (1) use of antibiotics within the previous month; (2) use of cortisone or other non-topical steroid medication within the previous 6 months; (3) pregnancy; (4) undergoing psychotherapy in the past year; (5) report of serious illness within the previous 3 months; (6) reported consumption of greater than 10 alcoholic drinks per week at the time of recruitment; (7) history of major illness; (8) history of symptoms which might indicate an active immunoregulatory disorder such as allergy, asthma, or eczema; or (9) presence of symptoms of an active disease process such as fever, drowsiness, sore throat, mouth sores, nasal congestion, in the preceeding month. Individuals experiencing symptoms indicative of marked psychological distress (e.g. suicidal ideation, panic attacks, depression) were also excluded.

Of the remaining seventy-six subjects forty were randomly assigned to the experimental intervention and thirty-six were assigned to the control condition. Ten of these seventy-six subjects were subsequently found to be EBV-VCA seronegative and were eliminated from analyses using antibody titres as a dependent measure. All subjects whose EBV-VCA antibody titres were in the 1:640 range were also tested for early antigen (EA) and IgM antibodies to determine if their EBV-VCA IgG antibody titre was the result of a recent viral infection, since recovery from a recent EBV viral infection might confound the results (as elevated titres could indicate primary response to a viral infection rather than latent virus control). Five students were found to be EBV-EA positive and one subject was positive for IgM as well as EA. All of these subjects were eliminated from analyses using EBV-VCA values as a dependent measure. Thus analyses involving immune titres used fifty-nine subjects, thirty-one experimental subjects and twenty-eight controls.

Procedures

This study employed a randomized repeated measures design with two experimental cells. Before the study began, subjects met as a group at which time the outline of the study and its requirements were discussed. At this initial meeting subjects were asked to fill out an informed consent form, a questionnaire regarding the study's exclusionary criteria, one assessing potential immunomodulatory confounds (e.g. diet, sleep, exercise), and several psychosocial questionnaires as described below. Because it was thought that social desirability might affect the quality of a subject's involvement in the intervention, before randomization, subjects who met exclusionary criteria were divided into matched groups based on high verus low scores on the Marlowe Crowne Social Desirability Scale [34]. From these groups, experimental and control groups were selected by a coin toss performed by a research assistant unfamiliar with the subjects. At this time, subjects were provided with a schedule of study sessions and followup appointment. Both groups had morning blood draws within 48 hours after the information session (week 0) and five weeks later. Strict confidentiality was maintained regarding all psychosocial measures and disclosures.

Psychosocial measures

Psychometric control measures. As mentioned previously, the Marlowe–Crowne Social Desirability

scale was administered at study entry and used as a blocking variable to control for effects of social desirability. This scale consists of thirty-three true/false items which assess the degree to which the subject strives to present themself in a favorable light [34]. The Taylor Manifest Anxiety (MAS) short form [35, 36] consists of twenty true/false items which assess the extent to which the subject experiences specific symptoms of anxiety. This scale was administered at study entry and considered as a control variable. To assess the degree of environmental stressors experienced by subjects in this study we administered the Hassles Scale [37], a 117-item list of common hassles of daily life that are rated on a three-point scale of intensity. Endorsed hassles are rated as to frequency (the sum of the number of items checked) and average intensity (the sum of the severity divided by the frequency). The scale has demonstrated high external validity and high predictive ability for psychological symptomatology [37]. We administered the Hassles scale at study entry and used the frequency and intensity scores as control variables.

Impact of Event Scale. The Impact of Event Scale (IES; 38) is a fifteen-item self-report instrument which was administered at the initial and final time points to assess changes in cognitive processing of the trauma/stressor topic disclosed by subjects. The IES includes an intrusion subscale which measures the degree to which the respondent experiences recurring thoughts, dreams, daydreams, and other intrusions related to a previously experienced stressor/trauma. The avoidance subscale assesses the degree to which the subject employs avoidance strategies in coping with the stressful or traumatic event. Responses are rated on a four-point scale regarding frequency of occurrence. The intrusion and avoidance subscales have been empirically supported by factor analysis. Test–retest reliability as well as cross-validation have demonstrated the psychometric soundness of this instrument [38, 39].

Nowlis Mood Adjective Checklist. Since depression has been shown to be associated with EBV antibody titres in some studies [40, 41], we assessed for mood changes over the course of the study using a shortened form of the Nowlis Mood Adjective Checklist (MACL) [42, 43]. This instrument consists of twenty-four adjectives which are Likert-rated as describing a subject's feelings: very well (3); somewhat well (2); not sure (1); or not at all (0). This scale has demonstrated external validity and construct validity [42]. Eight factors are derived from the MACL: sadness, elation, surgency, aggression, social affection, anxiety, fatigue, and vigor [43]. Further analysis has yielded two factors, positive and negative mood. Both factors possess high internal consistency [22]. In this study the positive and negative mood factors were used to assess intra- and intersession fluctuations in affect within the experimental group.

Millon Behavioral Health Inventory. The Millon Behavioral Health Inventory (MBHI) [44] is a 150-item true/false questionnaire composed of twenty scales, eight of which describe interpersonal coping styles derived from Millon's personality theory. These scales have demonstrated high test–retest reliabilities as well as a high degree of internal consistency. Five MBHI scales indicative of sensitizer or repressor characteristics were used in this study to control for personality differences which may have affected both immune function and reaction to both the stressor and the intervention [27, 45]. Three MBHI scales delineate repressive styles and are denoted as Introversive, Cooperative, and Respectful. Two other scales, the Inhibited and Sensitive scales characterize more expressive or sensitizer styles. High scorers on the MBHI Sensitive scale are believed to be more expressive of their inner feelings, and may complain more about their distress. Individuals scoring high in the Inhibited scale tend to keep their problems to themselves and are extremely sensitive to rejection by others and are slow in establishing trust [44].

Behavioral assessment

The content of the audiotaped verbal disclosures provided by the experimental group for each of the three 20-min sessions were rated using the Experiencing scale (EXP; 46). The EXP scale is an empirically derived observer-rated instrument which assesses a subject's involvement in a therapeutic interaction along a seven point scale. A low score indicates detachment from the event described, and a high score indicates a great degree of affective and cognitive involvement in the disclosure process. The scale also assesses the extent to which the subject is engaged in reorganizing meaning in the session. This scale has been correlated with level of disclosure, successful outcome in therapy, and cognitive change in therapy [47]. Before rating tapes of the intervention, two raters were trained by means of training tapes provided with the EXP scale training manual [46]. Rater reliability with the manual was established, using Ebel's intraclass method [46, 48]. Recommended rater reliabilities are ≥ 0.70 [49]. Audiotaped experimental disclosure sessions were divided into three segments of approximately 6-6.5 min [46]. Each segment was rated according to a modal rating (an average rating that the subject achieves during that segment), and a peak rating (the highest rating for the subject within that segment). Rater 1 established a 0.73 reliability on modal ratings and a 0.78 reliability on peak ratings, while rater 2 established a 0.80 reliability on modal ratings and a 0.91 reliability on peak ratings. The r_{kk} was 0.92 for modal ratings and 0.93 for peak ratings. In analyses, the sum of the modal ratings over all segments as well as the sum of the peak ratings over all segments were examined separately.

Subject's reports of behavioral changes related to their topic of disclosure and made during the time

between sessions were assessed on a 1–7 Likert scale by the experimenter after the session to yield an understanding of the role of behavior change in this process. Sample ratings are as follows: no change was scored as 1; rating of 4 indicated for example, that a subject had made one attempt to talk to a female where the subject had previously been very shy; and a rating of 7 indicated for instance, that the subject confronted an individual previously avoided because of a trauma. The validity and reliability of this measure has not yet been demonstrated.

Experimental manipulation. Subjects assigned to the experimental (verbal disclosure) condition attended three weekly experimental sessions and one follow-up meeting. At session 1 subjects were asked to fill out a presession MACL and were given the following instructions which were adapted from those used in previous work in our lab [27]:

'I would like you to talk about an event which you have experienced that has been highly stressful, traumatic, or about which you have felt very guilty. I would like you to talk as if you were talking to a close friend to whom you could tell anything. The event should be one which you have not widely discussed with others. These events may include such subjects as divorce of parents, breaking up with a boy/girlfriend, being raped or molested, leaving home to go to college, alcohol or drug problems, or being publically humiliated. Please use the entire twenty minutes. If you finish before the time is over, you can think through the event again and describe certain aspects of it more deeply.'

Subjects were requested to talk to an experimenter for the entire period.* During the first 6 min the experimenter mainly engaged in reflective listening so as to collect information on the subject's spontaneous degree of experiential involvement in disclosure. For the rest of the session, the experimenter used responses designed to help the subject increase emotional involvement in the disclosure [50–53]. After the first session subjects filled out the MACL, a brief questionnaire regarding the severity, recency, painfulness, intrusiveness, and previous disclosure of the stressor discussed, and the IES.

Subjects returned one week later for session 2. At this time they completed a a pre-session MACL, a questionnaire regarding the painfulness of their topic at the current time, and how much they had thought about their topic and discussed it with others since the last session. During the first 5 min of this session subjects were given an exercise to increase their level of emotional involvement in the disclosure process, by increasing their somatic awareness of their emotions as they described someone they cared about and someone they disliked (adapted from ref. [51]). During the remaining time they were asked to discuss their topic from the previous week, or if that seemed completed to select another stressful or traumatic topic to talk about for the remainder of the session. Following the session they completed the MACL. Session three, 1 week later, followed the pattern of session 2. Following each session, the experimenter completed a likert rating of reported behavioral change.

The following week (wk 4) all subjects had a morning blood draw at the University Health Center. At this time, they also completed the IES, the MACL, and a followup questionnaire. This questionnaire asked subjects to rate on a seven point Likert scale several questions regarding cognitive change, sense of relief, and mood change. These questionnaires are slightly modified forms of instruments used in previous disclosure studies [22, 54]. Their validity and reliability have not yet been demonstrated. Control group subjects were seen individually and completed psychosocial questionnaires similar to those used for the experimental group at weekly assessment sessions as well as at the follow-up time point. Morning bloods were drawn for the control group at the same time points as the experimental group.

EBV-antibody titres

Serum was separated and stored frozen at −20°C until analyzed. Serum for IgG antibody titre to EBV-VCA was analyzed using an indirect immunoflorescence assay with reagents supplied as kits following the instructions of the supplier (Organon Teknika, #9100-11). Samples were coded and analyses were done blind. Samples were initially diluted in sequential double dilutions in phosphate buffered saline (PBS), pH 7.4 and then absorbed for 30 min at 37°C on slides containing acetone fixed lymphocytes containing EBV-VCA. The cells were washed with PBS and treated with goat anti-human IgG conjugated to fluorescein isothyocyanate (FITC) and Evans Blue Counterstain in a combined preparation and examined by epi-fluorescence microscopy (Nikon). The highest dilution of serum able to

*Many of those who participated in the experiment in the fall semester had just left home for the first time, and 10% of these subjects chose to discuss this departure as the most traumatic event they had experienced. Other events discussed included breakup of a relationship (15%), death of a sibling or close family member (12.5%), sexual molestation (5%), severe accident or illness involving self, close friend, or family member (12.5%), problems with parents including abuse and alcoholism (15%), problems with social relationships, including being scapegoated or not getting along with roommates (12.5%), dealing with a handicap or with a family member with a handicap (5%), academic stresses (7.5%), and secrets such as affairs and bulemic behavior (5%).

demonstrate IFA-positive cells determined the antibody titres to EBV-VCA. If any subject showed a titre of 1:640 or above, that subject's blood was also tested for EBV Early Antigen (EA) and EBV-VCA IgM to rule out the possibility of cross reactivity of current or recent primary infection as the cause of change in antibody titre to EBV-VCA. Subjects testing positive for EA or IgM were removed from any further analyses. Only specific binding was observed because of the use of positive and negative controls. All titre values were reported as the mean $\log_2$ transformed dilution factor.

RESULTS

Control variables

There were no significant between-group differences in sleep, alcohol consumption, drug intake, lean body mass, physical activity, Hassles frequency or intensity, Marlowe–Crowne Scores, Taylor Manifest Anxiety scores, self-reported negative emotion, or days of illness in the month preceding study entry (all $p > 0.05$). No significant differences were found for gender on EBV baseline or change scores ($p > 0.10$), and so data was combined for both sexes. For the entire sample, antibody titres to EBV-VCA ranged from 1:10 to 1:640 with a baseline mean of 1:195 and a SD of 114. No significant group differences were found at baseline for personality styles as measured by the MBHI, except that the experimental group was found to have significantly higher scores on one repressive scale of the MBHI (scale 3-Cooperative). This, if anything would have affected the study by providing a conservative bias against the experimental group. The contribution of each of the control variables to baseline EBV-VCA antibody titre was determined using stepwise multiple regression. Predictor variables included amount of restful sleep, physical activity, lean body mass, drug and alcohol use, and extraneous environmental stressors (hassles frequency and intensity). Caloric intake was eliminated from this analysis because many of the men in the study could not recall their caloric intake and left the item blank. The overall model relating the remaining control variables to baseline EBV-VCA antibody titres was not significant, $F(6,23) = 1.02, p < 0.44$, and none of the individual predictors contributed significantly to EBV-VCA antibody titre variance.

Intervention effects on EBV-VCA antibody titres

A one-way ANOVA revealed that the control group entered the study with a significantly higher mean EBV-VCA antibody titre than the experimental group, $F(1,57) = 6.01$ $p < 0.02$. Therefore in all between groups analyses of EBV-VCA, initial antibody titre values were used as a covariate. A MANOVA performed on change scores of EBV-VCA titre from week 0 to 4 with baseline titre as a covariate revealed no significant difference between groups over time. When this analysis was performed with baseline negative mood added as a covariate to control for effects of depression, no significant difference emerged between groups. Subsequently, the experimental group was subdivided into those who had reported that they were at least somewhat upset about the topic they were discussing, and those who indicated that they were not upset about their topic. A MANOVA procedure performed on the EBV-VCA antibody titre change score with baseline titre as a covariate showed no significant difference between upset and non-upset individuals in the EBV-VCA antibody titres over time.

Individual differences

Because subjects assigned to the intervention group may have varied considerably in the extent to which they were able to trust the experimenter, involve themselves in the disclosure process, and change the ways in which they processed the material disclosed, we conducted within-experimental group analyses of disclosure variables and cognitive processing changes as they related to EBV-VCA antibody change scores over the study period.

Experiential involvement in topic and disclosure. We had hypothesized that the effect of disclosure would be greater with more experiential involvement, for more important topics, and for those individuals who had been 'holding' the event for a longer time. Greater experiential involvement summed across all disclosures was associated with a greater decrease in EBV antibody titres over the course of the experiment, $r = -0.46, p < 0.01$ for modal rate, and $r = -0.38, p < 0.05$ for peak rate (See Table I). The more important the subject rated the topic of their disclosure, the greater was their decrease in EBV-VCA antibody titre, $r = -0.29, p < 0.05$. Greater time since the event was associated with lower final EBV titres, with baseline titre covaried, partial $r = -0.33$, $p < 0.05$ and with greater EBV titre decreases, $r = -0.31$, $p < 0.05$.

Mood effects. We had also hypothesized that extent of revealing feelings as well as mood change would be related to changes in antibody titre. We found that self reports regarding how much subjects perceived they had revealed their feelings in the disclosures were significantly correlated with lower antibody titre at the end of the experiment, partial $r = -0.34$, $p < 0.05$. However, in assessing the effects of positive and negative mood change, neither mood change within sessions nor mood change over the course of the experiment was significantly associated with antibody titre changes. However increased aggressive feelings aroused during the first disclosure were associated with significant decreases in EBV titres from week 0 to

TABLE I.—PEARSON CORRELATIONS AMONG POST-INTERVENTION AND PRE-POST CHANGE IN EBV ANTIBODY VALUES AND PSYCHOMETRIC AND BEHAVIORAL MEASURES

Variable	EBV change titre (Final-baseline)
Modal Experiential Rating (Summed)	−0.46**
Peak Experiential Rating (Summed)	−0.38*
IES Avoidance (final)	0.37*
IES Avoidance change (final-baseline)	0.42*
Introspection between sessions 1 and 2	−0.38*†
Degree of Upset, Session 2	−0.41*†
Reveal Feelings	−0.26
How long ago	−0.31*
Aggressive feelings change Session 1 (final-initial)	−0.42*†
Social Affection change Session 1 (final-initial)	0.31*†
Importance	−0.29*

*$p < 0.05$; **$p < 0.01$ (one-tailed hypothesis driven correlations).
† Two-tailed correlations.

week 4, $r = -0.42$, $p < 0.05$*. Increased feelings of social affection following session 1 were associated with *increased* EBV titres from week 0 to week 4, $r = 0.42$, $p < 0.05$*. Examiner ratings of self-reported behavioral change were not significantly correlated with EBV-antibody titre changes.

Cognitive change. We had hypothesized that decreases in avoidance and intrusive cognitions regarding the event, as measured by the IES, would be related to decreased antibody titres in the experimental group. We found greater decreases in IES-avoidance scores to be significantly associated with EBV antibody titre decreases, $r = 0.42$, $p < 0.02$, and with lower antibody titres at the end of the experiment, after controlling for baseline EBV, partial $r = 0.57$, $p < 0.003$. High Avoidance scores at the end of the intervention were also significantly associated with increases in EBV titre, $r = 0.37$, $p < 0.03$. Decreases in IES-Intrusion scores were not significantly associated with final EBV antibody titres or titre changes. After controlling for baseline EBV, we found significant differences in final EBV titres between those individuals whose avoidance stayed the same or increased ($N = 15$) and those whose avoidance decreased over the course of the experiment ($N = 12$), $F(1,24) = 5.89$, $p < 0.02$. After adjusting for initial antibody titres, the mean final EBV antibody titre for the avoidance increase group was 1:178 with a standard deviation of 89, while the mean EBV antibody titre for the group which decreased in avoidance was 1:113 by the end of the experiment, with a standard deviation of 87. (Standard deviations are expressed as reciprocals of titres). The pre–post intervention antibody titre changes for these subjects are displayed in Fig. 1.

Having identified changes in style of cognitive coping as one of the factors that seems to influence antibody titre changes, we attempted to further delineate those factors that influence this coping process. Interestingly, decreases in avoidance scores were also significantly associated with how much individuals reported thinking about their topic between sessions 1 and 2, $r = 0.38$, $p < 05$*, and how upset they still felt when thinking about their topic at the beginning of the second session, $r = 0.42$, $p < 0.05$.*

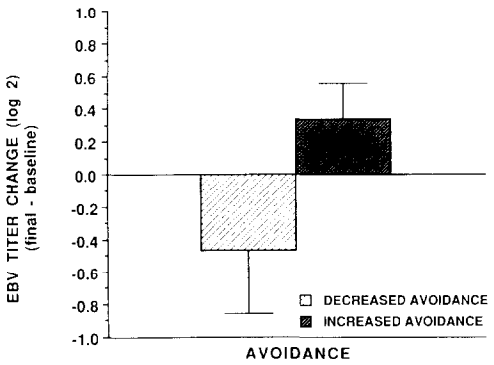

FIG. 1. Pre-post changes in EBV antibody titres (± SEM) for experimental subjects who decreased the use of avoidant strategies vs those who either increased or showed no change in avoidant strategies across the study period.

*Signifies 2-tailed significance for non-hypothesis driven correlations.

It was hypothesized that the subjects' emotional involvement in disclosure, together with cognitive changes would be significant predictors of change in EBV-VCA antibody titres. A hierarchical multiple regression was performed using the following variables as predictors of EBV change scores: baseline EBV titre, IES-Avoidance change scores, time since the disclosed event occurred, and summed modal EXP score (see Table II). In this equation, baseline EBV titre, IES-Avoidance change scores, and time since the event were significant predictors of EBV titre change scores. Overall, the model was highly significant, $F(4,16) = 14.41$, $p < 0.0001$, and accounted for 78% of the variance in EBV change scores. When examiner ratings of self-reported between session disclosure related behavior change was substituted for the modal EXP score in this equation it did not add significantly to the variance.

DISCUSSION

In this study we induced emotional disclosure in a group of subjects who were asked to verbally disclose stressful or traumatic events to a listener over a 3 w period. A comparison group of subjects filled out questionnaires at equivalent intervals over the same time period. Psychologic and immunologic variables were measured at the beginning of the study and five weeks later. Our finding that the control group entered the study with a significantly higher EBV titre might at first glance suggest some unconscious bias in subject selection. However, the lack of a significant baseline difference between these two groups on any of the control psychological variables (MBHI scores, Hassles, MACL) suggests that the groups were psychologically similar at study entry, as well as physically similar on measured control variables. We found that individual differences within the experimental group played a more important role than the presence or absence of an experimental manipulation in influencing EBV antibody titres. Among the factors that related to changes in EBV values within the experimental group were a decrease in 'cognitive avoidance' of the disclosed stressor/trauma and high levels of experiential involvement in the disclosure process. These effects were more pronounced for individuals who indicated that they were upset about their disclosure topic and for disclosure topic events that had occurred at least five months previously. Self-reports indicating minimal holding back of emotions were highly correlated with final EBV antibody titre. The results of this study thus support previous work which has shown that disclosure of traumatic events is related to the *in-vivo* production of antibody to EBV-VCA [27].

Due to the marked variation in the intensity of the disclosures, it is not surprising that there were no significant between group differences in EBV-VCA antibody changes in the present sample. Some individuals chose to discuss topics that were very personal and very painful to them, while other participants had difficulty thinking of something traumatic or stressful that had happened to them. These differences may reflect dispositional differences in the ability, desire, or need to trust or disclose to another person [54], or alternately, to differences in the degree to which subjects were burdened by stressful or traumatic material. As self-reported negative mood scores tended to be uniformly low for all subjects at the beginning of the study, and since depression was an exclusionary factor, it is unlikely that

TABLE II.—HIERARCHICAL MULTIPLE REGRESSION ANALYSIS OF EBV ANTIBODY TITRE CHANGE SCORES IN THE EXPERIMENTAL GROUP

Variable	Beta	S.E. Beta	T	sig T	R^2	R^2	Signif. of R^2 change
Baseline EBV titre	−0.479	0.1045	−4.59	0.0003	0.50	0.50	$F(1,19) = 18.78$, $p = 0.0004$
Avoidance change	0.062	0.016	3.85	0.001	0.68	0.18	$F(2,18) = 9.94$, $p = 0.005$
Time since event	−0.111	0.048	−2.28	0.037	0.75	0.07	$F(3,17) = 5.01$, $p = 0.039$
Modal EXP involvement	−0.048	0.029	−1.56	0.139	0.78	0.03	$F(4,16) = 2.43$, $p = 0.14$

$F(4,16)$ of entire model = 14.41, $p = 0.0000$; $R = 0.88$; $R^2 = 0.78$.

baseline levels of depression were substantial factors in willingness of subjects to discuss traumatic events, or in predicting antibody results.

Disclosure and physiological correlates

Changes in avoidance. We found that the combination of being upset about a topic and making changes in one's style of cognitive processing by becoming less avoidant was related to EBV antibody titre decreases. As it is used in the IES scale, avoidance consists of specific cognitive and behavioral operations reflected in items such as 'I stayed away from things or situations that might remind me of it', 'I made an effort to avoid talking about it', 'I avoided letting myself get emotional when I thought about it or was reminded of it.' Endorsement of these statements suggests that the respondent may be exerting continual energy to keep mental representations of the event and its accompanying emotional experience from consciousness, as well as expending energy on more overt avoidant behaviors.

Physiological correlates of avoidance. The effort of trying to banish a thought from consciousness, or to inhibit behaviors has been related to increases in skin conductance [5, 11, 20, 56]. Avoidance involves a sense of hypervigilance—of scanning the environment and possible thought content to enable the individual to continue his/her defense [57]. Studies of arousal indicate that memories of a feared or traumatic event can arouse autonomic activation resembling that of the initial event [15, 16, 18, 58]. It has been proposed that the hypervigilance of individuals who characteristically use avoidance to deal with stressors stimulates frequent arousal of the orienting response [59]. Importantly, avoidant cognitive processing (as measured by the IES scale) has been associated with some measures of sympathetic arousal. For example elevations in urinary norepinephrine levels as well as increases in systolic blood pressure and heart rate were observed in residents of Three Mile Island during the period following the nuclear reactor accident [60]; these elevations were greatest among those who had elevated IES avoidance scores. In addition, avoidant coping has been specifically related to poorer health outcomes in several studies [61, 62]. Avoidance is thus more than a strictly mental event, but is rather an experiential stance which encompasses a physiological tension as well as an action pattern.

Cognitive changes and time effects. It is noteworthy that neither examiner ratings of reported behavioural change nor globalized positive or negative mood change was significantly associated with changes in antibody titres. While state mood changes are often transitory, cognitive changes may be more longlasting and provide a substrate for a succession of mood changes, thus contributing more impact to physiological change.

Once an individual overcomes avoidance about an issue and begins to come to terms with it, an active process of mastery and reassimilation of the material is set in motion [63]. In such cases the issue is in process not only during the 20-min disclosure session, but in addition, the therapeutic work continues between sessions [8]. Subjects in the present study who were more introspective between sessions had a greater likelihood of altered cognitions, as reflected in decreased avoidance scores by the end of the experiment.

It is not surprising that the present effects showed up most strongly for disclosed events that had occurred at least five months previously. It may take that amount of

time for the effects of avoidance or behavioral inhibition to build up to a degree that unburdening would produce any kind of measurable physiological change. Although previous work has related emotionally repressive coping styles to a greater incidence and progression of certain carcinomas (e.g. refs [64–67]), the long-term effects of behavioral inhibition are not known.

Experiential involvement. It is noteworthy that level of experiential involvement in disclosure was strongly associated with EBV antibody titre change. Experiential re-accessing of emotionally-laden memories allows the individual to examine different facets of an experience that may have been blocked from awareness at the time of the trauma, leading to insight, cognitive reorganization, affective change, and a decrease in arousal [4, 63, 68–72]. The extent of an individual's ability to access this introspective processing is thought to be related to therapeutic change [46, 51, 70]. The correlations found between experiencing levels and change in EBV antibody titres are quite high, considering that very few disclosures reached the higher levels of the EXP scale, due to the nature of the population, the purpose of the experiment, and the time limitations involved in the intervention. We would expect that an individual's level of experiencing would emerge as an even stronger predictor of a biological index such as EBV antibody titres in a study designed to use subjects who themselves initiated a therapeutic process to come to terms with a significant trauma or stressor, and who were seen for more sessions in more depth than was possible in this study.

Our inability to replicate Esterling *et al.*'s [27] demonstration of an interaction effect between personality and behavioural expression related to EBV-antibody titres may be explained by the differences in methodology. The written nature of their disclosure paradigm may have given more latitude for personality factors to influence degree of expression than the interpersonal interaction over time which was utilized in the current study.

Disclosure, regulation, and immune surveillance

This brief intervention appears to have given some subjects the opportunity to unburden themselves, express their feelings and change their cognitive appraisals of previously experienced stressful events. We propose that decreases in cognitive avoidance and subsequent decreased inhibition reduces bodily tension. Consistent with Schwartz's theory of disregulation [23, 72] these changes might increase the efficiency of physiologic regulation. The present study may extend the disregulation hypothesis to the immunologic control of ubiquitous herpes viruses such as EBV.

Once a person has been infected by EBV, after the acute stage of the infection, the virus is believed to remain in a latent state within the central nervous system [73] and the B-lymphocytes [31] of the infected host. Efficient regulation of EBV in this latent state is not clearly understood but is believed to be largely maintained by the cellular immune system, particularly by T-lymphocytes [31], and also by a type of non EBV specific activated natural killer cell [74, 75]. During periods of either acute or chronic stress, it has been hypothesized that the cellular control of EBV may be less efficient, but the mechanisms involved are not clear [30], although it has been shown that glucocorticoids can induce latent EBV expression *in vitro* [76].

Is a time-limited short term disclosure intervention actually potent enough to produce clinically important changes in immune functioning? Short term stress

management, relaxation and/or problem solving interventions have been shown to positively affect immune measures in an elderly population [77], in a population of medical students facing the stress of examinations [78], in post-surgical malignant melanoma patients [79] and in HIV-1 seropositive gay men dealing with the stress of serostatus notification [80, 81]. The weight of the above evidence is that short term interventions can effect change in immunological parameters in healthy and clinical populations. While healthy individuals such as our subjects may not have any consequence of mild elevations or decrements in EBV antibody titres, in immunocompromised populations (e.g. HIV+ve patients) mild alterations in EBV titres may be associated with more serious consequences, such as HIV viral replication or secondary infection [81–83].

The relationship between disclosure, EBV titres, and actual health status is still unclear. In previous work using disclosure paradigms, effects on health center visits and symptomatology have not been consistent [6–26, 27, 84]. We did not collect followup data in this study and so cannot speculate as to the endurance of the antibody titre changes observed. Because this was an initial study, designed for description of the relationship between variables, rather than as a confirmatory study, it was considered to be important to include findings from correlational analyses. However, confirmation of the present findings await cross validation with a larger sample. While the findings of this study are limited to healthy students and have no clear linkage to disease, they point to the possible importance of the use of disclosure as an intervention in medical populations, where receipt of a life threatening diagnosis can be highly distressing and possibly physiologically compromising, and where a psychosocial intervention may have important ameliorative or buffering effects.

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