Psychoneuroendocrine Effects of Resource-Activating Stress Management Training

Maja Storch, Jens Gaab, Yvonne Küttel, Ann-Christin Stüssi, and Helmut Fend
University of Zurich

Objective: The stress-induced release of cortisol has been linked to detrimental health outcomes. Therefore, strategies to attenuate cortisol stress responses are of interest for prevention and treatment of stress-related symptoms and problems. Previous studies have found protective effects of cognitive–behavioral stress management training—which focuses on the modification of stress-inducing cognitions—on cortisol stress responses; however, the effects of resource-oriented interventions on cortisol stress responses are unknown. *Design*: The longitudinal effects of resource-oriented stress management training (Zurich resource model training) on cortisol stress responses and cognitive appraisal of a standardized psychosocial stress test were evaluated in 54 healthy male participants assigned randomly to treatment and control groups. The Trier Social Stress Test (TSST; C. Kirschbaum, Wust, & Strasburger, 1992) was administered to all participants 3 months after the treatment group underwent stress management training. *Main Outcome Measures*: Saliva cortisol samples were taken before, during, and after the TSST, and cognitive stress appraisal was assessed before the test. *Results*: The treatment group had significantly attenuated cortisol responses and stress appraisals in comparison to the control group. The endocrine differences were mediated by differences in cognitive appraisals. *Discussion*: These results indicate that resource-oriented stress management training effectively reduces endocrine stress responses to stress in healthy adults.

Keywords: Zurich resource model, stress management training, resource, cortisol

Psychosocial stress can be conceptualized as incongruence between the abilities and needs of a person and the environment. At the individual level, psychosocial stress is the result of a cognitive appraisal of what is at stake and what can be done about it (Lazarus, 2005; Lazarus & Folkman, 1984). It is assumed that the result of this subjective appraisal influences the emotional, behavioral, and biological response to stress. People with higher optimism scores report fewer sick days and faster recovery after a specific life stress event (Kivimäki et al., 2005). The effect of optimism, in turn, is supposed to be dependent on the person's belief and/or capacity to manage stress effectively (Penedo et al., 2003). As Richman et al. (2005) stated, work in health psychology has emphasized risk factors more than protective factors when examining health outcomes.

With regard to biological responses to psychosocial stress, hormones of the hypothalamus–pituitary–adrenal (HPA) axis have been examined extensively. Although the activation of the HPA axis in response to stress and its effects on cardiovascular, immune, and metabolic as well as emotional, behavior, and cognitive processes helps to maintain equilibrium during and after stress (Sapolsky, Romero, & Munck, 2000), extensive and/or long-standing release of HPA axis hormones has been shown to have detrimental effects on somatic and emotional well-being (Mc-Ewen, 1998; Seeman, McEwen, Rowe, & Singer, 2001).

As to the processes involved in the activation of the HPA axis during stress, it has been shown that besides genetic (Wust et al., 2004), endocrine (Kirschbaum, Kudielka, Gaab, Schommer, & Hellhammer, 1999), and habitual (Kirschbaum, Wust, & Strasburger, 1992) factors, situation-specific anticipatory cognitive appraisal, but not general personality variables, substantially account for the extent of the biological response in the face of stress (Gaab, Rohleder, Nater, & Ehlert, 2005). This finding is congruent with the results of a recent meta-analysis of 208 studies, which shows that the perception of threat to the social self is a major situational trigger of an HPA axis activation in response to stress (Dickerson & Kemeny, 2004). Thus, threat to social status, social esteem, respect, and/or acceptance that is judged as not controllable by the person leads to a biological stress response. Therefore, from an individual–subjective as well as a situational perspective, interventions aiming to influence perceived social threat could be used to prevent adverse consequences of biological stress responses.

A number of studies have shown that cognitive–behavioral stress management (CBSM) effectively reduces basal cortisol levels shortly after the intervention in clinical as well as nonclinical populations (HIV: Antoni et al., 2000, and Cruess et al., 1999; breast cancer: Cruess et al., 2000; athletes: Perna, Antoni, Kumar, Cruess, & Schneiderman, 1998). Also, in healthy participants, CBSM was observed to attenuate cortisol responses to a standardized stress test 2 weeks as well as 4 months after training (Gaab et al., 2003; Hammerfald et al., 2006).

Maja Storch, Yvonne Küttel, Ann-Christin Stüssi, and Helmut Fend, Department of Educational Psychology, Institute of Education Sciences, University of Zurich, Zurich, Switzerland; Jens Gaab, Department of Clinical Psychology and Psychotherapy, Institute of Psychology, University of Zurich.

Correspondence concerning this article should be addressed to Maja Storch, Department of Educational Psychology, University of Zurich, Freiestrasse 36, 8032, Zurich, Switzerland. E-mail: storch@paed.unizh.ch

All of the interventions mentioned above have in common that they aim to address explicit, conscious levels of self-evaluation. Thus, individuals reflect on their experiences, evaluate the contents of consciousness, and introspect about the causes and meanings of stressful situations. Dealing with implicit aspects of the self is not the direct focus of these interventions. However, it is important to differentiate between implicit and explicit self-esteem as distinct constructs, from both a psychological and a neural perspective (Cunningham, Johnson, Gatenby, Gore, & Banaji, 2003; Greenwald & Farnham, 2000). In this regard, it has been assumed that implicit aspects of the self have an important impact on social cognition and self-evaluation and that this implicit mode of self-evaluation dominates when the capacity to engage in conscious self-reflection is lacking (for a review, see Devos & Banaji, 2003).

On the basis of these assumptions, Storch and colleagues developed a self-management training that focuses on implicit self-aspects by combining psychoanalytic with cognitive–behavioral methods (Zurich resource model [ZRM] training; for review, see Storch, 2004a, 2004b; Storch & Krause, 2002; see also the Method section for details). The goal of ZRM training is to help participants use personal resources in order to maintain the integrity of the social self in situations that are otherwise perceived as threatening the social self. Because resource activation has been discussed as a crucial prerequisite for psychotherapeutically induced change (Gassmann & Grawe, 2006; Grawe, 2002), ZRM training focuses on the participants' personal resources rather than problematic behavior and cognitions.

In summary, the majority of studies on the effects of stress management training are based on a problem-oriented rather than a resource-oriented model. Therefore, the present study set out to test the effects of resource-focused intervention focusing on psychological and biological stress responses during a standardized psychosocial stress test, using a methodological approach similar to that used in previous CBSM studies (Gaab et al., 2003; Hammerfald et al., 2006).

Method

Participants

Participants were recruited by e-mail. All students at the Swiss Federal Institute of Technology, Zurich, Switzerland, were sent an e-mail message that contained a link to an Internet site that described the study in brief. Interested persons had the opportunity to enroll in the study online. Exclusion criteria were assessed using a screening questionnaire. The exclusion criteria were being female (Kirschbaum et al., 1999) and being a smoker (Kirschbaum et al., 1992), both of which are confounding factors that have been shown to affect physiological dependent measures. Also, persons were excluded if they reported acute or chronic somatic or psychiatric disorders. All students who were eligible for the study obtained a complete description of the study, gave written informed consent, and completed a set of questionnaires (see below for details), which allowed us to obtain comprehensive descriptions of relevant sample characteristics. Of 165 students who enrolled, 66 returned the screening questionnaire. Of these, 64 students fulfilled participation criteria. Because the optimal group size for the ZRM trainings is 15–17, participants were randomized in four groups: Groups 1 and 2 were assigned to the treatment

condition receiving ZRM training before the stress test, and Groups 3 and 4 were assigned to the control condition, receiving ZRM training after the completion of the stress test. As all four groups did not differ significantly on any of the assessed demographic or psychometric variables at baseline (data not shown), the respective groups were joined to form a treatment and a control group for statistical analyses (for comparison between treatment and control group, see Results section and Table 1). Three months after the treatment group completed ZRM training, all participants took a standardized psychosocial stress test (the TSST; Kirschbaum, Pirke, & Hellhammer, 1993). To evaluate the effects of the ZRM training on perceived stress levels, the Perceived Stress Scale (PSS) was administered at baseline and after the intervention in the treatment group or before intervention in the control group.

Psychosocial Stress Test

The TSST has repeatedly been found to induce profound endocrine and cardiovascular responses in 70%–80% of the persons tested (Kirschbaum et al., 1993). In our study, after a saliva sample was collected for basal levels of free salivary cortisol, the participants were given an introduction to the standardized TSST (2 min). They then went to a different room, where they were given 10 min to prepare and to complete a questionnaire designed to assess cognitive appraisal processes (the Primary Appraisal Secondary Appraisal Scale, or PASA; see below) regarding the stress situations in the TSST. Afterward, the participants returned to the TSST room, where they took part in a simulated job interview (5 min) followed by a mental arithmetic task (5 min) in front of an audience of two people. To assess salivary cortisol levels, a saliva sample was taken immediately before and after the TSST, with further samples taken at 10, 20, 30, 45, and 60 min after the TSST. The TSST was administered between 2 p.m. and 6 p.m. All participants received 300 ml of a drink with high glucose content to raise blood glucose levels, as low glucose levels have been shown to blunt stress-induced increases of cortisol (Kirschbaum et al., 1997). Also, participants were asked not to eat in the 2 hr preceding the TSST. The TSST protocol used differs from the protocol used in other TSST studies in terms of the 10 min of preparation time before the TSST (and after the introduction), during which the participants in the current study completed the PASA (see below).

ZRM Training

All participants attended group-based ZRM training. Groups of 16 participants met separately on two alternate, consecutive weekends (Friday to Sunday). Daily sessions lasted from 9 a.m. to 5 p.m. Eight weeks after the ZRM training, all participants attended a booster session that lasted 2 hr. Two experienced ZRM trainers (Yvonne Küttel and Ann-Christin Stüssi) conducted the ZRM training sessions according to the ZRM training manual (Storch, 2004b; Storch & Krause, 2002). The ZRM training is manualized and is equally suitable for work with individuals and with groups.

The purpose of the ZRM training is to foster personal resources in successfully coordinating personal needs with the urges of the environment. In this regard, personal resources are defined as personal means that, when activated, put the person in the state

Table 1

Psychometric Characteristics of All Participants at Baseline

	Treatment group		Control group				
Questionnaire	M	SD	M	SD	F	dfs	p
FKK					0.11	3, 50	.95
Self-concept of one's own competence	52.6	9.1	51.9	51.9	0.06	1, 52	.81
Internality	53.5	8.7	52.1	52.1	0.34	1, 52	.56
Powerful others	47.2	6.4	47.3	47.3	0.001	1, 52	.98
Chance control	40.8	8.1	45.1	45.1	3.91	1, 52	.05
MESA					0.30	6, 47	.93
Sensitivity to failure	11.7	11.7	11.5	11.5	0.12	1, 52	.73
Tolerance to work overload	6.5	2.0	6.9	6.9	0.27	1, 52	.61
Tolerance to social conflict	7.3	2.2	7.4	7.4	0.05	1, 52	.83
Sensitivity to criticism	9.7	2.4	10.1	10.1	0.46	1, 52	.50
Tolerance of uncertainty	9.2	2.3	8.8	8.8	0.43	1, 52	.52
Ability to relax	8.2	2.1	8.0	8.0	0.14	1, 52	.71
ADS-K	54.0	7.6	53.7	53.7	0.01	1, 36	.92
PSS (pretreatment)	22.7	4.4	21.5	21.5	0.01	1, 52	.67

Note. FKK = Questionnaire for Competence and Control Orientations; MESA = Measure for Assessment of General Stress Susceptibility; ADS–K = Center for Epidemiological Studies Depression Scale, German version; PSS = Perceived Stress Scale.

required for well-being. As recommended by dual-process theories (for review, see Strack & Deutsch, 2004), the formation of these personal resources is organized according to the person's explicit motives as well as implicit needs. According to Damasio (1994), somatic markers as evaluative signals stem from an experience-based part of the brain that has an implicit mode of information processing. Thus, the ZRM training uses somatic markers as diagnostic indicators of activated implicit needs. In this understanding, somatic markers function as indicators of personal authorship, adding an embodied quality to the experience of will (Wegner, 2002).

To achieve this purpose, the ZRM training aims to enhance the proprioception of somatic markers to become aware of important implicit needs and to develop cognitions and behaviors that synchronize implicit needs and explicit motives. ZRM training consists of five phases (for further details, see Storch, 2004b; Storch & Krause, 2002):

1. The first phase is designed to activate personal resources. To activate these resources, participants are presented with a set of pictures showing positive content (flowers, friendly encounters, beautiful landscapes, animals, etc.) and encouraged to select the picture that evokes positive somatic responses, such as pleasant bodily feeling (e.g., "Picture of a running dog" → somatic response: "Rush of blood to the head, feeling strong and capable of doing things, wanting to jump and run"). Then the participants are asked to explore why the respective pictures produced positive responses. This process is facilitated through group participation in the form of questions and hypotheses.

2. In the second step, action-oriented personal goals are developed on the basis of activated controllability by the participants and their motivational properties. To do so, personal goals are proposed and discussed in small groups of 3 (e.g., personal resource ["Picture of a running dog"] → personal goal: "To be active and to take risks"). After the formulation of a personal goal, participants are asked to write down a definition and operationalization of this goal with regard to its application and its anticipated positive and negative consequences.

3. Once a personal goal has been established, individual resources, defined as helpful means to achieve the personal goal, are built up around this goal. To enhance the facilitation of goal achievement, psychodramatic embodiment techniques are used. Embodiment work in the ZRM training is based on facial and postural feedback theories (Ekman, 2003; Neumann & Strack, 2000). To do so, participants develop their individual goal-related embodiment; this is a posture and/or a movement that, subjectively perceived by the participant, expresses the attitude, information-processing style, emotion, and behavior that facilitates the attainment of the personal goal. The physical, emotional, and cognitive experiences of the individual goal-related embodiment are then captured on paper.

4. In Phase 4, the goal-oriented use of these resources in predictable as well as unpredictable situations is prepared and practiced in role-plays. An emphasis in the fourth phase is placed on the identification and knowledge of precursors (so-called warning signals, e.g., "I turn away and a strong feeling of being powerless rushes through me") of problematic or unwanted emotions, cognitions, or behaviors (e.g., "I begin to stutter and, then, black out"). On the basis of these warning signals, strategies to stop the unwanted emotions, cognitions, or behaviors are sought and practiced, such as positive self-instructions and thought-stop techniques.

5. In the last phase, the contents and results of ZRM training are revised and discussed. Also, observed changes are discussed in small groups of 2 persons, with the aim of integrating these changes into the self-concept of one's own abilities and to allow transfer in daily life.

Measures

Sampling methods and biochemical analyses. Participants collected saliva using a device called the Salivette (manufactured by Sarstedt AG, Sevelen, Switzerland). Saliva samples were stored at room temperature until completion of the session. Samples were then stored at –20 °C until biochemical

analysis. The Salivettes were then centrifuged at 3,000 rpm for 5 min, which resulted in a clear supernatant of low viscosity. Salivary free cortisol concentrations were measured using a commercially available kit (Cortisol LIA; IBL, Hamburg, Germany) for chemiluminescence assay with high analytical sensitivity of 0.16 ng/ml.

Psychometric measures. To allow group comparison of relevant parameters at baseline (Questionnaire for Competence and Control Orientations; Measure for Assessment of General Stress Susceptibility; Center for Epidemiological Studies Depression Scale, German version; and PSS) in the TSST (PASA) and before and after the intervention (PSS), we used the following questionnaires:

• Questionnaire for Competence and Control Orientations (*Fragebogen zur Kontrollüberzeugungen und Kompetenzerwartung,* or FKK; Krampen, 1989)—This 32-item questionnaire assesses the following personality traits (Cronbach's α): self-concept of one's own competence (α .76), internality (α .70), powerful others control (α .73), and chance control (α .75).

• Measure for Assessment of General Stress Susceptibility (*Messinstrument zur Erfassung der Stressanfälligkeit,* or MESA; Schulz, Jansen, & Schlotz, in press)—This instrument assesses stress susceptibility on six scales (Cronbach's α): Sensitivity to Failure (α .81), Tolerance of Work Load (α .87), Tolerance of Social Conflicts (α .56), Sensitivity to Criticism (α .80), Tolerance of Uncertainty (α .88), and Ability to Relax (α .81). The MESA yields information on the duration and magnitude of cognitive, physical, social, and emotional reactions that a person typically shows in response to a stressful event. Although the single scales provide information about distinct aspects of stress susceptibility, the total test score serves as a measure of general stress susceptibility.

• Center for Epidemiological Studies Depression Scale, German version (*Allgemeine Depressions Skala—Kurzform,* or ADS–K; Hautzinger & Bailer, 1993)—The ADS–K is a German version of the Center for Epidemiological Studies Depression Scale (Radloff, 1977). It was developed specifically for use in investigations in nonclinical samples to screen for depressive affect and negative thought patterns. Cronbach's alpha for this measure is .90.

• PSS (Cohen, Kamarck, & Mermelstein, 1983)—A German translation of the PSS was used to assess the degree to which situations in life experienced during the previous month are appraised as stressful. The PSS was designed to assess with 14 items how predictable, uncontrollable, and overloading participants find their lives. Cronbach's alpha is .85.

• PASA (Gaab et al., 2005)—This instrument was specifically constructed to assess cognitive appraisal processes in the TSST according to transactional stress theory. The PASA is composed of four situation-specific subscales assessing (primary appraisal) Challenge (α .64) and Perceived Threat (α .85) as well as (secondary appraisal) Self-Concept of One's Own Competence (α .79) and Control Expectancy (α .76). The primary scales can be summarized to form two secondary scales (Primary Appraisal, α .80, and Secondary Appraisal, α .74). Scales range from 1 (*very little*) to 6 (*very much*). To be able to assess anticipatory cognitive appraisals, the PASA was administered between the introduction to the TSST and the actual TSST (see Figure 1).
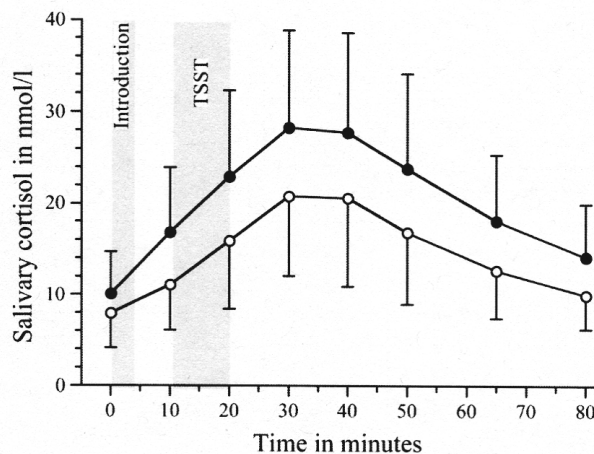

Figure 1. Cortisol responses in the Trier Social Stress Test (TSST) between groups (means and standard deviations). Treatment group white circle; control group black circle. Note: Absolute levels are depicted.

Data Analysis Methods

Analyses of covariance and variance for repeated measures were computed to analyze endocrine responses between groups, controlling for differences in endocrine baseline levels when indicated. All reported results were corrected by the Greenhouse-Geisser procedure where appropriate (violation of sphericity assumption). Regression analysis was used to assess associations between psychological and cortisol parameters. For cortisol parameters, areas under the response curve were calculated with respect to increase (AUCi) and ground (AUCg), using the trapezoidal method as an indicator for the integrated cortisol response in the TSST (Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). Data were tested for normal distribution and homogeneity of variance using the Kolmogorov-Smirnov test and Levene's test before statistical procedures were applied. The optimal total sample size of 64 to detect an expected multivariate effect size of .25 (representing a medium to large effect size) with a power of .85 and equal to .05 was calculated a priori with the statistical software G-Power (Buchner, Faul, & Erdfelder, 1997). For all analyses, the significance level was .05. Unless indicated, all results are shown as means and standard deviations.

Results

As a result of dropout, not all allocated participants participated in the ZRM training (treatment condition, n 26; control condition, n 28). Reasons for dropout were as follows: inability to attend intervention dates (n 7), lost interest in participating in study (n 2), or no reasons provided (n 1). Groups did not differ in their proportion of dropouts, and dropouts did not differ in any baseline variable from participants (data not shown). Groups did not differ significantly in mean age in years (treatment group M 24.8, SD 2.5; control group M 24.8, SD 2.8), $F(1, 52)$ 0.001, p .98; body mass index (treatment group M 22.1, SD 1.9; control group M 21.7, SD 1.7), $F(1, 52)$ 0.7, p .41; or in any of the descriptive and pretreatment psychometric questionnaires (Table 1).

The TSST resulted in a significant cortisol response, time effect $F(2.10, 109.41)$ 83.51, p .001 (Figure 1). Groups showed a trend to differ in their basal cortisol levels before the TSST, $F(1, 52)$ 3.27, p .07 (Figure 1); therefore, baseline cortisol levels were treated as covariates in the following repeated measures analysis. Controlling for baseline cortisol levels, which significantly influenced cortisol responses over time, Baseline Cortisol Level   Time interaction effect $F(1, 52)$ 10.59, p .001, stress responses over time differed significantly between groups, Group   Time Interaction effect $F(2.00, 102.33)$ 3.81, p .03, effect size f^2 0.28 (Figure 1), with participants in the treatment group showing a lower cortisol response curve. When baseline cortisol level differences were not controlled for, groups showed a trend to differ in their cortisol stress response over time, Group   Time interaction effect $F(2.10, 109.41)$ 2.25, p .10; effect size f^2 0.22 (Figure 1). Groups differed significantly in the overall cortisol response, group effect $F(1, 52)$ 10.83, p .002, and the integrated cortisol responses, as indicated by the AUCg, $F(1, 52)$ 4.41, p .04, effect size d 0.83 (Figure 2, left), and AUCi, $F(1, 52)$ 11.11, p .002, effect size d 0.55 (Figure 2, right).

Groups differed significantly in their anticipatory cognitive appraisal of the TSST, as assessed by the PASA (see Table 2). To assess whether group differences in cognitive appraisal of the TSST (see below) had an influence on the cortisol stress response, the PASA scales were included in the calculations as covariates. Analysis of covariance results indicated that primary stress appraisal showed a trend to influence the cortisol stress response, time effect $F(2.07, 105.44)$ 2.25, p .10, effect size f^2 .15. The inclusion of this psychological factor eliminated the observed trend toward significance of group differences in the cortisol response over time, Group   Time interaction effect $F(2.07, 105.44)$ 0.89, p .42.

The possible mediation of the intervention effects on the cortisol response through primary stress appraisal was also tested by the statistical approach described by Baron and Kenny (1986, p. 1177). Therefore, we ran the following three regression equations:
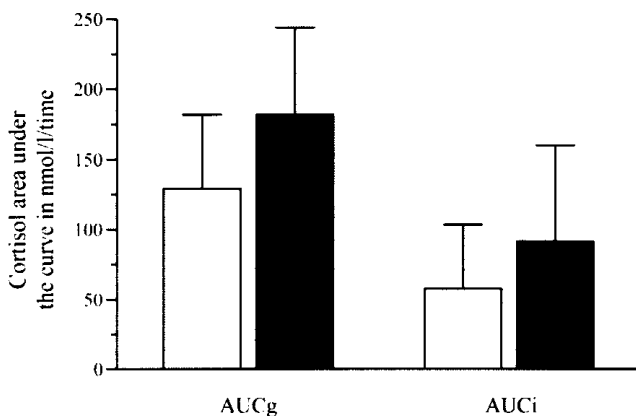

Figure 2. Area under the cortisol response curve in the Trier Social Stress Test (means and standard deviations). Treatment group   white bars; control group   black bars; AUCg   area under the response curve with respect to ground; AUCi   area under the response curve with respect to increase.

(a) regressing the mediator (PASA Primary Appraisal scale) on the independent variable (grouping), (b) regressing the dependent variable (AUCg) on the independent variable (grouping), and (c) regressing the dependent variable (AUCg) on the independent variable (grouping) and the mediator (PASA Primary Appraisal scale) variable. Results of these regression analyses indicated that all three conditions were needed for the mediation of the primary appraisal between the grouping and the cortisol responses held in the predicted direction: (a) The independent variable (grouping) affected the mediator (PASA Primary Appraisal scale), adjusted R^2 .12, $F(1, 51)$ 8.16, p .006,   0.37, $t(50)$ 2.86, p .006; (b) the independent variable (grouping) affected the dependent variable (AUCg), adjusted R^2 .16, $F(1, 51)$ 11.12, p .002,   0.42, $t(50)$ 3.34, p .002; and (c) the mediator (PASA Primary Appraisal scale) affected the dependent variable (AUCg), and the effect of the independent variable (grouping) is lower in the third equation than in the second, adjusted R^2 .22, $F(1, 51)$ 8.59, p .001 (grouping   0.31, $t(50)$ 2.86, p .02; PASA Primary Appraisal   0.30, $t(50)$ 2.27, p .02).

With regard to the level of perceived stress, groups showed a trend toward differences over time, Group   Time interaction effect $F(1, 49)$ 3.5, p .07, effect size f^2 .06, with a moderate reduction of PSS levels in the treatment group (treatment group: pretreatment M 22.7, SD 4.4; posttreatment M 20.0, SD 4.5; and control group: pretreatment M 21.5, SD 6.6; posttreatment M 21.9, SD 5.1).

Discussion

This study set out to evaluate the effectiveness of a resource-focused intervention to reduce psychobiological stress responses in healthy participants. Randomization yielded two groups with comparable baseline stress susceptibility, levels of perceived stress, depressive symptoms, and personality profile, with the exception of a single personality scale (the FKK's Chance Control). Both groups also had inconspicuous scores on these scales, making it unlikely that the participants were particularly stressed or stress prone.

Three months after receiving ZRM training, participants in the treatment group showed a decreased cortisol stress response in the standardized stress test. As indicated by analysis of covariance and the regression analyses, the endocrine response differences were influenced by differences in participants' stress appraisal of the situation, which was lower in the treatment group than in the control group. The participants trained in ZRM also showed a trend toward a modest reduction in the level of perceived stress. However, it should be mentioned that study participants had already low levels of perceived stress at baseline, so that chances to further diminish perceived stress were restricted.

In summary, the results show that resource-activating self-management training has beneficial effects on the psychobiological stress response. The results are comparable in direction and magnitude to those seen in previous studies with similar designs and methods using CBSM techniques but focusing on problem-oriented procedures (Gaab et al., 2003; Hammerfald et al., 2006).

The fact that the treatment had an effect on primary but not secondary appraisal needs to be addressed. From an anatomical perspective, psychosocial stress is assumed to be processed through limbic forebrain circuits, with stress-inhibiting inputs from

Table 2
Group Differences in Anticipatory Cognitive Appraisal in the Trier Social Stress Test

PASA scales	Treatment group		Control group		F	dfs	p	Effect size (f^2)
	M	SD	M	SD				
Primary					2.7	4, 49	.04	0.20
Threat	2.5	0.9	3.1	0.9	5.5	1, 52	.02	
Challenge	4.1	0.7	4.5	0.7	5.1	1, 52	.03	
Self-concept of one's own competence	4.0	0.8	4.1	0.8	0.1	1, 52	.72	
Control Expectancy	4.6	1.2	4.7	0.8	0.2	1, 52	.70	
Secondary					4.3	2, 51	.02	0.16
Primary appraisal	3.3	0.7	3.8	0.6	8.2	1, 52	.01	
Secondary appraisal	4.3	0.8	4.4	0.6	0.2	1, 52	.60	

Note. PASA Primary Appraisal Secondary Appraisal Scale.

prefrontal cortex areas and stress-enhancing inputs from the amygdala (Herman et al., 2003). This anatomical differentiation may reflect the distinction between implicit, affective evaluation through limbic system areas, such as the amygdala, and the explicit, mnemonic functions of the frontal cortex and the hippocampus. In line with these anatomical assumptions, a recent study reported the interesting finding that primary appraisal, reflecting the affective evaluation of a given situation, is an important predictor of consecutive cortisol responses, whereas secondary appraisal processes were of lesser importance in this regard (Gaab et al., 2005). The observed differences between primary and secondary appraisal could also be a result of differences in the importance of these two aspects of cognitive appraisal. As Slovic, Peters, Finucane, and MacGregor (2005) stated, the implicit affective evaluation may serve as a cue for judgment—in our case, for judging a situation as not stressful. Meichenbaum and Fitzpatrick (1993) discussed that primary appraisal is specifically needed in the face of oncoming stressors, whereas secondary appraisal processes are useful for coping with past stressors. Consequently, to proactively buffer people against the stresses of daily life, it may be crucial to address primary appraisal processes. Here, implicit self-enhancement might be the way to go.

It should be noted that, with regard to possible psychological mediators between the intervention and the observed endocrine responses, we did only assess the results of a seemingly effortful cognitive evaluation process of the oncoming situation. However, we did not attempt to assess processes that might have been more directly related to the type of intervention in use. Here, other procedures and approaches need to be addressed in future research. For example, Ellenbogen, Schwartzman, Stewart, and Walker (2006) recently reported that effortful and automatic processing regulate different aspects of the stress response. It would be very interesting to examine the effect of psychotherapeutic interventions on these different aspects of stress processing and to study possible differences between different psychotherapeutic approaches to influence these processes.

Several limitations to this research warrant comment. First, the sample consisted of healthy, highly educated young men. Although the restrictive exclusion criteria used helped to guarantee a high internal validity and comparability to previous studies, they limit the generalizability of the findings. For example, stress responses seen in young, male, and healthy participants cannot be extrapolated directly to elderly individuals (Kudielka, Buske-Kirschbaum, Hellhammer, & Kirschbaum, 2004) or to patient populations with preexisting HPA axis dysregulations (see, e.g., Gaab et al., 2002; Heim et al., 2000). Further studies are clearly needed to replicate the reported effects in other populations before definite conclusions are drawn. Also, it needs to be noted that the described inclusion and exclusion criteria were solely assessed through self-report. As our study protocol did not include a medical examination, we cannot rule out the possibility that study participants did not meet the described criterion for participation.

Second, we did not assess cortisol levels under resting conditions. Therefore, we cannot rule out that the response differences were caused by preexisting HPA axis differences. Likewise, because cortisol responses in the TSST habituate in the majority of people (Kirschbaum et al., 1995), it was not possible to assess cortisol stress responses before and after the intervention. However, groups did not differ in their baseline cortisol levels before the stress test, but they clearly differed in their total integrated cortisol responses. Furthermore, both groups showed similar scores on the pretreatment personality and stress scales. For this reason, we are confident that the results are not due to preexisting endocrine or psychological differences between treatment and control groups.

Third, we did not include a direct comparison with other treatments, such as CBSM. This makes it difficult to determine what treatment component or combination of components, respectively, was responsible for modification of the cortisol response.

Fourth, our findings focus on the TSST, a standardized laboratory stressor, that has been shown to be a potent and reliable activator of the HPA axis response (Kirschbaum et al., 1993). However, changes in cortisol levels in response to naturalistic daily stressors and negative affect are clearly of a smaller magnitude (Smyth et al., 1998). Also, there are no studies as yet available with direct comparisons between the psychobiological stress responses to the TSST and to naturalistic daily stressors.

The results of this study have implications for future research. This is the first study to report that resource-activating self-management training has effects on endocrine and psychological responses to acute laboratory stress. More important, the effects were observed 3 months after the participants had been trained in ZRM. Compared with CBSM, ZRM training has potentially advantageous elements, as working with individually developed

resource-activating methods may have a beneficial impact on the sustainability of intrinsic motivation, thus improving clients' commitment and minimizing training drop-out rate. Studies to come will have to show whether this type of training can also be useful with clinical groups.

References

Antoni, M. H., Cruess, S., Cruess, D. G., Kumar, M., Lutgendorf, S., Ironson, G., et al. (2000). Cognitive-behavioral stress management reduces distress and 24-hour urinary free cortisol output among symptomatic HIV-infected gay men. *Annals of Behavioral Medicine, 22*(1), 29–37.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51,* 1173–1182.

Buchner, A., Faul, F., & Erdfelder, E. (1997). *G Power: A priori, post-hoc, and compromise power analyses for the Macintosh* (Version 2.1.2). Trier, Germany: University of Trier.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385–396.

Cruess, D. G., Antoni, M. H., Kumar, M., Ironson, G., McCabe, P., Fernandez, J. B., et al. (1999). Cognitive-behavioral stress management buffers decreases in dehydroepiandrosterone sulfate (DHEA-S) and increases in the cortisol/DHEA-S ratio and reduces mood disturbance and perceived stress among HIV-seropositive men. *Psychoneuroendocrinology, 24,* 537–549.

Cruess, D. G., Antoni, M. H., McGregor, B. A., Kilbourn, K. M., Boyers, A. E., Alferi, S. M., et al. (2000). Cognitive-behavioral stress management reduces serum cortisol by enhancing benefit finding among women being treated for early stage breast cancer. *Psychosomatic Medicine, 62*(3), 304–308.

Cunningham, W. A., Johnson, M. K., Gatenby, J. C., Gore, J. C., & Banaji, M. R. (2003). Neural components of social evaluation. *Journal of Personality and Social Psychology, 85,* 639–649.

Damasio, A. (1994). *Descartes' error: Emotion, reason and the human brain.* New York: Avon.

Devos, T., & Banaji, M. R. (2003). Implicit self and identity. *Annals of the New York Academy of Sciences, 1001,* 177–211.

Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. *Psychological Bulletin, 130,* 355–391.

Ekman, P. (2003). *Emotions revealed: Understanding faces and feelings.* London: Weidenfeld & Nicolson.

Ellenbogen, M. A., Schwartzman, A. E., Stewart, J., & Walker, C. D. (2006). Automatic and effortful emotional information processing regulates different aspects of the stress response. *Psychoneuroendocrinology, 31,* 373–387.

Gaab, J., Blattler, N., Menzi, T., Pabst, B., Stoyer, S., & Ehlert, U. (2003). Randomized controlled evaluation of the effects of cognitive-behavioral stress management on cortisol responses to acute stress in healthy subjects. *Psychoneuroendocrinology, 28,* 767–779.

Gaab, J., Huster, D., Peisen, R., Engert, V., Heitz, V., Schad, T., et al. (2002). Hypothalamic-pituitary-adrenal axis reactivity in chronic fatigue syndrome and health under psychological, physiological, and pharmacological stimulation. *Psychosomatic Medicine, 64*(6), 951–962.

Gaab, J., Rohleder, N., Nater, U. M., & Ehlert, U. (2005). Psychological determinants of the cortisol stress response: The role of anticipatory cognitive appraisal. *Psychoneuroendocrinology, 30,* 599–610.

Gassmann, D., & Grawe, K. (2006). General change mechanisms: The relation between problem activation and resource activation in success-

ful and unsuccessful therapeutic interactions. *Clinical Psychology and Psychotherapy, 13,* 1–11.

Grawe, K. (2002). *Psychological psychotherapy.* Seattle, WA: Hogrefe & Huber.

Greenwald, A. G., & Farnham, S. D. (2000). Using the implicit association test to measure self-esteem and self-concept. *Journal of Personality and Social Psychology, 79,* 1022–1038.

Hammerfald, K., Eberle, C., Grau, M., Kinsperger, A., Zimmermann, A., Ehlert, U., et al. (2006). Persistent effects of cognitive-behavioral stress management on cortisol responses to acute stress in healthy subjects—A randomized controlled trial. *Psychoneuroendocrinology, 31, 333*–339.

Hautzinger, M., & Bailer, M. (1993). *Allgemeine Depressions-Skala* [Center for Epidemiological Studies Depression Scale] Weinheim, Germany: Beltz.

Heim, C., Newport, D. J., Heit, S., Graham, Y. P., Wilcox, M., Bonsall, R., et al. (2000). Pituitary-adrenal and autonomic responses to stress in women after sexual and physical abuse in childhood. *Journal of the American Medical Association, 284,* 592–597.

Herman, J. P., Figueiredo, H., Mueller, N. K., Ulrich-Lai, Y., Ostrander, M. M., Choi, D. C., et al. (2003). Central mechanisms of stress integration: Hierarchical circuitry controlling hypothalamo-pituitary-adrenocortical responsiveness. *Frontiers in Neuroendocrinology, 24,* 151–180.

Kirschbaum, C., Gonzalez Bono, E., Rohleder, N., Gessner, C., Pirke, K. M., Salvador, A., et al. (1997). Effects of fasting and glucose load on free cortisol responses to stress and nicotine. *Journal of Clinical Endocrinology and Metabolism, 82,* 1101–1105.

Kirschbaum, C., Kudielka, B. M., Gaab, J., Schommer, N. C., & Hellhammer, D. H. (1999). Impact of gender, menstrual cycle phase, and oral contraceptives on the activity of the hypothalamus-pituitary-adrenal axis. *Psychosomatic Medicine, 61*(2), 154–162.

Kirschbaum, C., Pirke, K. M., & Hellhammer, D. H. (1993). The "Trier Social Stress Test"—A tool for investigating psychobiological stress responses in a laboratory setting. *Neuropsychobiology, 28*(1–2), 76–81.

Kirschbaum, C., Prussner, J. C., Stone, A. A., Federenko, I., Gaab, J., Lintz, D., et al. (1995). Persistent high cortisol responses to repeated psychological stress in a subpopulation of healthy men. *Psychosomatic Medicine, 57*(5), 468–474.

Kirschbaum, C., Wust, S., & Strasburger, C. J. (1992). "Normal" cigarette smoking increases free cortisol in habitual smokers. *Life Sciences, 50*(6), 435–442.

Kivimäki, M., Vahtera, J., Elovainio, M., Helenius, H., Singh-Mandoux, A., & Pentti, J. (2005). Optimism and pessimism as predictors of change in health after death or onset of severe illness in family. *Health Psychology, 24,* 413–421.

Krampen, G. (1989). *Fragebogen zu Kompetenz- und Kontrollüberzeugungen (FKK)* [Questionnaire for competence and control expectancies]. Göttingen, Germany: Hogrefe.

Kudielka, B. M., Buske-Kirschbaum, A., Hellhammer, D. H., & Kirschbaum, C. (2004). HPA axis responses to laboratory psychosocial stress in healthy elderly adults, younger adults, and children: Impact of age and gender. *Psychoneuroendocrinology, 29,* 83–98.

Lazarus, R. S. (2005). Emotions and interpersonal relationships: Toward a person-centered conceptualization of emotions and coping. *Journal of Personality, 74,* 1–38.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping.* New York: Springer.

McEwen, B. S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine, 338,* 171–179.

Meichenbaum, D., & Fitzpatrick, D. (1993). A constructivist narrative perspective of stress and coping: Stress inoculation applications. In L. G. S. Breznitz (Ed.), *Handbook of stress: Theoretical and clinical aspects* (2nd ed., pp. 706–724). New York: Free Press.

Neumann, R., & Strack, F. (2000). Approach and avoidance: The influence

of proprioceptive and exteroceptive cues on encoding of affective information. *Journal of Personality and Social Psychology, 79,* 39–48.

Penedo, F. J., Dahn, J. R., Gonzalez, J. S., Molton, I., Carver, C. S., Antoni, M. H., et al. (2003). Perceived stress management skill mediates the relationship between optimism and positive mood following radical prostatectomy. *Health Psychology, 22,* 220–222.

Perna, F. M., Antoni, M. H., Kumar, M., Cruess, D. G., & Schneiderman, N. (1998). Cognitive-behavioral intervention effects on mood and cortisol during exercise training. *Annals of Behavioral Medicine, 20*(2), 92–98.

Pruessner, J. C., Kirschbaum, C., Meinlschmid, G., & Hellhammer, D. H. (2003). Two formulas for computation of the area under the curve represent measures of total hormone concentration versus time-dependent change. *Psychoneuroendocrinology, 28,* 916–931.

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement, 1,* 385–401.

Richman, L. S., Kubzansky, L., Maselko, J., Kawachi, I., Choo, P., & Bauer, M. (2005). Positive emotion and health: Going beyond the negative. *Health Psychology, 24,* 422–429.

Sapolsky, R. M., Romero, L. M., & Munck, A. U. (2000). How do glucocorticoids influence stress responses? Integrating permissive, suppressive, stimulatory, and preparative actions. *Endocrine Reviews, 21,* 55–89.

Schulz, P., Jansen, K. L., & Schlotz, W. (2005). Stressreaktivität: Theoretisches Konzept und Messung [Stress reactivity: Construct and measurement]. *Diagnostica, 51,* 124–133.

Seeman, T. E., McEwen, B. S., Rowe, J. W., & Singer, B. H. (2001). Allostatic load as a marker of cumulative biological risk: MacArthur studies of successful aging. *Proceedings of the National Academy of Sciences of the United States of America, 98,* 4770–4775.

Slovic, P., Peters, E., Finucane, M. L., & MacGregor, D. G. (2005). Affect, risk, and decision making. *Health Psychology, 24,* 35–40.

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

Storch, M. (2004a). Implications of neuroscientific research for psychotherapy. *European Psychotherapy, 1,* 1–24.

Storch, M. (2004b). Resource-activating self-management with the Zurich Resource Model (ZRM). *European Psychotherapy, 1,* 27–64.

Storch, M., & Krause, F. (2002). *Selbstmanagement—ressourcenorientiert. Grundlagen und Trainingsmanual für die Arbeit mit dem Zürcher Ressourcen Modell ZRM* [Self-management—resource oriented: Theoretical background and training manual of the Zurich Resource Model (ZRM)]. Bern: Huber.

Strack, F., & Deutsch, R. (2004). Reflective and impulsive determinants of social behavior. *Personality and Social Psychology Review, 8,* 220–247.

Wegner, D. M. (2002). *The illusion of conscious will.* Cambridge, MA: MIT Press.

Wust, S., Van Rossum, E. F., Federenko, I. S., Koper, J. W., Kumsta, R., & Hellhammer, D. H. (2004). Common polymorphisms in the glucocorticoid receptor gene are associated with adrenocortical responses to psychosocial stress. *Journal of Clinical Endocrinology and Metabolism, 89,* 565–573.