

L'exploration des réponses psychoneuroendocriniennes à la menace de cancer : réflexions à partir d'une tâche réalisée en contexte d'imagerie mentale dirigée assistée par ordinateur

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Il est proposé que les ordinateurs puissent servir à examiner l'expérience subjective des patientes face à la menace de cancer. Cette étude fournit une validation initiale d'une tâche assistée par ordinateur inductrice de stress en examinant les aspects psychologiques et relatifs aux systèmes nerveux autonome et endocrinien liés à l'expérience subjective vécue par une personne face à la menace de cancer, à l'occasion d'un examen de dépistage par mammographie. Un modèle d'analyse par mesures répétées a été employé. Un total of 38 femmes en bonne santé ont effectué une tâche induisant un stress (se rapportant à la mammographie) et une tâche témoin (se rapportant à la prévention de l'ostéoporose), réalisée chacune un jour différent, et les réactions d'ordre psychologique et relatives aux systèmes nerveux autonome et endocrinien de ces femmes ont été contrôlées. Comparativement à la tâche témoin, la tâche induisant un stress a entraîné des réactions plus importantes du système nerveux autonome (variabilité de la conductance cutanée et du rythme cardiaque) et du système endocrinien (sécrétion de cortisol salivaire), mais aucune détresse psychologique. De plus, tant la réaction du système nerveux autonome (conductance cutanée) que les réactions endocriniennes à la menace de cancer ont été modérées par la maîtrise, trait reconnu pour ses effets régulateurs de stress. Mais cet effet modérateur n'a pas été observé au chapitre des indices psychologiques de stress, c'est-à-dire de l'humeur. Les implications de ces constatations pour la recherche et les interventions en soins infirmiers font présentement l'objet de discussions.

Mots clés : stress, tâche induisant un stress, mammographie, imagerie

Exploring Women's Psychoneuroendocrine Responses to Cancer Threat: Insights from a Computer-Based Guided Imagery Task

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It is proposed that computers could be used to examine patients' subjective experience in the face of cancer threat. This study provides initial validation of a computer-based stress task by examining the psychological, autonomic, and endocrine aspects of an individual's subjective experience of cancer threat surrounding mammography screening. A repeated measures design was used. A total of 38 healthy women performed a stress task (pertaining to mammography) and a control task (pertaining to osteoporosis prevention) on separate days during which psychological, autonomic, and endocrine reactions were monitored. Compared with the control task, the stress task induced higher autonomic responses (skin conductance and heart rate variability) and endocrine responses (salivary cortisol) but not psychological distress. Further, both the autonomic (skin conductance) and endocrine responses to cancer threat were moderated by mastery, a trait known to have a stress-buffering effect. Yet such a moderating effect was not observed for psychological indices of stress — that is, mood. Implications for nursing research and interventions are discussed.

Keywords: Stress, stress task, mammography, psychoneuroendocrine model, imagery

Over recent decades, developments in information-processing and communication technology have opened up broad-ranging possibilities in various aspects of health care. The Internet and computers are now playing an important role not only in providing health information but also in building virtual communities and facilitating nursing and other health-care interventions (Robinson, Patrick, Eng, & Gustafson, 1998; Rogers & Chen, 2005). In the present work, it is proposed that the power of technology can be harnessed further to examine patients' emotions and other aspects of their subjective experience when they are faced with threats to their health and well-being. Careful consideration of patients' emotions is critical to the success of nursing care, in particular when it comes to health communication and disease prevention/detection (Dubé, 2003; Dubé, Ferland, & Moskowitz, 2003; Thorpe et al.,

2006). In this study we provide the first validation of a computer-based stress task designed to capture the various psychophysiological facets of stress experience in the face of cancer threat.

Studies have found that for many women the perceived cancer threat is particularly salient surrounding a mammography procedure (Brett, Bankhead, Henderson, Watson, & Austoker, 2005). In addition to the fear of pain and discomfort associated with mammography, women report fear and anxiety about a possible finding of cancer, with significant health consequences (Stewart-Brown & Farmer, 1997; Wardle & Pope, 1992). Although both the fear of the procedure and the fear of cancer detection may contribute to women's stress experience, the stress task that we report on here focuses on women's stress experience arising from intensified fear of cancer detection.

The subjective experience of cancer threat has typically been measured by self-report of physical and/or psychological distress taken at different points over the course of detection procedures. An important limitation of self-report is that it captures only the psychological part of subjective experience, the part that is accessible to consciousness (Tomarken, 1995; Wright, 1980). Yet it is well known that subjective experience, in particular stress, is also shaped by neurophysiologic and endocrine responses to one's environment. This multifaceted view of stressful experience has been encapsulated in the psychoneuroendocrine (PNE) model of stress (Ursin & Eriksen, 2004). Research has found that the three components of stress experience — psychological, autonomic, and endocrine — do not necessarily evolve in tandem and that each component has a distinguishable impact on information processing and decision-making, as well as on health outcomes (Porter et al., 2003; Schommer, Hellhammer, & Kirschbaum, 2003). In real life and actual time, however, the measurement of these three components of the subjective experience becomes a challenge due to the extended time boundaries of diagnostic procedures as well as the functional and technical constraints attached to the measurement of the neurological and endocrine components of stress in the midst of everyday life.

In the present study we examine the possibility that, beyond its extremely useful application in providing health information, the computer can be used to examine the different facets of emotional experience of cancer threat that are particularly salient during anomaly screening. We draw from recent developments in mental imagery as a valid way to simulate subjective experience (e.g., Roffe, Schmidt, & Ernst, 2005), in order to develop a computer-supported laboratory task that simulates the subjective experience of being exposed to cancer threat with benign outcomes. We will show that the neuroendocrine components of the stressful experience in the face of breast cancer threat are

more easily elicited than self-reported subjective feelings of distress. We will further show that the computer-based guided imagery task, akin to robust evidence in field settings (Holmes & Mathews, 2005; Mathews & Mackintosh, 2000; Mathews & MacLeod, 2002; Roffe et al.), is able to capture the buffering effect of mastery over stress response intensity.

Theoretical Background

The PNE Approach to Stress

Studies across various domains are converging to suggest that stress is essentially an integrated PNE process (for a review, see Ursin & Eriksen, 2004). Specifically, exposure to aversive stimuli triggers psychological, autonomic, and endocrine responses. The psychological responses are manifested in various discrete subjective feelings such as anxiety and depression. The autonomic responses include changes in electrodermal properties (e.g., skin conductance) and cardiovascular activities (e.g., heart rate). The endocrine responses include increased secretion of certain hormones, such as cortisol. The PNE view of stress has received robust theoretical and empirical support from various fields, including animal studies (Toates, 2004), human psychology (Ursin & Eriksen), and neuroscience (LeDoux, 1995).

Although a stress response typically involves changes in all PNE components, research evidence suggests that the different response modes are mediated through relatively distinct neural pathways (LeDoux, 1995). Thus the PNE stress responses may not be highly correlated (Cohen, Scribner, & Farley, 2000; LeDoux; Schommer et al., 2003) and may uniquely predict behavioural/attitudinal change under stress. The relative independence of the PNE components suggests that stress responses are ideally measured using an integrated protocol that traces autonomic and endocrine as well as psychological changes.

Stress Experience Associated with Mammography Screening

Numerous studies have investigated the impact of mammography screening on women's emotional well-being. Overall, the preponderance of research evidence suggests that, partly due to the temporarily salient perception of cancer threat, a mammography procedure is associated with considerable psychophysiological stress responses, even when the outcome is benign (Britton, 2005; Grossi, Ahs, & Lundberg, 1998). However, most of the studies have focused on the psychological aspects of the stress experience surrounding mammography (Consedine, Magai, Krivoshekova, Ryzewicz, & Neugut, 2004; Heckman et al., 2004). Some studies also looked at the physiological aspects of stress responses to mammography or other cancer screening procedures, particularly

endocrine reactivity before or after such procedures (Gustafsson et al., 1995; Porter et al., 2003). For example, Porter et al. found that, in women without cancer history, mean daily cortisol levels increased around the time of mammography compared with baseline levels. Gustafsson et al. examined men's reaction to prostate cancer screening and found that, for examinees as a whole, serum cortisol levels at the examination were higher than corresponding levels of a comparable sample of men during normal daily activities.

Findings from these studies, in particular those that focused on the psychological aspect of stress, suggest that the stress experience is contingent upon the outcome of the screening procedure. Specifically, mammography screening with negative results, equivocal results, false-positive results, or delayed results has consistently been found to trigger stress (Kahn & Luce, 2003; Lerman et al., 1991; Lindfors, O'Connor, & Parker, 2001). However, some studies did not find elevated stress levels following a screening procedure with immediate benign results (Lerman et al.; Lindfors et al.), which is the focus of the present study. In addition, these studies have typically relied on self-report as a measure of stress, which may have failed to capture the stress experience in its totality.

Use of Mental Imagery to Evoke Emotions

Mental imagery is a technique that exploits the mind's ability to form representations of objects, places, or situations, which are perceived through one's senses, to simulate subjective experience (Post-White & Fitzgerald, 2001; Wilson & Barber, 1978). Researchers have long assumed that there is a link between mental imagery and emotions (Holmes & Mathews, 2005; Lang, 1979), and psychotherapists often use mental imagery to treat emotional disorders such as anxiety and phobia (Wolpe, 1958). Recent experimental studies provide evidence that mental imagery can induce emotion (Holmes & Mathews; Mathews & Mackintosh, 2000; Mathews & MacLeod, 2002). For example, Holmes and Mathews found that participants who had imagined unpleasant events experienced increased negative emotions such as anxiety. One technique widely used in psychotherapy and nursing care is guided imagery (Roffe et al., 2005), whereby the practitioner "guides" the individual through a mental experience in order to access physical, emotional, and spiritual dimensions of imagery for the purpose of inducing bodily change (Achterberg, 1985). In a guided mental imagery session, the practitioner typically leads the individual through imagery by following a script or asking the person to imagine himself or herself experiencing a situation as vividly as possible, with the imagery unfolding in a predetermined sequence that reflects the naturally occurring event.

The Moderating Effect of Mastery

Oncologists have stressed the importance of personality characteristics and psychological resources in patients' responses to nursing interventions (e.g., Loiselle, 2001). Research findings suggest that an individual's stress responses to cancer threat may be influenced by certain personality traits. One consistently observed moderator of stress experience is mastery, which refers to "the extent to which one regards one's life-chances as being under one's own control in contrast to being fatalistically ruled" (Pearlin & Schooler, 1978). Studies in both nursing care and psychotherapy have found mastery to be an important psychological resource for buffering stress in times of adversity. People with a weaker sense of mastery generally experience a higher degree of psychological distress and endocrine reactivity in stressful situations, whereas a strong sense of mastery generally attenuates such stress responses (e.g., Britton, 2005; Grossi et al., 1998; Kim, Han, Shin, Kim, & Lee, 2005; Mausbach et al., 2006). However, few studies have investigated the moderating effect of mastery on autonomic responses, conceivably due to functional or technical constraints in measurement.

The present study was designed to develop and validate a computer-based guided imagery stress task. The stress task was validated using a PNE measurement protocol, concurrently measuring an individual's psychological, autonomic, and endocrine responses to cancer threat perceived during a mammography procedure. It was hypothesized that, given the consistently observed stress-buffering effect of mastery, the validity of the stress task would be further supported if individuals' PNE responses to the task were moderated by mastery in a way that is consistent with its stress-buffering effect.

Methods

Overview

The stress task was validated through an experimental study using a one-factor (experimental condition: stress vs. control) repeated measures design. Each participant performed two health-related imagery tasks: one control task and one stress task. The two tasks were performed on separate days roughly 2 weeks apart. The control task, pertaining to osteoporosis prevention, was performed during the first session and the stress task, pertaining to mammography screening with a benign outcome, during the second session. During both tasks, participants' PNE reactions were continuously measured. The study was approved by the ethics committee of the institution.

Participants

A total of 38 healthy women ($M_{\text{age}} = 58$, $SD = 7.83$) were recruited from the community through newspaper advertisements. When potential participants phoned in they were screened by the research assistant on several selection criteria. Only post-menopausal women were selected, in order to control for the effect of menstrual cycle on endocrine responses (Kirschbaum & Hellhammer, 1989). Other criteria were Body Mass Index < 30 ; no prior cancer history; and no drug, alcohol, or nicotine addiction. These factors potentially affect PNE reactions to stressors (Kirschbaum & Hellhammer).

Procedure

All experiments were conducted in individual sessions between 1 pm and 7 pm in a well-ventilated room. Participants sat in a high-back chair in front of an IBM-compatible computer. Two baseline salivary samples were obtained, at 5 and 10 minutes after the participant's arrival, followed by measurement of baseline mood. Next, participants were connected to the equipment for measurement of physiological responses. After a 2-minute rest period, they began performing either the control task or the stress task. They were instructed to concentrate on the respective task and minimize their body movements. Autonomic responses — skin conductance and heart rate — were continuously measured during the imagery tasks. Endocrine reaction — salivary cortisol — was sampled three times: at 6, 13, and 20 minutes into the task. Upon completion of the task, the physiological sensors were removed from the participant and post-task mood was measured. Two post-task endocrine measurements were taken: at 5 and 10 minutes after completion of the task. After the first session the women were given a questionnaire containing various measures, including the mastery scale, to take home. At the second session they returned the questionnaire, completed the imagery task, were thanked and debriefed, and left the laboratory. All participants received an incentive of \$75 for taking part in the study.

Computer-Administered Guided Imagery Tasks

Stress was manipulated using the technique of guided mental imagery administered via computer. The control task pertained to osteoporosis prevention and the stress task pertained to mammography screening. Each task lasted 20 minutes and consisted of several phases replicating real-life screening and diagnostic procedures. The stress task began with an introduction to breast cancer, followed by the two critical steps of detecting a suspicious lump in the breast and undergoing mammography screening. In the final phase participants imagined receiving screening

results indicating a benign outcome. They were guided through the task by instructions presented via multimedia Microsoft PowerPoint slides. To enhance the vividness of the imagery, the computer instructions included audio and visual cues. For example, at the moment of waiting for the mammography results, the participants heard the sound of a pounding heart and the ticking of a clock and saw the image of a looming office door. The control condition entailed a similar sequence in the context of osteoporosis: screening and a visit to the clinic with a prescription for prevention activities such as jogging or gardening. The two conditions were carefully matched in terms of length, cognitive complexity, and number of audio and visual cues.

Measures

Subjective experience was measured using the short form of the Profile Of Mood States (POMS-SF) (Shacham, 1983), which consists of a global negative mood scale — total mood disturbance (TMD) — and six subscales: anxiety, depression, anger, confusion, vigour, and fatigue. This scale is widely used by psycho-oncologists to capture transient mood states in both clinical and non-clinical settings. Consistent with reports of previous studies (Baker, Denniston, Zabora, Polland, & Dudley, 2002), Cronbach's alpha ranging from .80 to .90 was obtained for the TMD and each of the subscales. For the TMD and each subscale, a change score was calculated to index changes from pre- to post-task level.

Autonomic responses were measured in terms of skin conductance and heart rate, using MP equipment (Model 100A), a computer-based physiological data acquisition system developed by BIOPAC® Systems, Inc. Changes in skin conductance were measured via two EL500 Ag/AgCl disposable electrodes attached to the palmar surface of the participant's non-dominant hand. Variations in heart rate were recorded via two electrodes placed in a bipolar configuration on opposite sides of the participant's body. Consequently, if the participant was right-handed, one electrode was placed on her neck, on the aorta, and the other under her left ribcage. If the participant was left-handed, the reverse applied. Two indices of autonomic response were calculated: heart rate variability (HRV) and skin conductance. HRV was analyzed on the basis of an electrocardiogram (ECG). From the ECG, inter-beat (RR) intervals or time intervals between consecutive heartbeats were spectral analyzed using the Fast Fourier Transform technique. Analysis of HRV was carried out on two frequency bands: low frequency (LF) (.04 to .15 Hz), reflecting sympathetic activity with vagal modulation, and high frequency (HF) (.16 to .40 Hz), reflecting parasympathetic activity. The LF/HF ratio was calculated as a single index of mental stress (Hjortskov, Blangsted, Fallentin, Lundberg, & Sogaard, 2004). Skin conductance was measured

in terms of mean frequency of skin conductance spontaneous fluctuations (SCSF). A spontaneous fluctuation was defined as an elevation in magnitude of skin conductance level by .05 microSiemens (μS) lasting at least 2 seconds. Final analysis of SCSF was done using response per minute (SCSF/min). The mean SCSF for the 2 minutes immediately preceding the task was taken as the baseline measure. Prior to analysis, SCSF was adjusted by baseline level — that is, by subtracting the mean baseline from the task-related levels.

Endocrine activity was measured using salivary cortisol, sampled with a device called the salivette (Sarstedt Inc., Rommelsdorf, Germany). A salivette consists of a small cotton swab placed inside a standard centrifugation tube. By chewing on the swab, participants stimulate saliva flow to rates that generate sufficient material for radioimmune assay. After sampling, the tubes were frozen until assayed. The concentration level of cortisol was determined using a commercially available radioimmunoassay kit (Kirschbaum & Hellhammer, 1989). Preliminary analysis showed that the mean basal level of cortisol concentration did not differ for the two conditions ($F(1, 38) = .65, p > .40$). The area under the curve (AUC) was derived as an index of cortisol response and was used in the final analysis (Pruessner, Kirschbaum, Meinlschmid, & Hellhammer, 2003). AUC was calculated using both the basal and the task-related cortisol concentration values.

Mastery was measured using the mastery scale of Pearlin, Menaghan, Lieberman, and Mullan (1981). The instrument consists of seven items rated on a four-point scale (1 = does not apply at all; 4 = applies completely). Previous studies have found that the scale has good internal consistency (Cronbach's $\alpha = .76$) and test-retest reliability ($r = .65$ at 1-month interval) (Reich & Zautra, 1989). A mean score for mastery was calculated and used in the final analysis.

Results

PNE Responses to Cancer Threat

The first task was to examine whether the participant's psychophysiological reactions differed for the two experimental tasks. To this end, a series of repeated measures ANOVA were performed, with the PNE response variables as the dependent variable and stress condition as the independent variable. The means and standard deviation as well as the test statistics are presented in Table 1.

As can be seen in Table 1, the stress condition is associated with higher physiological reactions to cancer threat than the control condition. Specifically, regarding the autonomic responses, participants in the stress condition evidence higher SCSF ($p < .02$) and greater HRV

Table 1 *Mood, Autonomic, and Endocrine Changes in the Control and Stress Conditions*

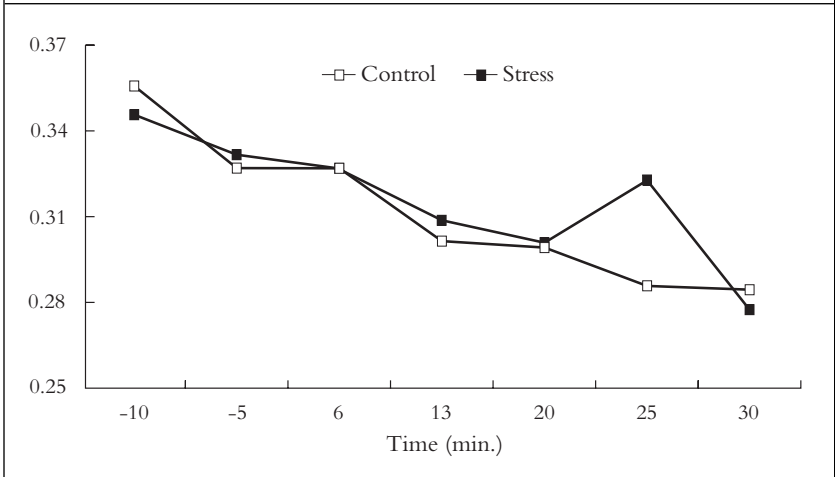
Dependent Variables	Control		Stress		F(1, 38)	p
	Mean	SD	Mean	SD		
Mood						
TMD	-.85	.36	-.36	1.08	.50	.48
Anxiety	-.35	.11	-.15	.19	.07	.79
Depression	-.15	.08	-.10	.24	.00	.96
Confusion	-.26	0.09	-.05	.19	.19	.66
Anger	.01	.09	-.21	.22	.55	.46
Fatigue	-.13	.11	-.01	.19	.27	.61
Vigour	-.11	.10	-.19	.17	.26	.62
Autonomic						
SCSF	2.02	.26	2.15	.24	6.28	< .02
HRV	3.37	.22	4.25	.23	8.62	< .01
Endocrine						
Salivary cortisol (AUC)	1.80	.05	1.93	.08	7.33	.01
<p>Note: Mood and autonomic responses are adjusted by baseline level; salivary cortisol is indexed by AUC. TMD = total mood disturbance; SCSF = skin conductance spontaneous fluctuation; HRV = heart rate variability; AUC = area under the curve.</p>						

($p < .01$). Compared with the control condition, the stress condition also induced higher endocrine response, as shown by the elevated salivary cortisol response ($p = .01$). Figure 1 shows the changes in cortisol concentration over time in the two conditions. Self-report measures of subjective experience, as indexed by the various POMS scales (TMD and the six subscales), did not differ for the two conditions, $ps > .40$. In other words, after receiving a benign outcome immediately following anomaly mammography screening, women did not report higher psychological distress or less intense upbeat feeling (as indexed by *vigour*; see Table 1) compared with the pre-screening level, in spite of the fact that manifestations of stress were present at the physiological and endocrine levels.

The Moderating Effect of Mastery

To investigate the potential moderating effect of mastery, a series of repeated measures analysis of covariance (ANCOVA) of the PNE response variables were performed, with the stress condition as a factor and trait mastery as a continuous covariate. The moderating effect of

Figure 1 *Changes in Cortisol Concentration Over Time in Control and Stress Conditions*

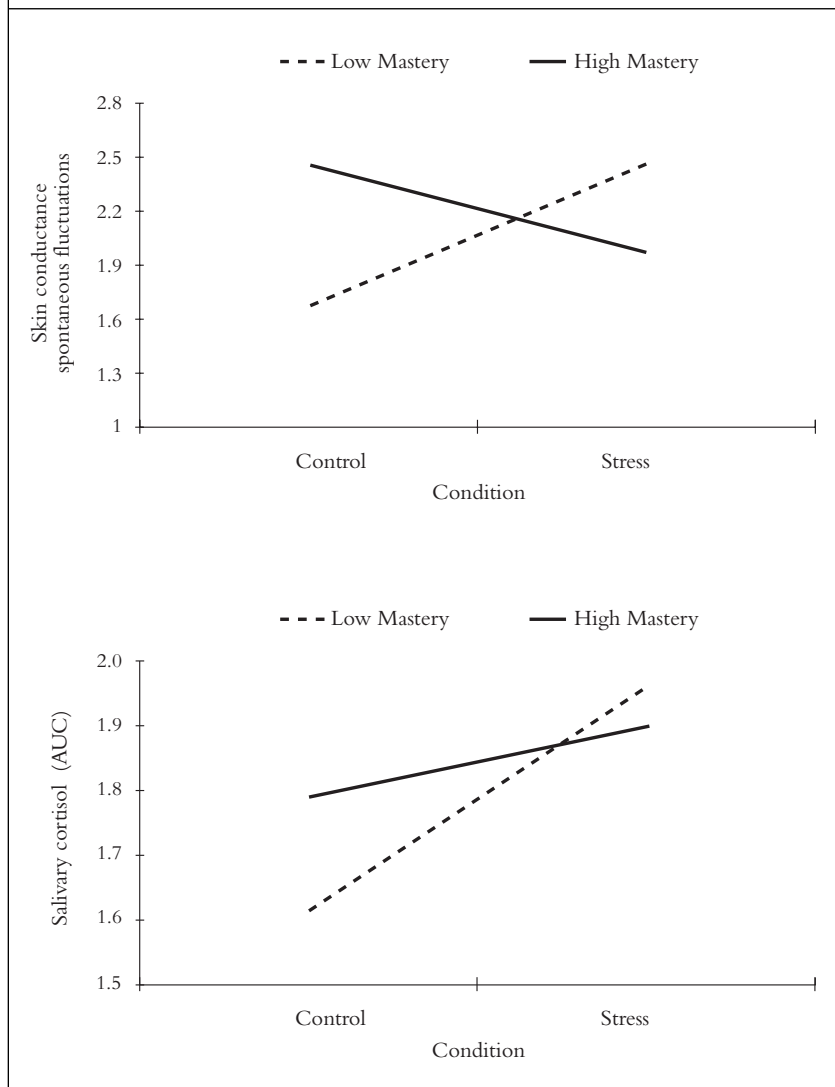


mastery could thus be detected by the presence of a significant *condition x mastery* interaction term. The ANCOVA showed a significant *condition x mastery* interaction effect on salivary cortisol, $F(2, 347) = 5.86, p < .01$, and skin conductance, $F(2, 29) = 4.9, p = .01$. However, no *condition x mastery* interaction effect was found on HRV, $p = .98$, or on any of the psychological variables — that is, POMS scores, $ps > .30$. The results also show a marginally significant negative effect of mastery on salivary cortisol, $\beta = -.02, F(1, 38) = 3.49, p = .07$, although mastery had no direct impact on any of the other psychophysiological variables.

To facilitate interpretation of the *condition x mastery* interaction effect on salivary cortisol and skin conductance, the participants were subsequently divided into high- and low-mastery groups based on a median split, $Mdn = 42$. Then salivary cortisol and skin conductance were subjected to repeated measures ANOVA, with the stress condition and mastery group as independent variables. Analysis showed a significant *condition x mastery group* interaction for both salivary cortisol, $F(2, 37) = 3.34, p = .01$, and skin conductance, $F(2, 37) = 3.11, p = .05$. Post-hoc contrast analysis showed that, consistent with the stress-buffering notion of mastery, low-mastery women evidenced increased cortisol reaction in the stress-versus-control condition, $M_{\text{stress}} = 1.96$ vs. $M_{\text{control}} = 1.61, F(1, 37) = 8.66, p < .01$. However, the cortisol responses of high-mastery participants did not differ between conditions, $M_{\text{stress}} = 1.90$ vs. $M_{\text{control}} = 1.79, F(1, 37) = .74, p = .40$. There was no difference between low- and high-mastery participants in either the control or the stress condition

($ps > .10$). Similarly, low-mastery participants showed increased skin conductance in the stress-versus-control condition, $M_{\text{stress}} = 2.45$ vs. $M_{\text{control}} = 1.67$, $F(1, 37) = 4.61$, $p < .05$, whereas high-mastery participants did not differ between conditions, $M_{\text{stress}} = 1.96$ vs. $M_{\text{control}} = 2.45$, $F(1, 37) = 1.54$, $p < .22$ (see Figure 2).

Figure 2 *Moderating Effect of Mastery on Skin Conductance and Salivary Cortisol*



Discussion

In this study we provided initial validation of a computer-based stress-induction task pertaining to the cancer threat that is typically experienced during a mammography procedure by tapping into the various psychophysiological facets of the stress experience. Compared with women in the control (low-threat) condition, those who underwent the simulated mammography procedure evidenced higher autonomic responses (as indexed by skin conductance and HRV) and endocrine responses (as indexed by salivary cortisol), although no difference in terms of psychological indices of stress (mood) was observed between conditions. The validity of the stress task was further supported by the observed stress-buffering effects of mastery on both autonomic and endocrine responses to cancer threat.

The use of a computer to capture the participant's subjective experience of being exposed to cancer threat opens many promising horizons. For example, researchers can use a modified imagery script to have patients recollect the anomaly screening experience once the benign diagnosis is known, in order to identify subgroups of patients whose stress response to the experience is most intense and who would benefit most from a stress-recovery intervention. Currently, the standard of care is that no support is given once the benign diagnosis is known. Considering the enormous impact of patient emotion on the effectiveness of nursing intervention programs, researchers can use this stress task for pilot-testing the effect of such programs, particularly in the area of health communication. In addition, the computer-supported guided imagery stress task could allow for pilot-testing and refinement of computer-supported interventions centred on the provision of health information prior to their empirical validation in clinical trials. The protocol of the stress task will also permit researchers to monitor both psychological and physiological responses to their intervention, thus having the potential to offer fresh insights into the mechanisms through which interventions influence patient attitudes and behaviours.

Although our primary purpose is to develop and validate a health-related laboratory stress task, findings from this study have several implications for nursing research and practice in general. One of our most notable findings was that after experiencing a temporarily salient cancer threat, participants evidenced stronger autonomic and endocrine stress responses but reported no change in subjective feelings (mood). Further, the stress-buffering effect of mastery was observed for autonomic and endocrine responses but not for the psychological indices of stress. Taken together, these findings clearly indicate that the psychological and physiological indices of stress experience do not always evolve in tandem. The

dissociation between the psychological and physiological measures also suggests that research that relies primarily on self-report to capture a person's experience of cancer threat may not be sufficiently sensitive to capture all facets of the emotional experience. If these facets cannot be assessed, nursing care cannot alleviate them. Thus, in future research and practice, nursing oncologists are advised to simultaneously monitor the various psychophysiological processes of patient emotional experience by employing a multi-method measurement protocol. Such multi-method measurement may be particularly useful when the subjective measures are least effective in capturing a patient's emotional experience or when dissociation between psychological and physiological measures is most likely to occur.

The stress-buffering effect of mastery observed in this study may also be interesting to nursing researchers and practitioners. Previous studies have verified the stress-buffering impact of mastery on psychological indices of stress experience. The results of this study show that mastery affects an individual's physiological stress responses as well. Since mastery has proven to be an important psychological resource in the face of adversity such as cancer threat, it is crucial that nursing oncologists and practitioners identify low-mastery individuals and promote a sense of mastery in them. For effective identification of individuals varying in mastery, here again a multi-method assessment/measurement protocol is recommended, because our findings show that the stress-buffering effect of mastery may operate differently for the different psychophysiological components of stress experience.

These results must be interpreted with due consideration of the study's limitations. The first limitation concerns our research design. We did not counter-balance the order of experimental conditions, with the control task being performed in the first session and the stress task in the second. The lack of counter-balancing is justifiable in light of the primary purpose of this study: validation of the stress task. Had the stress task been performed in the first session, the participant's reaction to the subsequent control task could have been unduly biased due to the memory of a highly emotional task. For this reason, all stress tasks were performed in the second session. Further, this experimental order helps to ensure that the observed stress responses in the stress condition are not confounded with the "novelty" effect — that is, the novelty of a new situation/task due to unfamiliarity with the situation/task. However, this experimental order does raise concerns with regard to the observed stress-buffering effect of mastery. It could introduce practice effect, which is likely to increase with level of mastery. Thus the observed buffering effect of mastery may be confounded with the practice effect. Further research is needed to replicate the findings on the stress-buffering effect of mastery

in a counter-balanced design. Also, it should be noted that the stress-buffering effect of mastery is used as a means of providing further validation to the stress task rather than as an end in itself. Thus, the observed impact of mastery on autonomic and endocrine responses should be viewed as exploratory rather than confirmatory. Further empirical evidence is needed, preferably from both field and laboratory settings, to ensure the generalizability of these findings on the stress-buffering effect of mastery.

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