Gender Differences in Biobehavioral Aftereffects of Stress on Eating, Frustration, and Cardiovascular Responses[1]

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Eating, persistence, and cardiovascular responses were evaluated after exposure to a 25-min noise stressor with or without perceived control. Participants were healthy men (n = 29) and women (n = 34), aged 21 to 45 years. There were no group differences in cognitive task performance or blood pressure during the stressor. However, perceived control resulted in lower mean blood pressure and heart rate after cessation of the stressor for men and women. Women without perceived control displayed greater frustration levels following the stressor, and frustrated women ate more bland food than did nonfrustrated women. Perceived control and frustration did not affect food consumption among men following the stressor. These findings indicate that there are health-relevant gender differences in

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biobehavioral responses that occur in the aftermath of stressor exposure. In addition, perceived control was especially important for women to attenuate the behavioral and biological effects of stressor exposure.

Gender differences in response to stress occur in behavioral (e.g., eating, drug use), neuroendocrine (e.g., cortisol), and immunological domains (Cannon & St. Pierre, 1997; Jezova, Jurankova, Mosnarova, Kriska, & Skultetyova, 1996; Klein, Popke, & Grunberg, 1997; for a review, see Taylor et al., 2000). Men and women also differ in the likelihood of stress-related diseases, including cardiovascular disease, obesity, and autoimmune diseases (e.g., Verbrugge, 1990).

Behavioral and biological responses to stress can occur in anticipation of stressors, during stressors, or after the stressors have stopped. Sustained biobehavioral responses following the cessation of a stressor are most likely to have long-term health consequences (e.g., Cohen, 1980, Mason, 1974; McEwen, 1998; Sapolsky, 1992, 2000). For example, an individual who at the end of a stressful workday reacts with elevated blood pressure and cortisol and who ingests high-calorie snacks is at increased risk to develop cardiovascular disease, depression, and obesity (Giacosa, Franceschi, La Vecchia, Favero, & Andreatta, 1999; Hu et al., 2000; Li, Stanford, & Daling, 2000; Mark, Correia, Morgan, Shaffer, & Haynes, 1999; McEwen, 1998; Sapolsky, 2000). Moreover, slower recovery to pre-stress levels of cardiovascular function has been suggested as a potential risk factor for cardiovascular disease and increased all-cause mortality (Cole, Blackstone, Pashkow, Snader, & Lauer, 1999; Gerin & Pickering, 1995). In addition, some studies have suggested that those with ambulatory hypertension who fail to show a normal nocturnal dip or decline in blood pressure are at greater risk for cardiovascular abnormalities and cardiovascular disease (Verdecchia et al., 1990, 1994). The nocturnal dip reflects, in part, the normal diurnal variation, but also may be related to aftereffects of or recovery from daily stressors. Thus, the aftermath of a stressor may have important health consequences beyond those engendered by the stressor per se.

Glass and Singer (1972) developed a laboratory paradigm to evaluate the behavioral, cognitive, and physiological toll of stress after the stressor had ceased. These investigators reported that individuals quickly adapted to unpredictable and uncontrollable noise while the stressor was ongoing (i.e., skin resistance responses and cognitive performance briefly disrupted). Once the noise ceased, however, performance decrements occurred, including reduced frustration tolerance, reduced persistence, and poor task performance. These post-stressor decrements, or *aftereffects* of stress, were attenuated when subjects were given perceived control over the noise or when the noise was predictable. Thus, the Glass and Singer paradigm extended the large human and animal literature showing that perceived control or predictability can reduce stress responses by demonstrating that longer term, mild stressors that do not produce potent or prolonged stress responses still can have a lasting impact by altering behavior after a stressor has ended.[3] Taken together, these findings reveal that detrimental cognitive and behavioral stressor effects may continue or not appear until after the stressor ceases, and that the psychological environment (i.e., the presence of control or predictability) is a key moderator or mediator of post-stressor consequences. One behavioral response that likely is moderated by stressors but that has not been examined in the context of stressor aftereffects is eating.

What and how much individuals eat has a profound impact on long-term health, morbidity, and mortality. The relationship between stress and eating is complex. Gender, dietary restraint, and emotional eating affect the stress–eating relationship (e.g., Greeno & Wing, 1994; Grunberg & Straub, 1992; Oliver, Wardle, & Gibson, 2000). Timing of eating in relation to the stressor also is important. Grunberg and Straub investigated eating behavior during stress and found that women increased consumption of sweet foods during stress. Oliver et al. evaluated eating in response to anticipatory stress and found that stressed emotional eaters (men and women) ate more high-fat sweet foods. No one has evaluated eating after cessation of a stressor.

With regard to physiological stressor aftereffects, these indexes have played a relatively limited role in studies using the aftereffects paradigm, probably because the initial studies using these measures (e.g., skin resistance and vascular dilation responses) did not reveal significant aftereffects on these measures.[4] However, the previous physiological measures used to assess aftereffects (e.g., Glass & Singer, 1972) may have been too insensitive to reveal prolonged stressor-induced aftereffects. As noted earlier, some cardiovascular aftereffects or recovery following stressors appear predictive of future poor health. Because measures of blood pressure (Verdecchia et al., 1994) and heart rate (Cole et al.,

[3]Experimental manipulations of perceived control also have played an important role in cardiovascular reactivity studies where high-perceived control has been conceptualized as *active coping* and no- or low-perceived control as *passive coping* (although investigators have not always confirmed that the subject does or does not actually perceive having control). However, the focus of studies on active and passive coping typically has been on the behavioral, cognitive, and physiological effects during the coping task, rather than after the coping task, as was explored in the current study.

[4]Aftereffects previously have been defined as stressor-induced changes in behavior, physiology, or cognitive–subjective state that continue after the cessation of a stressor. In the original aftereffects studies, physiological variables usually did not play a significant role since they often did not reveal aftereffects. However, more recent studies have recorded physiological responses after a stressor (now often referred to as *recovery*) and have tended to focus on cardiovascular dependent variables (e.g., systolic blood pressure, diastolic blood pressure, heart rate) and on multiple parameters of the post-stressor response. For example, one can derive a reliable measure of rate of recovery by modeling the post-stressor cardiovascular response as a logistic function (Christenfeld, Glynn, & Gerin, 2000). This technique provides parameters reflecting the magnitude of the stressor response (i.e., reactivity), the level of the outcome variable after the stressor (i.e., post-stressor level, which is highly correlated with reactivity), and the rate of return to the pre-stressor state (recovery rate). Thus, recent work on cardiovascular recovery as a potential predictor of later cardiovascular illness extends the original aftereffects work to parameters other than the magnitude of the post-stress response.

1999) following stressful experiences have been proposed as predictors of later health consequences, we chose to employ blood pressure and heart rate as additional measures of potential biobehavioral aftereffects. We expected these measures to provide more theoretically meaningful measures of aftereffects than those used previously.

Taken together, the stress literature suggests that there are gender differences in the biobehavioral effects of stress and that the timing of stress measures is important in evaluating biobehavioral responses. The present study uses Glass and Singer's (1972) stress aftereffects paradigm to determine (a) whether there are changes in eating after the termination of a stressor, to complement the work of Grunberg and Straub (1992) and of Oliver et al. (2000); (b) whether cardiovascular responses are altered after exposure to a noise stressor; and (c) whether there are gender differences in these biobehavioral responses both during and after stressor exposure. The study includes male and female human subjects to evaluate potential gender differences in the stress–eating relationship. The study also includes measures of cardiovascular response to determine whether the experimental manipulation of stress caused any physiological changes during the stressor or after it was terminated. The foods include sweet, salty, and bland foods of low- and high-fat content, based on the findings of Grunberg and Straub and of Oliver et al.

Method

Overview

The present study examines biological and behavioral aftereffects of stress in men and women using a 2 × 3 (Gender × Noise Condition) between-subjects experimental design. Based on the aftereffects paradigm developed by Glass and Singer (1972), perceived control over an unpredictable, intermittent noise stimulus was manipulated. Participants were randomly assigned to one of three experimental groups: (a) no noise (10 men, 11 women); (b) noise with perceived control (9 men, 11 women); and (c) noise without perceived control (10 men, 11 women). Following cessation of the no-noise/noise condition, persistence on a frustrating task was measured based on Glass and Singer's report that this behavioral task is sensitive to stress aftereffects and to perceived control of the stressor. Food consumption, blood pressure, and heart rate also were measured.

Participants

Healthy, nonsmoking men (n = 29) and women (n = 33) between the ages of 18 and 45 years (M age = 32.5 years) participated in a study that was described as an investigation of the effects of noise on performance. They were recruited by local newspaper advertisements and were paid $30 for their participation in the 2-hr study. Participants initially were screened by telephone and were excluded from the study for significant health problems (e.g., high or low blood pressure, diabetes), prescription medications (including oral contraceptives), claustrophobia, food allergies, and hearing loss or sensitivity to loud noises. Weight and height were measured for each participant at the end of their laboratory session, and body mass indexes (BMI; kg/m^2) were calculated. Mean BMI did not differ across experimental groups (see Table 1 for BMI data).

Table 1 presents the demographic data for the entire sample. The majority of participants (73%, $N = 45$) were Caucasian ($N = 45$); 18% were African American ($N = 11$); and the rest were Hispanic, Asian American, or self-described as "Other" ($N = 6$). All participants were high school graduates, 32% were college graduates, and 18% of the participants had a master's degree or doctorate.

Participants in the three groups also reported similar levels of general life stress (Symptom Check List-90-Revised; Derogatis, Rickels, & Rock, 1976) and desire for control (Burger & Cooper, 1979). This similarity among groups ensured that a priori life stress and desire for control levels did not bias our groups in such a way as to confound our manipulations of stress or control.

Noise Stimulus

Following Glass and Singer (1972), participants in the noise conditions (i.e., noise with or without perceived control; hereafter referred to as the *stressor period*) were exposed to 25 min of intermittent, unpredictable bursts of complex noise consisting of five sounds that were superimposed on one another. The sounds included voices speaking in different languages and various office machine noises (e.g., phone ringing, typewriter typing). The noise was delivered under free field conditions through two stereo speakers (Advent Legacy II; International Jensen, Inc., Schiller Park, Illinois) at a sound pressure level of 103-108 dBA (measured at participant's chair) in a 7 ft × 7 ft × 10 ft (2.13 m × 2.13 m × 3.05 m) sound-attenuated chamber. The frequency composition of the noise bursts centered around 500-700 cycles per second (Hz), with a total frequency range of 150 to 7000 Hz. Noise bursts were delivered using a variable interval schedule with an average noise length of 9 s (range = 3 to 21 s; Glass & Singer, 1972). Noise bursts occurred once a minute in either the first, second, third, or fourth quarter of each minute, for a total of 25 bursts with a total of 5 min of noise exposure within the 25-min period. Each noise session began with approximately 1 min of silence. These stimulus parameters have been used extensively in the laboratory and pose no risks to participants (e.g., Glass & Singer, 1972; Glass, Singer, & Friedman, 1969; Singer, Acri, & Schaeffer, 1990).

Perceived Control

Perceived control was manipulated through instructions given to the participants. Specifically, participants assigned to the perceived-control condition were

Table 1

Demographic Data of Men and Women in Each Experimental Group

	Experimental noise group		
	No noise	Perceived control	No perceived control
Women			
Age (years)	31.82 ± 2.17	33.00 ± 2.10	32.27 ± 1.70
Body mass index (kg/m^2)	27.16 ± 2.49	26.05 ± 2.25	24.43 ± 1.24
Ethnicity			
African American	0.0% (*N* = 0)	27.3% (*N* = 3)	9.1% (*N* = 1)
Caucasian	72.7% (*N* = 8)	72.7% (*N* = 8)	90.9% (*N* = 10)
Other	27.3% (*N* = 3)	0.0% (*N* = 0)	0.0% (*N* = 0)
Marital status			
Single (never married)	54.5% (*N* = 6)	45.5% (*N* = 5)	27.3% (*N* = 3)
Married	36.4% (*N* = 4)	54.5% (*N* = 6)	63.6% (*N* = 7)
Separated/divorced	9.1% (*N* = 1)	0.0% (*N* = 0)	9.1% (*N* = 1)
Men			
Age (years)	31.60 ± 2.20	31.33 ± 2.11	33.00 ± 1.91
Body mass index (kg/m^2)	27.27 ± 1.51	25.61 ± 1.18	27.78 ± 0.97
Ethnicity			
African American	20.0% (*N* = 2)	33.3% (*N* = 3)	20.0% (*N* = 2)
Caucasian	60.0% (*N* = 6)	66.7% (*N* = 6)	70.0% (*N* = 7)
Other	20.0% (*N* = 2)	0.0% (*N* = 0)	10.0% (*N* = 1)
Marital status			
Single (never married)	70.0% (*N* = 7)	55.6% (*N* = 5)	50.0% (*N* = 5)
Married	30.0% (*N* = 3)	44.4% (*N* = 4)	40.0% (*N* = 4)
Separated/divorced	0.0% (*N* = 0)	0.0% (*N* = 0)	10.0% (*N* = 1)

Note. Mean ± standard error of the mean.

exposed to intermittent noise bursts and were told that they could terminate the noise at any point during the session by pressing a button near the side of the chair. Participants also were informed that, although the experimenter would prefer that they not use the button, the choice was entirely theirs. The button was connected to a relay switch, and the noise would have terminated if the participant depressed the button. However, none of the participants in the perceived-control condition pressed the button during the experiment. Participants in the no-perceived-control condition were exposed to intermittent noise bursts in a manner similar to the perceived-control group. The button was in the same position beside the participant's chair, but the experimenter did not mention it, and the choice of control was not addressed. The no-noise group served as a noise control group and was not exposed to any noise bursts. Again, the button was next to the participant's chair, but the experimenter did not mention it. No participants in the no-perceived-control group or the no-noise group asked about the button.

Tasks During the Stressor

Cognitive task performance during uncontrollable noise is an important component of the original aftereffect manipulation (Glass & Singer, 1972). Therefore, participants were asked to complete various cognitive tasks (number comparisons, math problems, cube comparisons) during the 25 min of the no-noise/noise presentation. These tasks were selected from previous research that examined behavioral aftereffects to uncontrollable noise stimuli (Glass & Singer, 1972; Glass et al., 1969; Reim, Glass, & Singer, 1971; Singer et al., 1990). The number and cube comparisons consisted of determining whether pairs of cubes or numbers were the same or different. All problems were presented on a projection screen through a slide projector. The projector was preset to automatically deliver a new slide every 10 s, and participants were instructed to write their correct answer in a booklet on their lap. There was a total of 525 problems presented across 154 slides.

Food Presentation

The snack food and amounts presented were based on a paradigm used in previous eating behavior research (Grunberg, 1982; Grunberg & Straub, 1992; Oliver et al., 2000). Snack foods included high- and low-fat foods that were sweet (white chocolate, jelly beans), salty (potato chips, pretzels), or bland (Sonoma Jack cheese, unsalted air-popped popcorn). Each bowl was weighed before and after the experiment to determine the amount of each food eaten by the participant. All food bowls appeared three-quarters full when presented to the participants, and bowl positions on the tray were rotated before each laboratory session.

Persistence Task

In addition to food consumption, aftereffects of noise exposure were measured by persistence on an unsolvable task (Feather, 1961) following the procedures of Glass, Singer, and colleagues (Glass & Singer, 1972; Glass et al., 1969; Reim et al., 1971; Singer et al., 1990). Participants were asked to complete a tracing task 13 min after the stressor. Specifically, they were asked to trace with a marker over all lines of two different diagrams without tracing any line twice and without lifting the marker from the diagram. Puzzle 1 was unsolvable, and Puzzle 2 was solvable. However, participants were unaware of this difference between the two puzzles. There were 20 copies of each puzzle, and participants could take as many tries at each puzzle as they wanted until they completed it or ran out of copies of the puzzle.

Participants were told that there was a limit on how long they could work on a given card (40 s per card). After every 40-s interval, participants were told to move on to the next card in the pile by the experimenter over an intercom. When the participant heard the experimenter say "Time," he or she had to decide whether or not to take another card from the same pile (Puzzle 1) to continue working on that puzzle or to move on to the next puzzle (Puzzle 2). The participant picked up another copy of the puzzle if he or she wanted another try at the same puzzle. Once participants moved on to the second puzzle, they could not go back to the first puzzle. Participants were instructed to signal the experimenter through the intercom when they finished with the second puzzle. The task took 26 min to complete. Participants who finished the task early (i.e., gave up quickly) were asked to sit back and relax until the balance of the 26-min window had passed.

Cardiovascular Measures

Systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were recorded from the participant's nondominant arm using an automated, oscillometric monitor (Dinamap, Model 1846-SX, Critikon, Tampa, Florida). This monitor has been shown to yield blood pressure values that are highly correlated with intra-arterial and ambulatory blood pressure measurements (Borow & Newburger, 1982; Mueller et al., 1997). From a control room adjacent to the room where the participant was seated, two baseline readings were recorded at 3-min intervals. Aggregation across two measures of basal resting SBP and DBP in a laboratory setting has been shown to provide within-subject reliability of .90 or better (Llabre et al., 1988). BP and HR readings were taken every 3 min throughout the stress and post-stress periods, with at least eight readings during the stressor period and at least four readings during the post-stressor period.

Procedure

Laboratory sessions took place at either 10 a.m. or 2 p.m., and these two session times were counterbalanced across participants and across experimental conditions. Participants were randomly assigned to one of two female experimenters (first or second author), and this assignment was counterbalanced across experimental conditions. Upon arrival at the laboratory, participants were brought to the sound-attenuated chamber. They were asked to sit comfortably in a chair while the experiment was described to them in more detail. Following informed consent, participants were fitted with the BP cuff and were asked to relax for 10 min while two baseline BP readings were recorded.

Next, instructions about the no-noise/noise part of the experiment were given. Specifically, participants were told that they were going to perform several different cognitive tasks and that we were interested in how noise/no-noise affected the quality and speed of their work. They also were told that they would hear loud noises (or no noise) from the speakers while they completed the tasks, that the noise bursts would continue periodically for about 25 min, and that they should work as quickly and accurately as possible. Next, the experimenter reviewed an example of each of the cognitive tasks and answered any remaining questions. The experimenter then left the room to begin the tasks and the noise stimulus. The experimenter re-entered the room half way through the task to change the slides. BP and HR measurements were taken automatically every 3 min throughout the stress period. Each participant was instructed not to move his or her arm during inflation and deflation of the BP cuff.

After the 25-min stressor, the experimenter re-entered the room casually with a tray of food and a pitcher of water. The experimenter placed the tray and pitcher on a nearby table and explained in a friendly manner that although the task was finished, she still needed time to prepare for the next part of the study. The participant then was informed that there were some magazines and food available to make the wait more comfortable while the experimenter prepared for the second part of the study. The experimenter left the room and re-entered 13 min later to begin the last part of the experiment. The food tray was moved away from the participant and the bowls were weighed later to determine consumption. BP and HR readings continued every 3 min throughout this 13-min post-stressor period.

Next, the BP cuff was removed and participants were asked to work on the tracing task that lasted 26 min. Finally, participants were asked to complete several questionnaires, including a manipulation-check measure on perceived control (described in more detail in Results section) and the Dutch Eating Behavior Questionnaire (DEBQ; vanStrien, Frijters, Bergers, & Defares, 1986) as a measure of restrained, emotional, and external eating.

Results

Overview

Two-way ANOVAs, with Gender (2 levels) and Experimental Group (3 levels) as the independent variables, were conducted to evaluate the aftereffects

Table 2

Number of Correct Responses on Cube and Number Comparisons and Math Problems Presented During the 25-Min No-Noise/Noise Session

Experimental condition	Men	Women
No noise	431.80 ± 23.89 (82.3%)	428.73 ± 16.79 (81.7%)
Perceived control	400.67 ± 29.45 (76.3%)	427.64 ± 13.16 (81.4%)
No control	394.80 ± 20.43 (75.2%)	426.73 ± 23.86 (81.3%)

Note. Mean ± standard error of mean, and percentage correct in parentheses.

of stress in men and women. Physiological aftereffects were determined using MANOVAs. Because of gender differences in DEBQ (vanStrien et al., 1986) emotional and restrained eating scores, ANCOVAs were used to determine eating behavior aftereffects with emotional and restrained eating scores as covariates. All significance tests were two-tailed and were evaluated at an alpha level of .05. Tukey's HSD post hoc analyses ($\alpha = .05$) were conducted where appropriate.

Manipulation Checks

Task performance during 25-min no-noise/noise period. Cognitive task performance (i.e., cube and number comparisons, math problems) during the 25-min stress period is a standard component of the aftereffects manipulation, and it is important that participants do not differ in level of performance during the stressor in order to interpret the aftereffects phenomenon (Glass & Singer, 1972). Consistent with Glass and Singer, experimental groups did not differ significantly in the number of correct responses to the problems, and there were no gender differences in task performance during the stressor (Table 2). Therefore, differences in aftereffects as a function of group cannot be attributed to differences in performance during the stressor.

Perceived control. At the end of the study, participants were asked about their perceptions of control over the noise during the laboratory session. There was a main effect for group where the perceived-control group indicated a stronger belief that they could turn off the noise than did the no-perceived-control group, $F(1, 38) = 18.40, p < .05$. Men and women also did not differ in their levels of perceived control. Further, 100% of participants in the no-perceived-control group believed that they could not signal the experimenter to turn off the noise. Taken together, these task-performance and self-report measures suggest that the perceived-control manipulation was effective.

Cardiovascular Measures

Mean SBP, DBP, and HR were measured before, during, and after the stressor. The two baseline readings were averaged to derive mean baseline SBP, DBP, and HR measures (Llabre et al., 1988). The eight readings during the stressor were averaged to derive mean task measures, and the four post-stress readings were averaged to derive the mean post-stress or aftereffects measures. Change scores (i.e., stress minus baseline, post-stress minus baseline) were calculated for the stress and post-stress periods of the experiment for each of the cardiovascular measures based on prior recommendations (Llabre, Spitzer, Saab, Ironson, & Schneiderman, 1991). Change scores for each cardiovascular dependent measure were included in MANOVAs to assess both cardiovascular responses during stressor and post-stressor cardiovascular responses.

First, we examined whether there were differences in baseline SBP, DBP, or HR across gender or groups. MANOVAs reveal only a main effect of gender for SBP, with males having higher SBP than females, which is consistent with previous literature (e.g., McCubbin et al., 1991; Page & France, 1997). This gender effect appears to be a result, at least in part, of differences in BMI as the gender effect was not significant when BMI was used as a covariate. Most importantly, however, our randomly assigned groups did not differ in baseline BP, HR, or BMI.

Next, 2 × 3 (Gender × Experimental Groups) MANOVAs were conducted with stress and post-stress changes in cardiovascular levels as the dependent measures in the model. Analyses reveal no main or interactive effects involving gender, so a second set of analyses was completed using only the group variable. Figures 1 and 2 present changes in SBP (Figure 1) and HR (Figure 2) during and after stress collapsed across gender. Analyses of cardiovascular changes during the stressor reveal no main or interactive effects of gender or group (all Fs < 2.5, all ps $> .09$). This finding is in accord with Glass and Singer (1972), who also reported no overall physiological effects (skin conductance and finger vasoconstriction) during the stressor, and it is not surprising, given the relatively long stress period (i.e., approximately 25 min).

With regard to post-stress effects, however, these MANOVAs reveal a significant effect of group on SBP, $F(2, 61) = 3.53$, $p < .05$; and a marginal effect on HR, $F(2, 61) = 2.61$, $p = .08$ (Figures 1 and 2). Post hoc tests reveal significant post-stress SBP and HR differences between the no-noise and perceived-control groups ($p < .05$) and a marginal difference between the perceived-control and no-perceived-control groups (SBP, $p = .06$; HR, $p = .09$). There was no effect of group for DBP. Together, these results suggest that an explicit instruction that one has control over an experimental stressor results in somewhat lower cardiovascular reactivity after the stressor than when there is no explicit instruction of control (both no control and no noise).

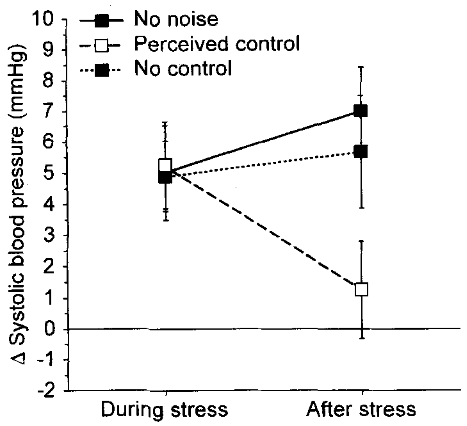

Figure 1. Mean (± standard error of mean) systolic blood pressure changes from baseline during and after stressor exposure in no-noise, perceived-control, and no-control groups.

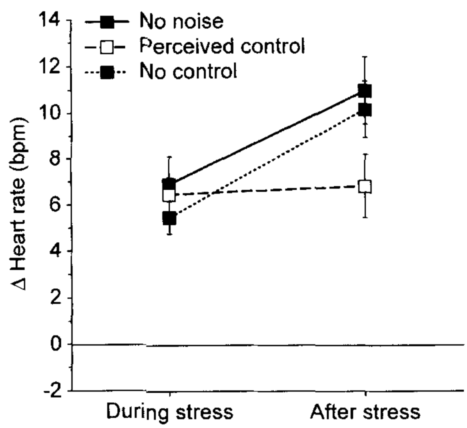

Figure 2. Mean (± standard error of mean) heart rate changes from baseline during and after stressor exposure in no-noise, perceived-control, and no-control groups.

Behavioral Measures

Feather (1961) task. Persistence on the unsolvable puzzle (number of attempts on Puzzle 1) was used as a behavioral index of stress aftereffects. According to Glass and Singer (1972), persistence on the puzzle should be greater in the perceived-control condition compared to the no-perceived-control condition. Glass and Singer used this behavioral task as an index of frustration. Persistence was analyzed using a 2 × 3 (Gender × Experimental Group) ANOVA.

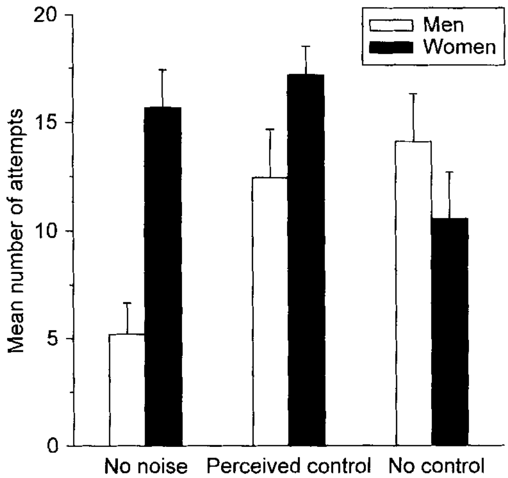

Figure 3. Mean (± standard error of mean) number of attempts to complete the first puzzle of the Feather (1961) task made by men and women exposed to no-noise and noise conditions.

Figure 3 presents the mean number of attempts to complete the first puzzle made by men and women in each of the experimental conditions. Overall, women persisted more on the puzzle than did men, $F(1, 57) = 6.39, p < .05$. The experimental groups did not differ from one another in the number of puzzle attempts. However, there was a significant Group × Gender interaction, $F(2, 57) = 7.19, p < .05$. ANOVAs were conducted separately for men and women to examine the interaction.

The experimental groups differed significantly from one another in their persistence on the task for men, $F(2, 26) = 5.81, p < .05$; and women, $F(2, 31) = 3.75, p < .05$. Consistent with Glass and Singer (1972), post hoc analyses indicate that women who did not have perceived control over the noise gave up more quickly on the task than did women who had perceived control over the noise. There were no differences in the number of puzzle attempts made by women in the perceived-control and no-noise experimental conditions. In contrast, men in the perceived-control and no-perceived-control groups persisted longer on the task than did men in the no-noise group. There were no differences in persistence between men in the perceived-control and no-perceived-control conditions, suggesting that perceived control had no effect on persistence (or frustration levels) in men.

Eating. Responses on the DEBQ (vanStrien et al., 1986) were analyzed first to evaluate potential group differences in restrained, emotional, and external eating. ANOVAs were conducted separately for each subscale with experimental condition and gender as the independent variables. Women reported significantly higher levels of restrained (M = 3.05 ± 0.11) and emotional (M = 2.63 ± 0.16) eating than did men (M restraint = 2.56 ± 0.13; M emotional = 1.94 ± 0.12), $F(1, 57) = 9.02$, $p < .05$; and $F(1, 57) = 12.02$, $p < .05$, respectively. However, men and women did not differ in their reports of external eating (M = 3.18 ± 0.09 and M = 2.97 ± 0.08, respectively). In addition, there were no significant differences among the no-noise, no-perceived-control, and perceived-control experimental groups in reported levels of restrained, emotional, or external eating. Because of gender differences in reports of restrained and emotional eating, these two subscores were used as covariates in the first set of eating behavior analyses. However, restraint did not emerge as a significant covariate in these initial eating ANCOVAs, so it was removed from subsequent analyses.

There were no differences among noise groups or between men and women in the number of calories or total grams of food eaten after the stressor ended (Table 3). Because of the possibility that gender differences in emotional eating may have impaired our ability to detect a gender difference in eating behavior following stress, analyses were conducted without controlling for emotional eating. Again, there were no group or gender differences in eating behavior. Next, separate ANCOVAs were conducted to determine noise group differences in the amount of sweet, salty, and bland food consumption, with group and gender as the independent variables, and emotional eating subscores as the covariates. These results indicate no differences in consumption of sweet, salty, bland, high-fat, or low-fat food consumption between men and women or among groups. Therefore, neither gender nor the presence or absence of control specifically related to eating behavior after the stressor ceased.

According to Glass and Singer (1972), low persistence on a frustrating task is indicative of a behavioral aftereffect of stress. Therefore, we conducted a median split on frustration (i.e., persistence) and placed participants into high or low-frustration groups on the basis of their persistence on the Feather (1961) task. In other words, frustration was used as an as an index of the aftereffects of stress to evaluate effects on food consumption. This median split resulted in 11 men and 20 women in the low-frustration group, and 18 men and 13 women in the high-frustration group. A chi-square analysis indicates that there was no difference in the number of men and women in the two frustration groups, $\chi^2(1, N = 62) = 3.18$, *ns*. Men and women in high- and low-frustration groups also did not differ on any demographic variables, including BMI, or on reports of restrained, emotional, or external eating.

These groups did not differ on any of the baseline physiological measures. MANOVAs on SBP, DBP, and HR changes from baseline levels during the post-stress period were conducted to evaluate the hypothesis that the high-frustration group would display greater physiological aftereffects to the stressor than would the low-frustration group. Indeed, the high-frustration group had higher SBP and HR following the stressor than did the low-frustration group,

Table 3

Food Consumption by Men and Women in Each Experimental Condition Following Cessation of the No-Noise/Noise Period

	Experimental noise condition		
	No noise	Perceived control	No perceived control
Women			
Total kilocalories	314.15±63.35	155.21±58.71	328.07±54.21
Total grams (g)	74.71±15.66	38.39±13.96	78.90±12.88
Taste class			
Sweet foods (g)	20.58± 4.63	12.60± 5.53	19.27 ± 7.31
Salty foods (g)	13.15± 3.93	7.52± 3.18	17.37± 4.00
Bland foods (g)	40.98±11.27	18.27± 8.24	42.26±10.68
Fat class			
High-fat foods (g)	59.91±12.76	24.18±11.53	59.05±13.00
Low-fat foods (g)	14.79± 4.51	14.21± 3.95	19.85± 4.98
Men			
Total kilocalories	262.19 ± 55.28	262.58±50.07	256.29±60.42
Total grams	63.38±15.72	59.42±11.29	64.52±14.96
Taste class			
Sweet foods (g)	20.67 ± 3.67	17.88± 5.00	26.38± 8.51
Salty foods (g)	14.26± 3.08	17.55± 6.65	13.64± 4.07
Bland foods (g)	28.49±13.10	23.99± 9.13	24.50± 7.24
Fat class			
High-fat foods (g)	41.81±10.79	44.94±70.76	34.15± 9.29
Low-fat foods (g)	21.61± 6.11	14.48± 5.07	30.37± 9.59

Note. Mean ± standard error of mean.

$F(1, 59) = 3.98, p = .05$, and $F(1, 59) = 4.57, p < .05$, respectively (Figures 4 and 5). Interestingly, the high-frustration group did have a greater HR change from baseline during stress than did the low-frustration group ($M = 75.70 \pm 1.72$ and $M = 71.53 \pm 1.91$, respectively), $F(1, 59) = 10.87, p < .05$.

Because of gender differences in frustration, we conducted separate one-way ANOVAs on food consumption, with frustration as the independent variable. Consumption of high-fat and low-fat sweet, salty, and bland foods by men and

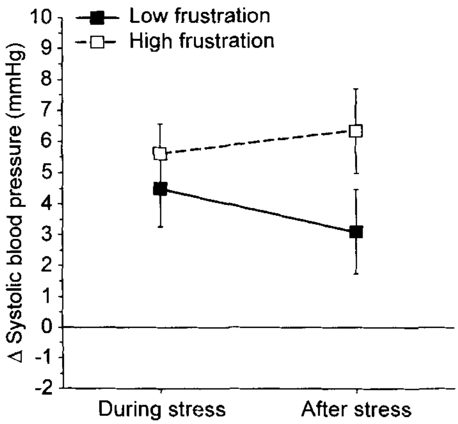

Figure 4. Mean (± standard error of mean) systolic blood pressure changes from baseline during and after stressor exposure in low- and high-frustration groups.

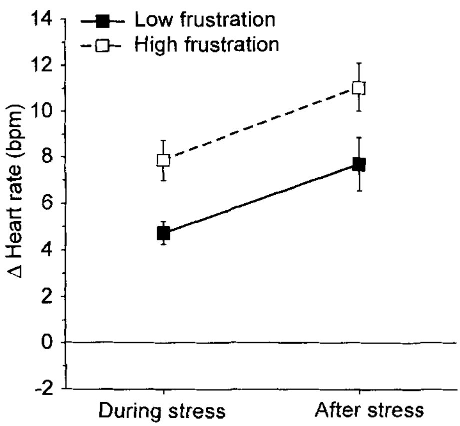

Figure 5. Mean (± standard error of the mean) heart rate changes from baseline during and after stressor exposure in low- and high-frustration groups.

women in high- and low-frustration groups are presented in Figures 6 through 9. Women who displayed high levels of frustration after the stressor ate significantly more bland food than did women who were not frustrated (i.e., those who showed no behavioral aftereffects), $F(1, 31) = 4.77, p < .05$. There also was a marginal effect of frustration on total kilocalories (low frustration, $M = 213.21 \pm 40.35$; high frustration, $M = 346.73 \pm 31.37$), total grams (low frustration, $M = 50.86 \pm 9.25$; high frustration, $M = 84.21 \pm 15.26$), and high-fat food consumption (low

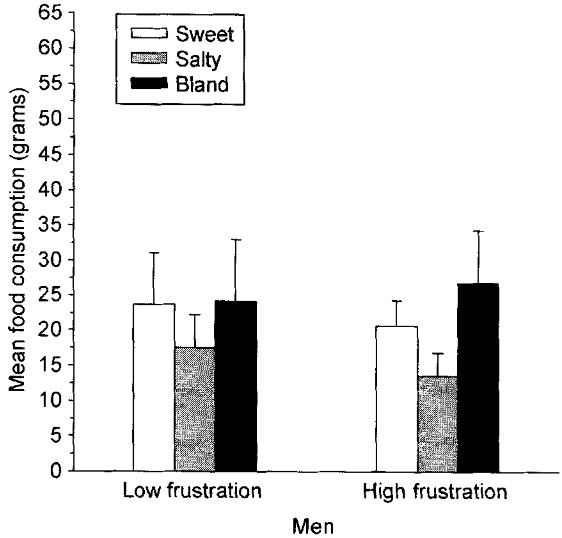

Figure 6. Mean (± standard error of mean) grams of sweet, salty, and bland food consumption by men in low- and high-frustration groups.

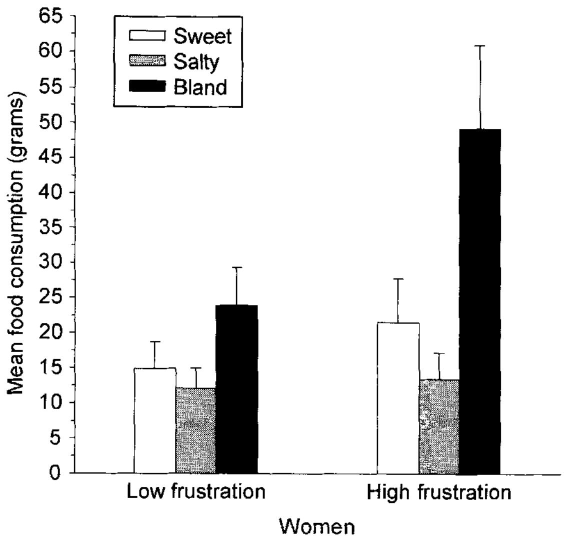

Figure 7. Mean (± standard error of mean) grams of sweet, salty, and bland food consumption by women in low- and high-frustration groups.

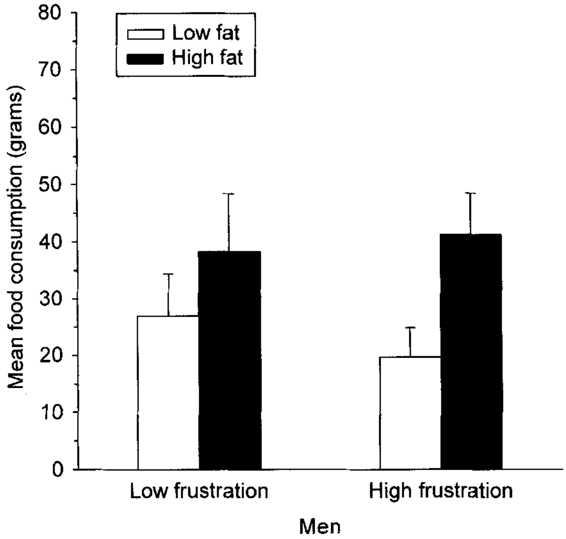

Figure 8. Mean (± standard error of mean) grams of high-fat and low-fat food consumption by men in low- and high-frustration groups.

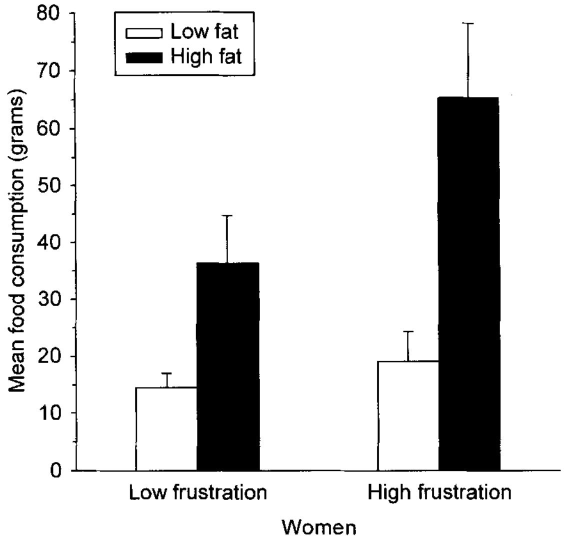

Figure 9. Mean (± standard error of mean) grams of high-fat and low-fat food consumption by women in low- and high-frustration groups.

frustration, $M = 36.35 \pm 8.41$; high frustration, $M = 65.20 \pm 13.11$; all $ps = .06$) in women. Frustration did not affect food consumption by men.

Discussion

This experiment examined the aftereffects of noise stressor exposure on eating, task persistence, and cardiovascular responses of men and women. Stressor aftereffects depended on participants' gender, frustration level, and the presence or absence of perceived control over the noise.

Eating Behavior

Men and women differed in eating behavior during the aftereffects period when frustration level was taken into account. Women in the high-frustration group ate more bland food, tended to eat more high-fat food, and also tended to eat more in terms of kilocalories and total grams of food than did low-frustration women. These effects, although just short of conventional significance levels in some cases (i.e., for high-fat food, kilocalories, and total grams of food, $p = .06$) were substantial and explained on average about 12% of eating variance in women (r^2 values ranged from .11 to .13; large effect sizes, according to the guidelines of Cohen, 1988). In contrast, frustration did not affect food consumption by men (frustration explained less than 1% of variance). It should be noted that although intriguing, these findings must be approached with caution because they are dependent on internal analyses. Further studies are needed in which frustration is manipulated as an independent variable before specific conclusions regarding the causal influences of frustration on eating behavior can be made.

Regardless of frustration level, consistent patterns in the food consumption data suggest gender differences in aftereffects eating responses that we did not have the statistical power to detect reliably. Specifically, examination of Table 3 reveals that among women, perceived control reduced total kilocalories and total grams of food consumed as well as consumption of salty, bland, and high-fat foods, as compared to the no-noise and no-perceived-control conditions. Although analyses of these data did not reach conventional significance levels (p values ranged from .08 to .18), on average about 13% of variance was explained by the group effect among women (r^2 values ranged from .11 to .15). Post hoc power analyses reveal that power averaged .42, indicating that there was insufficient power to achieve statistical significance. Importantly, however, the effect sizes were large. In contrast, a consistent pattern is not evident among men based on experimental condition, and the group effect on the same variables explained on average less than 1% of variance. These findings indicate that an *important* gender difference may exist in stressor aftereffects on eating such that perceived control reduced eating among women overall, particularly for bland and high-fat food consumption, but it had no effect for men.

Persistence

Women persisted longer on the frustrating tracing task than did men. Importantly, for women, exposure to noise without perceived control decreased their persistence. That is, women in the no-noise and the perceived-control groups persisted more (and at similar levels) than did women in the no-perceived-control group. This finding indicates that for women, the presence of perceived control—a psychological factor moderating environmental noise exposure—was more important than exposure to the noise per se, which replicates Glass and Singer's (1972) earlier findings.

In contrast, perceived control did not affect persistence among men. In fact, men in the perceived-control and no-perceived-control groups (the groups exposed to noise) persisted longer on the task than did men in the no-noise group. This finding is intriguing and suggests a gender difference in the role of psychological modifiers of the stress experience. There are some possible explanations for why exposure to the noise, regardless of perceived control, might have increased persistence in men. One possibility is that, for men, noise exposure may have engendered feelings of competition and a desire to assert control or to win (i.e., to successfully complete the tracing task). It also is possible that stressor exposure produced a need for distraction in men, that the tracing task provided an outlet for that need, or that men found the tracing task to be a coping strategy, whereas women did not. More work is needed to determine if these or other explanations account for the gender difference in effects of perceived control on persistence.

Cardiovascular Responses

In contrast to gender differences in persistence after exposure to noise and eating, there were no gender differences in cardiovascular aftereffects of noise. Perceived control modestly reduced SBP and HR when compared to the no-noise and no-perceived-control groups. The reductions produced by perceived control, compared to the no-perceived-control condition, suggest that perceived control decreased cardiovascular aftereffects.

The fact that perceived control also reduced these responses in comparison to the no-noise condition could be interpreted in several ways. It is possible, for example, that participants in the no-noise condition experienced the condition as stressful because stereo speakers were present in the room, and they expected to hear noise at some point during the experimental session, even though the experimenter told them that no noise would occur (i.e., unpredictable stress). It also is possible that participants in the no-noise condition were bored by the cognitive tasks presented during the no-noise period and that boredom itself was stressful or elicited a negative mood. In any case, the fact that perceived control reduced these responses suggests that there are modest cardiovascular aftereffects and that these aftereffects can be altered by psychological manipulations. This finding is in contrast to Glass and Singer's (1972) report that physiological aftereffects (as measured by skin resistance responses and vascular dilation) did not occur. The previous findings may stem from choosing physiological variables that were insensitive to longer term stressor effects and, indeed, even in the current study, the physiological aftereffects were quite modest. The emerging literature on slower or blunted cardiovascular recovery following stressors and blunted nocturnal BP dips in some participants suggests that slower or poorer recovery has negative future health consequences (e.g., Cole et al., 1999; Gerin & Pickering, 1995; Verdecchia et al., 1994).

Although the current investigation examined the magnitude of changes following a stressor, the study was not designed to examine the rate of recovery, which may be more sensitive to aftereffects than simple changes in SBP or HR magnitude. Our finding of modest cardiovascular aftereffects (i.e., magnitude differences) warrants a future study of rate of recovery following a stressor that is or is not perceived to be controllable.

Participants' level of frustration (as indexed by persistence on the tracing task) also related to the degree of cardiovascular aftereffects. Although high- and low-frustration participants did not differ in baseline cardiovascular responses, the high-frustration group had higher SBP and HR after the stressor than did the low-frustration group. These results could mean that frustration leads to greater cardiovascular reactivity, although we did not have the power to test this hypothesis. The fact that the cardiovascular changes occurred prior to the behavioral manifestation of frustration suggests that this interpretation is unlikely.

Alternatively, these data suggest that the high-frustration group may have experienced the no-noise/noise session as more stressful than did low-frustration subjects. In support of this hypothesis, the high-frustration group had higher HRs than did the low-frustration group during the no-noise/noise session. It is important to note that we grouped participants as high and low frustration based on their tracing task performance in the aftereffects period. The fact that this grouping also revealed differences in HR during the stressor (before the tracing task was performed) suggests that performance on the tracing task may have tapped into a preexisting characteristic in the participant that affected the stress experience. That is, cardiovascular responses in the aftereffects period were affected by two factors; namely, the experimental manipulation of perceived control (i.e., psychological factor) that reduced the effects of the noise stressor, and some participant-specific factor that affected participants' experience of the no-noise/noise session, independent of the experimental manipulation, and that was reflected in different physiological responses both during and after the stressor. These findings suggest that important individual differences in stress reactivity exist and that further studies are needed that include physiological measures more sensitive to longer term stressors and their aftereffects (e.g., neuroendocrine, immune).

Applications and Implications

Overall, this experiment reveals that there are gender differences in aftereffects of stress on persistence and eating behaviors. Specifically, for women, lack of perceived control over the stressor reduced persistence; for men, exposure to the stressor, regardless of perceived control, increased persistence. In terms of eating, high-frustration women ate more food overall and more of the bland and high-fat foods then did low-frustration women. Frustration did not affect eating by men. Data also suggest that perceived control reduced eating for women, but not for men.

These findings suggest that for women, having perceived control over the stressor, even when control is not exercised, is an important modifier of psychological and appetitive responses after a stressor has ceased. If these results parallel reactions to real-life situations, then for women, lack of real or apparent control over stressors may result in an increased consumption of bland and high-fat foods and decrements in persistence after the stressor has ended. For men, the costs of post-stressor adaptation appear to be minimal on these variables, with eating unaltered and persistence increasing rather than decreasing.

The experiment also reveals that men and women responded similarly in the aftereffects paradigm in terms of cardiovascular responses, with perceived control decreasing BP and HR. Frustration level also was important, with high-frustration participants exhibiting higher SBP and HR than low-frustration subjects in the post-stressor period. These findings suggest that, regardless of gender, real or perceived control over stressors and the extent to which an individual feels thwarted are important determinants of post-stressor cardiovascular effects. If the post-stressor period is conceptualized as a recovery period, then delayed recovery may be associated with these psychological variables.

The present findings reveal the value of studying the effects of psychological variables and individual differences on the behavioral and biological aftereffects of stress. Despite the fact that the stress aftereffects phenomenon was revealed 30 years ago, it remains understudied, with more current conceptions of stressor aftereffects focusing on recovery of cardiovascular function to pre-stress levels, and little attention to behavioral aftereffects, which have important implications for health functioning.

Some people are under the illusion that stress responses and their effects end when the stressor is no longer present. That clearly is not so. It is important to determine exactly which behavioral and biological consequences of stress can be reduced by psychological and behavioral strategies (e.g., perceived control, social support) and which biobehavioral stress responses elicit or require different approaches for women and men (e.g., eating, cardiovascular functioning).

References

Borow, K. M., & Newburger, J. W. (1982). Noninvasive estimation of central aortic pressure using the oscillometric method for analyzing artery pulsatile flow: Comparative study of indirect systolic, diastolic, and mean brachial artery pressure with simultaneous direct ascending aortic pressure measurements. *American Heart Journal*, *103*, 879-886.

Burger, J. M., & Cooper, H. M. (1979). The desirability of control. *Motivation and Emotion*, *3*, 381-393.

Cannon, J. G., & St. Pierre, B. (1997). Gender differences in host defense mechanisms. *Journal of Psychiatry Research*, *31*, 99-113.

Christenfeld, N., Glynn, L. M., & Gerin, W. (2000). On the reliable assessment of cardiovascular recovery: An application of curve-fitting techniques. *Psychophysiology*, *37*, 543-550.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum.

Cohen, S. (1980). Aftereffects of stress on human performance and social behavior: A review of research and theory. *Psychological Bulletin*, *88*, 82-108.

Cole, C. R., Blackstone, E. H., Pashkow, F. J., Snader, C. E., & Lauer, M. S. (1999). Heart-rate recovery immediately after exercise as a predictor of mortality. *New England Journal of Medicine*, *341*, 1351-1357.

Derogatis, L. R., Rickels, K., & Rock, A. F. (1976). The SCL-90 and the MMPI: A step in the validation of a new self-report scale. *British Journal of Psychiatry*, *128*, 280-289.

Feather, N. T. (1961). The relationship of persistence at a task to expectation of success and achievement-related motives. *Journal of Abnormal and Social Psychology*, *63*, 552-561.

Gerin, W., & Pickering, T. G. (1995). Association between delayed recovery of blood pressure after acute mental stress and parental history of hypertension. *Journal of Hypertension*, *13*, 603-610.

Giacosa, A., Franceschi, S., La Vecchia, C., Favero, A., & Andreatta, R. (1999). Energy intake, overweight, physical exercise, and colorectal cancer risk. *European Journal of Cancer Prevention*, *8*, S53-S60.

Glass, D., & Singer, J. E. (1972). *Urban stress*. New York, NY: Academic Press.

Glass, D., Singer, J., & Friedman, L. (1969). Psychic cost of adaptation to an environmental stressor. *Journal of Personality and Social Psychology*, *12*, 200-210.

Greeno, C. G., & Wing, R. R. (1994). Stress-induced eating. *Psychological Bulletin*, *115*, 444-464.

Grunberg, N. E. (1982). The effects of nicotine and cigarette smoking on food consumption and taste preferences. *Addictive Behaviors*, *7*, 317-331.

Grunberg, N. E., & Straub, N. E. (1992). The role of gender and taste class in the effects of stress on eating. *Health Psychology*, *11*, 97-100.

Hu, F. B., Stampfer, M. J., Manson, J. E., Grodstein, F., Colditz, G. A., Speizer, F. E., & Willett, W. C. (2000). Trends in the incidence of coronary heart disease and changes in diet and lifestyle in women. *New England Journal of Medicine*, *343*, 530-537.

Jezova, D., Jurankova, E., Mosnarova, A., Kriska, M., & Skultetyova, I. (1996). Neuroendocrine response during stress with relation to gender differences. *Acta Neurobiologiae Experimentalis*, *56*, 779-785.

Klein, L. C., Popke, E. J., & Grunberg, N. E. (1997). Sex differences in effects of predictable and unpredictable footshock on fentanyl self-administration in rats. *Experimental and Clinical Psychopharmacology*, *5*, 99-106.

Li, C. I., Stanford, J. L., & Daling, J. R. (2000). Anthropometric variables in relation to risk of breast cancer in middle-aged women. *International Journal Epidemiology*, *29*, 208-213.

Llabre, M. M., Ironson, G. H., Spitzer, S. B., Gellman, M. D., Weidler, D. J., & Schneiderman, N. (1988). How many blood pressure measurements are enough? An application of generalizability theory to the study of blood pressure reliability. *Psychophysiology*, *25*, 97-106.

Llabre, M. M., Spitzer, S. B., Saab, P. G., Ironson, G. H., & Schneiderman, N. (1991). The reliability and specificity of delta versus residualized change as measures of cardiovascular reactivity to behavioral challenges. *Psychophysiology*, *28*, 701-711.

Mark, A. L., Correia, M., Morgan, D. A., Shaffer, R. A., & Haynes, W. G. (1999). State of the art lecture: Obesity-induced hypertension: New concepts from the emerging biology of obesity. *Hypertension*, *33*, 537-541.

Mason, J. W. (1974). Specificity in the organization of neuroendocrine response profiles. In P. Seeman & G. Brown (Eds.), *Frontiers in neurology and neuroscience research*. Toronto, Ontario, Canada: University of Toronto.

McCubbin, J. A., Wilson, J. F., Bruehl, S., Brady, M., Clark, K., & Kort, E. (1991). Gender effects on blood pressures obtained during an on-campus screening. *Psychosomatic Medicine*, *53*, 90-100.

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

Mueller, U. K., Wells, M., Radevski, I., Ouwerkerk, J., Tager, R., Sliwa, K., & Sareli, P. (1997). Repeated versus daytime ambulatory blood pressure measurement in mild, moderate, and severe untreated Black hypertensive patients. *Blood Pressure Monitoring*, *2*, 21-25.

Oliver, G., Wardle, J., & Gibson, E. L. (2000). Stress and food choice: A laboratory study. *Annals of Behavioral Medicine*, *62*, 853-865.

Page, G. D., & France, C. R. (1997). Objective evidence of decreased pain perception in normotensives at risk for hypertension. *Pain, 73*, 173-80.

Reim, B., Glass, D., & Singer, J. (1971). Behavioral consequences of exposure to uncontrollable and unpredictable noise. *Journal of Applied Social Psychology, 1*, 44-56.

Sapolsky, R. M. (1992). *Stress, the aging brain, and the mechanisms of neuron death*. Cambridge, MA: MIT Press.

Sapolsky, R. M. (2000). Glucocorticoids and hippocampal atrophy in neuropsychiatric disorders. *Archives of General Psychiatry, 57*, 925-935.

Singer, J., Acri, J., & Schaeffer, M. (1990). Cognitive changes from noise control. In B. Berglund & T. Lindvall (Eds.), *Noise as a public health problem. New advances in noise research, Part I* (pp. 401-409). Stockholm, Sweden: Swedish Council for Building Research.

Taylor, S. E., Klein, L. C., Lewis, B. P., Gruenewald, T. L., Gurung, R. A. R., & Updegraff, J. A. (2000). Female responses to stress: Tend-and-befriend, not fight-or-flight. *Psychological Review, 107*, 411-429.

vanStrien, T., Frijters, J. E. R., Bergers, G. P. A., & Defares, P. B. (1986). The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behavior. *International Journal of Eating Disorders, 5*, 295-315.

Verbrugge, L. M. (1990). Pathways of health and death. In R. D. Apple (Ed.), *Women, health, and medicine in America: A historical handbook* (pp. 41-79). New York, NY: Garland.

Verdecchia, P., Porcellati, C., Schiallci, G., Borgioni, C., Ciucci, A., Battistelli, M., Guerrieri, M., Gatteschi, C., Zampi, I., Santucci, A., Santucci, C., & Reboldi, G. (1994). Ambulatory blood pressure: An independent predictor of prognosis in essential hypertension. *Hypertension, 24*, 793-801.

Verdecchia, P., Schiallci, G., Guerrieri, M., Gatteschi, C., Benemio, G., Boldrini, F., & Porcellati, C. (1990). Circadian blood pressure changes and left ventricular hypertrophy in essential hypertension. *Circulation, 81*, 528-536.