Active Coping and Cardiovascular Reactivity: A Multiplicity of Influences

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Objective: Active coping enhances cardiovascular response presumably by β-adrenergically mediated myocardial activation. This study examined impedance-derived hemodynamic parameters underlying blood pressure response to two laboratory tasks requiring active coping, performed either with or without an appetitive (ie, monetary) incentive. *Method:* Forty-eight healthy, young men completed the Stroop Color-Word Test and Mirror Tracing. Half received no incentive, whereas half were provided with a monetary incentive as an active coping manipulation. Task-related changes in blood pressure, heart rate, systolic time intervals, and hemodynamic parameters were monitored. Psychological responses to the tasks were also obtained. *Results:* On average, incentive virtually doubled blood pressure response to both Stroop and Mirror Tracing. The change in blood pressure was explained predominantly by a concomitant increase in total peripheral resistance. Heart rate response was also enhanced substantially with incentive. Individuals in the incentive condition reported greater interest in the task, but less perceived control, than persons in the no-incentive condition. *Conclusions:* The incentive-related increase in total peripheral resistance, combined with an absence of enhanced stroke volume, cardiac output, or preejection period response, indicates that active coping may, under certain conditions, elevate blood pressure via increased systemic resistance, presumably reflecting α-adrenergic activation. Furthermore, the enhanced heart rate associated with incentive may reflect a withdrawal of parasympathetic influence. **Key words:** Active coping, cardiovascular reactivity, blood pressure, impedance cardiography.

SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; PEP = preejection period; LVET = left ventricular ejection time; SV = stroke volume; SI = stroke index; CO = cardiac output; CI = cardiac index; TPR = total peripheral resistance; MAP = mean arterial pressure.

INTRODUCTION

Substantial interindividual variability has been noted in the magnitude and patterning of cardiovascular responses to psychological stressors. Such variability is thought to be a fairly stable dimension of individual differences (1). Furthermore, there is some evidence that persons showing relatively large cardiovascular responses to behavioral challenge may be at increased risk for the development of essential hypertension and coronary heart disease (2, 3). In this regard, specific hemodynamic response patterns may have differential etiologic significance (4). It has thus been of interest to identify pertinent psychosocial and situational predictors of the magnitude and patterning of behaviorally evoked cardiovascular responses. One such factor is the psychological dimension of active vs passive coping.

Active coping refers to the mental or physical effort exerted to achieve actual or perceived control over the outcome of an event. The dimension of active coping was first conceptualized by Obrist, Light, and colleagues (eg, 5–7). These investigators conducted a series of studies that led them to conclude that experimental tasks requiring effort to control task outcome, such as reaction time with contingent shock avoidance, led to a cardiovascular response pattern characterized predominantly by myocardial activation as a result of β-adrenergic stimulation of the heart. In contrast, tasks such as the cold pressor test, viewing of certain types of films, and inescapable shock were described as passive coping tasks; these tasks did not allow subjects to exert effort or control over aversive outcomes, but instead, required passive tolerance. Such tasks were described as eliciting a vascular response pattern, presumably reflecting α-adrenergic influences.

Since the time of these classic experiments, numerous investigations have corroborated that laboratory tasks and manipulations requiring active coping elevate blood pressure or heart rate, or both, significantly. However, few studies have examined the hemodynamic parameters underlying such cardiovascular responses while specifically manipulating active and passive coping conditions. In this regard, studies by Sherwood et al. (8) and Lovallo et al. (9) using impedance cardiography suggest that cardiovascular responses during active coping do reflect cardiac activation, as indicated by increased cardiac output and decreased vascular resistance during task performance. Yet, it remains difficult to determine what particular dimensions of active coping are involved in eliciting this hemodynamic response pattern. Indeed, Gerin et al. (10, 11) have noted that active coping is a multidimensional construct that is lacking in specificity. There are multiple aspects of active coping tasks and manipulations, plus a variety of subject variables, that are likely involved in eliciting cardiovascular activation during active coping.

Consider first that a multitude of experimental tasks, such as mental arithmetic, video games, and the Stroop Color-Word Test, have been denoted active coping tasks because they require effort to exert control over task outcome (eg, Refs. 12–15). However, such experimental tasks vary on a host of dimensions other than their ability to engage active coping (8), including their propensity to elicit somewhat different patterns of cardiovascular responses (4, 16–18). That is, certain tasks, such as reaction time, tend to elicit cardiovascular responses that are characterized, on average, by myocardial activation (4, 17), whereas other tasks, such as Mirror Tracing (ie, tracing a star using only its inverted mirror image), tend to elicit mean increases in peripheral vascular resistance (19).

Active coping is also thought to be enhanced by the introduction of certain experimental manipulations. Examples have included aversive stimulation such as shock avoidance, provision of an appetitive stimulus (eg, monetary incentive), or other more direct manipulations of actual or perceived control (6, 8, 20, 21). Task manipulations that enhance control or effort under moderate conditions of difficulty are thought to

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maximize active coping and concomitant cardiovascular activation (6, 21).

In addition to these pertinent task variables, several subject variables are also considered critical to the construct of active coping. These include subjects' perceptions of control, level of task difficulty, effort expended, task predictability, and self-efficacy (10, 11, 14, 21, 22). To date, few studies have actually measured psychological indices relevant to the construct of active coping. This makes it difficult to determine the extent to which the myocardial activation associated with active coping in prior studies was a direct result of psychological dimensions of active coping vs other characteristics of the tasks themselves.

In this regard, it remains important to determine whether cardiovascular responses to active coping tasks reflect a propensity for particular laboratory tasks to elicit a specific pattern of hemodynamic response, independent of any psychological dimensions of coping, or the degree to which psychological aspects of active coping contribute to such responses. Furthermore, it is possible that active coping manipulations, such as shock avoidance or monetary incentive, simply accentuate the propensity for an experimental task to elicit a particular hemodynamic response pattern, rather than specifically evoking β-adrenergic activation. One way to examine this issue is to determine whether an active coping manipulation enhances myocardial responsivity to a task that already tends to elicit a cardiac response pattern, and whether it superimposes a cardiac response pattern on a task that elicits predominantly vascular responsivity.

Accordingly, the present study examined the cardiovascular response patterns evoked by two experimental tasks that require active, effortful coping—a computerized Stroop Color-Word Test and Mirror Tracing. Although both tasks elicit some degree of mixed hemodynamic response, the Stroop can be characterized by a somewhat larger myocardial response (17), whereas Mirror Tracing tends to elicit a greater vascular response (19). The tasks were performed either with or without an appetitive (ie, monetary) incentive as an active coping manipulation. Impedance cardiography was used to derive the hemodynamic response patterns underlying blood pressure reactions to both tasks. Theoretically, introduction of incentive—an "active coping" manipulation—should enhance the myocardial activation associated with performance of the Stroop test and superimpose such a cardiac response pattern during Mirror Tracing. If this cardiac response is attributable to active coping, there should be an accompanying endorsement of self-report items indicative of psychological dimensions of active coping, such as increased effort expended and an enhanced perception of control.

METHODS

Participants

Study participants were 48 white male undergraduate student volunteers. Subjects ranged in age from 18 to 24 years (mean = 19.8), in weight from 109 to 197 lb (mean = 162.39), and in height from 63 to 74 in (mean = 69.07). There were no differences in age or body mass index as a function of any grouping variable (ie, incentive, task order). Individuals were ineligible for participation on the basis of resting systolic or diastolic blood pressures exceeding 140 or 90 mm Hg, respectively; obesity (greater than 25% overweight according to American Heart Association tables); or a self-reported history of hypertension, cardiovascular or pulmonary disease, psychiatric disorder, or use of medications affecting cardiovascular function. Informed consent was obtained in accordance with the University of Pittsburgh Biomedical Institutional Review Board guidelines. Subjects participated in one 90-minute laboratory session, and received $5.00, Introductory Psychology course credit, and any performance-related bonus money earned during the experimental tasks.

Cardiovascular Measurements

A Minnesota Impedance Cardiograph (Model 304B; Surcom, Inc., Minneapolis, MN) was used in conjunction with four circumferential, dry-tape aluminized electrodes to measure cardiac preejection period , stroke volume , cardiac output, and total peripheral resistance. In accordance with current methodological suggestions for use of impedance cardiography (23), a tetrapolar band-electrode configuration was used. One voltage-detecting band was placed at the base of the neck and the other at the level of the xiphisternal junction. Two current-emitting electrodes were placed at a distance of at least 3 cm distal to the inner two bands. Heart sounds were obtained by a Hewlett-Packard Contact Sensor (Model 20105A) placed at the second intercostal space on the left sternal border. Signals were filtered by the impedance cardiograph to remove frequencies below 80 Hz. Heart rate was derived from the electrocardiogram (ECG) measured from two electrodes attached bilaterally to the chest. Blood pressure measurements were obtained oscillometrically using a Dinamap (Model 8100) automated monitor (Critikon, Tampa, FL).

The following signals were filtered and amplified by Grass biological amplifiers, and charted on a Grass Instruments Model 7 Polygraph for the purpose of visual inspection: ECG, heart sounds, dZ/dt (first derivative of the change in thoracic impedance), and Z_o (basal thoracic impedance). All four channels of cardiovascular signals were interfaced with a Metrabyte DAS-16 data acquisition card installed in an AST IBM-AT compatible microcomputer that allowed analog to digital conversion at a rate of 1000 samples per second.

Experimental Tasks

Stroop Color-Word Test. A modified Stroop Color-Word Test (24, 25) was presented to subjects on a computer screen for 6 minutes. One of four color names (ie, red, green, blue, yellow) was displayed in the center of the screen in a color incongruent with the printed word (eg, blue printed in red). With the use of a computerized keypad, subjects were asked to choose the color *name* corresponding to the *color* of the word printed in the center of the screen from four color names (also printed in incongruent colors) positioned at the bottom of the screen. Coinciding with the presentation of each stimulus screen, one of the four color names was announced randomly by a computerized voice synthesizer. The task titrated to the subjects' level of performance, becoming faster with three consecutively correct responses and slower with two consecutive errors.

Mirror Tracing. With an automated mirror tracing apparatus (Lafayette Instruments Model 58024), subjects used a stylus to trace a star, guided only by its inverted mirror image, for a period of 6 minutes (19, 24).

Self-Report Items. With a Likert-type scale of 1 to 10, subjects rated items reflecting psychological dimensions of active coping (ie, difficult, predictable, in control, helpless, effort exerted), level of task engagement (ie, involved, motivated, interested, excited/aroused), and affective response to the tasks (ie, anxious, angry, sad, happy, frustrated).

Procedure

After instrumentation for cardiovascular monitoring, subjects were seated in a reclining chair in a sound-attenuated, temperature-controlled experimental chamber. A 30-minute rest period (last 6 minutes as baseline) was followed by completion of the Stroop and Mirror Tracing tasks. Task presentation was counterbalanced across subjects (Order 1 = Stroop first; Order 2 = Mirror Tracing first). The second task was preceded by a 15-minute rest period (last 6 minutes as baseline). Half of the subjects (No Incentive Group) were given standard task instructions and simply asked to perform the experimental tasks to the best of their abilities. The other half (Incentive Group) were offered a monetary incentive (up to $12.00 per task) for good performance.

Specifically, before performing the Stroop, participants in the incentive condition were told "... you can earn up to $2.00 per minute on this task depending upon both the speed and accuracy of your performance. Most people are typically able to get around 80% correct. Remember to maximize your speed as well as your accuracy." Before Mirror Tracing, subjects were told "... you can earn up to $2.00 per minute on this task depending upon your speed and accuracy. The amount of money you earn will be determined by a combination of the number of error-free linear segments which you complete and the number of gross errors. The computer will keep track of your performance. Most people are able to minimize their errors. Remember to maximize your speed as well as your accuracy." Self-report data were collected at the end of each task period.

SBP and DBP were measured at 90-second intervals during baseline and task periods. HR, PEP, and other impedance-derived hemodynamic indices (ie, SV, CO, TPR) were obtained continuously. Impedance-derived measures were ensemble-averaged in four and six 30-second blocks for baseline and task periods, respectively, using a computer-based scoring program developed initially at the University of Miami and revised at the University of Pittsburgh (26).

Data Reduction

SV was calculated using the Kubicek equation: $SV = [\rho \times (L/Z_o)^2 \times LVET \times dz/dt_{(min)}]$ (27). A fixed value of 135 ohm/cm was used for blood resistivity (ρ) (23). CO was computed as $(HR \times SV)/1000$. To adjust for subject differences in body mass, stroke index and cardiac index were calculated by dividing SV and CO by body surface area $[\text{weight(kg)}^{.425} \times \text{height(cm)}^{.725} \times .007184]$. Total peripheral resistance was calculated using the equation $TPR = MAP/CO \times 80$. PEP and LVET were measured in milliseconds as the following intervals: the Q-wave of the digitized ECG to the B-point of the dz/dt waveform and B-point to X-wave of the dz/dt waveform (ie, coincident with closure of the aortic valve, the second heart sound).

Arithmetic change scores (task value minus baseline value) were calculated as an index of task-induced SBP, DBP, HR, PEP, SI, CI, and TPR response during the Stroop and Mirror Tracing tasks. Four subjects were excluded because of technical difficulties or missing data. Statistical analyses were therefore based on the data of 44 subjects.

RESULTS

Cardiovascular Measures

Two-way analyses of variance (ANOVA) indicated that the incentive and order groups did not differ with respect to any resting cardiovascular measures. Repeated-measures ANOVAs ($\text{Group}_{(\text{No-incentive, Incentive})}$ by $\text{Order}_{(\text{Stroop first, Mirror Tracing first})}$ by $\text{Task}_{(\text{Stroop, Mirror Tracing})}$) of arithmetic change scores revealed a significant effect of incentive on SBP [$F(1,43) = 20.04$, $p = .0001$], DBP [$F(1,43) = 8.21$, $p < .007$], HR [$F(1,43) = 4.96$, $p < .04$], SI [$F(1,43) = 12.38$, $p < .002$], and TPR [($F(1,43) = 11.36$, $p < .002$], and a marginally significant effect on CI [$F(1,43) = 3.59$, $p < .07$]. As depicted in Figure 1, SBP, DBP, HR, and TPR increased more in the incentive condition than in the no-incentive condition, whereas SI and CI showed a more substantial decrease with incentive.

Significant task effects were also apparent for DBP [$F(1,43) = 20.13$, $p = .0001$], HR [$F(1,43) = 17.66$, $p =$

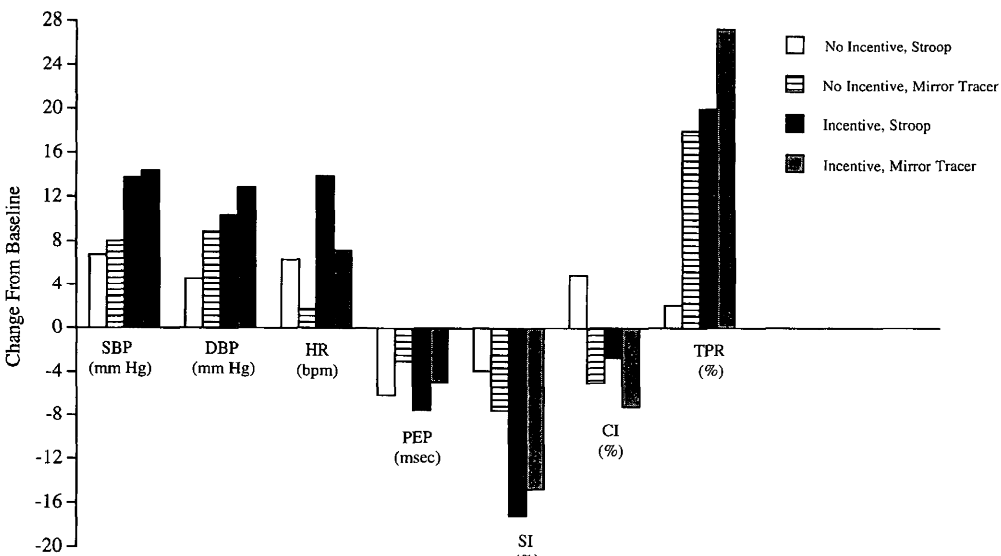

Fig. 1. Cardiovascular response to the Stroop Color-Word Test and Mirror Tracing as a function of incentive condition. SBP, DBP, HR, and PEP responses are depicted as arithmetic change scores. SI, CI, and TPR responses are shown as percent change scores in order to allow the depiction of all cardiovascular parameters on a single axis. Data analyses conducted using percent change scores were virtually identical to those using arithmetic change scores.

.0002], PEP [$F(1,43) = 15.75$, $p = .0004$], CI [$F(1,43) = 18.59$, $p = .0002$] and TPR [$F(1,43) = 24.65$, $p = .0001$). Mirror Tracing was characterized by greater increases in DBP and TPR in comparison to Stroop, whereas the Stroop test elicited greater increases in HR and greater decreases in PEP than did Mirror Tracing. Additionally, CI increased slightly during the Stroop, but decreased during Mirror Tracing.

All group-by-task interactions were nonsignificant. However, because significant main or interactive effects of order were apparent for SBP, DBP, HR, PEP, and SI, separate analyses were conducted for these measures within each order condition. In both Order 1 (Stroop first) and Order 2 (Mirror Tracing first), there were significant (or marginally significant) main effects of incentive on SBP [Order 1: $F(1,19) = 8.73$, $p < .009$; Order 2: $F(1,23) = 11.57$, $p < .003$], DBP [Order 1: $F(1,19) = 3.38$, $p = .08$; Order 2: $F(1,23) = 5.22$, $p < .04$], and HR [Order 1: $F(1,19) = 3.24$, $p < .09$; Order 2: $F(1,23) = 5.24$, $p < .04$], such that greater responses were noted in the incentive condition. In Order 2, a significant group effect was also apparent for SI [$F(1,23) = 13.63$, $p = .001$], indicating a greater decrease in the incentive than in the no incentive condition.

In both order conditions, a significant task effect for PEP [Order 1: $F(1,20) = 9.82$, $p < .006$; Order 2: $F(1,24) = 4.98$; $p < .04$] revealed that the Stroop elicited a greater decrease than Mirror Tracing. In Order 1, significant task effects for HR [$F(1,20) = 17.55$, $p = .0006$] revealed that the Stroop evoked greater increases than did Mirror Tracing. In Order 2, significant task effects for SBP [$F(1,24) = 4.59$; $p < .05$] and DBP [$F(1,24) = 43.62$; $p < .00001$] indicated that Mirror Tracing elicited greater blood pressure responses than did Stroop.

Self-Report Measures

Repeated measures ANOVAs (Group × Order × Task) revealed a significant effect of incentive on ratings of control [$F(1,43) = 4.60$; $p < .04$] and interest [$F(1,42) = 8.32$; $p < .007$]; participants in the incentive group reported feeling *less* in control, but more interested in the tasks than subjects in the no incentive group (Table 1).

Significant task effects were apparent for ratings of predictability [$F(1,44) = 61.49$) $p < .00001$], involvement [$F(1,44) = 16.43$; $p < =.0003$], anxiety [$F(1,44) = 5.45$; $p < .03$], and frustration [$F(1,44) = 6.84$; $p < .02$]. The Stroop was rated as less predictable than Mirror Tracing. Subjects also reported greater levels of involvement, anxiety, and frustration during the Stroop than during Mirror Tracing.

No main or interactive effects of group or task were present in relation to subjects' perceptions of task difficulty, motivation, excitement, anger, sadness, or helplessness. However, either main or interactive effects of order were apparent on the following items: predictability, effort expended, happy, and interested. Therefore, separate analyses were conducted on these items within each order group.

For Order 1 (Stroop first), there were no significant main effects for group or group-by-task interactions for any of the above four variables. However, significant main effects of task were present for predictability [$F(1,20) = 32.39$; $p < .00001$] and involvement [$F(1,20) = 7.67$; $p < .02$]. The Stroop test was rated as significantly less predictable than Mirror Tracing; Stroop also elicited greater levels of involvement.

TABLE 1. Self-Reported Active Coping, Engagement, and Affect

	No-Incentive Group	Incentive Group
Active Coping		
Difficult[a]	6.32 (1.93)	6.82 (1.78)
Unpredictable[a]	6.71 (2.97)	7.41 (2.31)
In Control[b]*	4.82 (2.42)	5.96 (2.29)
Helpless[a]	3.52 (2.17)	4.31 (2.39)
Effort Exerted[b]	2.73 (1.40)	2.25 (1.14)
Engagement		
Involved[b]	2.50 (1.56)	2.11 (1.21)
Motivated[b]	2.80 (1.72)	2.30 (1.37)
Interested[a]*	6.84 (2.07)	8.17 (1.56)
Excited/Aroused[a]	3.32 (1.25)	3.91 (2.56)
Affect		
Anxious[a]	6.30 (2.25)	6.14 (2.84)
Angry[a]	3.80 (2.51)	4.46 (2.67)
Sad[a]	1.39 (0.97)	1.84 (1.52)
Happy[a]	4.41 (2.51)	4.34 (2.64)
Frustrated[a]	5.66 (2.74)	6.10 (3.10).

[a] Greater scores indicate more.
[b] Smaller scores indicate more.
* p's < .05.

For Order 2 (Mirror Tracing first), significant effects of group were apparent for predictability [$F(1,23) = 5.44$; $p < .03$] and interest [$F(1,22) = 7.12$; $p < .02$]. Subjects reported less predictability and greater interest in the incentive than in the no-incentive condition. Significant task effects were noted for predictability [$F(1,24) = 27.98$; $p < .00001$], involvement [$F(1,24) = 9.27$, $p < .006$], and effort expended [$F(1,24) = 4.96$; $p < .04$]. Subjects reported the Stroop to be less predictable than Mirror Tracing; Stroop was also associated with greater levels of involvement and more effort expended than was Mirror Tracing.

Task Performance

Two-way ANOVAS revealed no significant main or interactive effects of group or order on subjects' performance of the Stroop and the Mirror Tracing tests.

DISCUSSION

Results of this study revealed that monetary incentive, an appetitive active coping manipulation, virtually doubled blood pressure response to Stroop and Mirror Tracing—two laboratory tasks that require effortful coping. However, this response was explained by a concomitant increase in TPR, rather than indices of cardiac performance (eg, PEP, SI, CI). Indeed, SI and CI actually decreased during task performance in the incentive condition. These results, combined with an absence of any significant incentive effects for PEP, indicate that an appetitive, "active coping" manipulation does not necessarily exert its effects on cardiovascular response via myocardial influence (of presumed β-adrenergic origin), but may, under certain circumstances, reflect a vascular resistance (presumably α-adrenergic) effect. Furthermore, given the absence of any other indices of enhanced myocardial activation, it is possible that the incentive-related increase in HR may reflect a withdrawal of parasympathetic influence.

Stroop and Mirror Tracing as Active Coping Tasks

Collapsed across incentive conditions, Mirror Tracing yielded a significantly greater DBP and TPR response than Stroop performance, thus suggesting relatively greater vascular influences; in contrast, Stroop performance was associated with a greater cardiac response as compared with Mirror Tracing, revealed by significantly greater HR response and shortening of the PEP. Although group-by-task interactions were not significant, these general response patterns were apparent in the no-incentive condition (see Figure 1). Thus, even in the absence of incentive, the Stroop and Mirror Tracing tasks tended to elicit somewhat different patterns of hemodynamic responses. Interestingly, both of these tasks can be defined as active coping tasks, inasmuch as they require individuals to expend effort to exert control over task outcome. Yet, neither task elicited the purely myocardial response pattern that would be expected during active coping. Additionally, both tasks were perceived quite similarly with respect to psychological dimensions of active coping. For example, subjects' endorsement of self-report items indicated that they expended comparable levels of effort during both tasks. Rated perceptions of control and task difficulty were also similar for both tasks, although the Stroop was rated as less predictable than Mirror Tracing.

As mentioned earlier, Sherwood (8) has indicated previously that active and passive coping tasks differ with respect to several dimensions other than individuals' abilities to exert control. Results of this study suggest that there is also substantial variability *among* active coping tasks in terms of psychological responses and concomitant hemodynamic response patterns.

Monetary Incentive as an Active Coping Manipulation

As discussed above, provision of monetary incentive, an active coping manipulation, enhanced the vascular resistance response associated with both the Stroop and Mirror Tracing tasks. It did not enhance cardiac response to Stroop nor did it superimpose a cardiac response during Mirror Tracing. Interestingly, incentive was associated with significantly *less* perceived control than in the no-incentive condition. In this regard, Gerin (10) also reported *decreases* in perceived control during active coping that were associated with greater cardiovascular responses.

Subjects in the incentive condition also reported the tasks to be significantly more interesting than in the no-incentive condition. This may reflect an increase in participants' task engagement. In a similar vein, Lovallo et al. (9) found greater levels of interest during performance of active than passive coping tasks, although their active coping task was associated with increased cardiac output. Manuck et al. (28) have proposed that task engagement plays a key role in eliciting cardiovascular reactivity, and that this may constitute a critical aspect of the active coping construct. These investigators also emphasized the importance of assessing both situational and dispositional variables as elicitors of cardiovascular reactivity. That is, although particular tasks may allow for active coping responses, individuals will likely vary in their propensity to cope in this fashion. In this regard, several individual difference variables (eg, self-efficacy, Type A Behavior Pattern) may moderate cardiovascular responses to tasks via subjects' task perceptions, desire for and perception of control, and effort expended (11, 12, 29). Gerin has suggested that a mismatch between task demands, such as control and subject attributes such as self-efficacy, may be critical to the elicitation of cardiovascular arousal (11).

Another potential moderator of active coping response is individuals' "response stereotypy" or propensity to respond with a particular psychophysiological, or specifically hemodynamic, response pattern regardless of the types of task that are performed (8, 19, 30). In this regard, Sherwood et al. (8) have found that active coping only partially moderates individual differences in hemodynamic response propensity.

Order Effects

Although several significant effects of order of task presentation were apparent in these data, separate analyses within each order group indicated that these effects were rather trivial with respect to both hemodynamic and psychological responses. Because this study used a between-subjects design with respect to the active coping manipulation, it is possible that individuals in Orders 1 and 2 differed on psychological dimensions pertinent to task perceptions and cardiovascular arousal. It would thus be useful to repeat this study using a fully within-subjects design.

Summary

In summary, results of this study indicate that hemodynamic response to tasks or experimental manipulations that necessitate effort to exert control over task outcome is not solely determined by either psychological dimensions of active coping or enhancement of the hemodynamic response pattern typically evoked by the task itself. Rather, such responses are likely determined by a multiplicity of influences including characteristics of the tasks and manipulations themselves, subjects' perceptions of and responses to the tasks (eg, engagement), individual response stereotypy with respect to hemodynamic patterning, and dispositional variables (eg, self-efficacy, preferred coping style). It is suggested that future research focus on further defining the psychological dimensions of active coping pertinent to the elicitation of myocardial reactivity and determine the extent to which these dimensions elicit such reactivity independent of individual hemodynamic response propensities and task-related influences. Furthermore, because this study used only healthy, white male undergraduates, the findings may not generalize to women, older adults, ethnic minorities, or individuals with cardiovascular disease. Future research may seek to extend these findings with more diverse groups of participants.

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