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Cardiovascular Responses in Type A and Type B Men to a Series of Stressors

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Fifty-six healthy adult males were administered the Type A Structured Interview and assessed as exhibiting either Type A (N = 42) or Type B (N = 14) behavior pattern. They were monitored for systolic (SBP) and diastolic blood pressure (DBP) and heart rate (HR) responses during a series of six challenging tasks: Mental Arithmetic, Hypothesis Testing, Reaction Time, Video Game, Handgrip, and Cold Pressor. The results indicated that Type A subjects exhibited greater cardiovascular responses than did Type B subjects during some (Hypothesis Testing, Reaction Time, Video Game and Mental Arithmetic) but not all (Handgrip and Cold Pressor) of the tasks. These results are discussed in terms of previously reported findings on conditions that do and do not produce differences in Type A/B cardiovascular stress responses.

KEW WORDS: Type A behavior; blood pressure; heart rate; stress.

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INTRODUCTION

Adult males with the Type A behavior pattern (TABP) exhibit approximately twice the risk of developing coronary heart disease (CHD) compared to their Type B counterparts (Rosenman *et al.*, 1975) independent of other major risk factors (Brand *et al.*, 1976). The most plausible theory relating the TABP to CHD suggests that the behaviors exhibited by Type A individuals are accompanied by excessive sympathetic nervous system arousal that promotes progression of the atherosclerotic process (Williams *et al.*, 1977). Generally, the empirical literature supports this theory. In response to laboratory stressors, for example, when differences are present, cardiovascular responses in Type A's are almost universally greater than in Type B's [see Matthews (1982) for a review]. However, laboratory stressors do not consistently induce A/B differences and the types of tasks that are associated with greater cardiovascular responses in Type A's remain to be determined.

The present protocol was designed to permit examination within Type A's and Type B's of cardiovascular responses to varying types of tasks. The tasks consisted of three stressors (i.e., reaction time, a video game, and cold pressor) that have previously elicited Type A/B differences in responses. Three additional tasks were added to characterize further the type of challenge associated with Type A/B differences in cardiovascular responses. These included hypothesis testing, mental arithmetic, and handgrip. These six tasks involved varying degrees of time and performance demands to facilitate the perception of challenge among susceptible subjects. Thus, in contrast to previous research, the present study was designed to investigate the intraindividual differences in cardiovascular responses in Type A and Type B adult subjects to varying types of challenge.

METHODS

Subjects

The subjects consisted of 56 male volunteers aged 35–65 years ($\bar{X}$ = 50 years). All were employed in salaried, white-collar positions at a large high-technology company; all reported being in good health at the time of the experimental session and taking no prescription medication.

Design

Prior to the experimental session, each participant was given the Type A Structured Interview by a trained interviewer and classified according to

the procedure given in Rosenman (1978). Pairwise agreement among the three independent judges was 73.8%. A total of 42 Type A and 14 Type B participants was identified.

The protocol consisted of six challenging tasks: Mental Arithmetic, Hypothesis Testing, Video Game, Reaction Time, Handgrip, and Cold Pressor. In order to diminish a possible effect due to the order of the tasks, four orders of presentation were randomly derived, each presenting the tasks in a different sequence. The subjects were assigned randomly to one of these four experimental orders. The experiment was conducted double-blind so that both the subjects and all personnel involved in gathering or scoring the cardiovascular responsiveness data were unaware of the behavior type ratings of the subjects.

Procedure

Upon arrival at the test session, electrodes for measuring heart rate (HR) as beats per minute (bpm) were taped over the subject's right clavicle and lowest left rib; an earclip electrode served as ground. A blood pressure (BP) cuff was placed on the dominant arm with the attached microphone positioned over the brachial artery.

The subject was instructed to relax while baseline measurements were collected. To accommodate the subjects to the BP cuff inflation, a series of at least five BP recordings was collected during an initial resting baseline period. The series of six tasks was then presented after the initial resting baseline period. A pretask baseline period consisting of three BP measurements preceded each of the six tasks. HR was recorded continuously. The tasks were presented as follows.

Mental Arithmetic. The subject was instructed to start at 1079 and count backward by 13 for 5 min. He was corrected at each mistake and told to perform the calculations as rapidly as possible.

Hypothesis Testing (Levine, 1975). For this task the subject was presented with 10 series of slides, each containing a pair of complex figures that differed on several dimensions. Within each series of slides there was one "correct" dimension which was randomly assigned to one of the two figures. The subject was instructed to identify the "correct" dimension for each series by formulating a hypothesis about which dimension was correct and testing it. Feedback was presented after each slide for the subject to use in order to confirm or reject these hypotheses. The first series of eight slides was used as practice. For the second, third, and fourth series of eight slides the pair of figures differed on only four dimensions. For the fifth through tenth series of 16 slides the pair of figures differed on eight dimensions. This task is considered to be practicularly challenging because only a fraction of the possible hypotheses can be tested within the allotted number of slides

in each series. The subject was provided with the "correct" dimension after each series.

Reaction Time. The subject was instructed to perform a Short and a Long Delay Reaction Time task according to the protocol described by Glass (1977).

Video Game. The subject played two relatively easy and two relatively difficult games of "Break-Out," a commercially available video game.

Handgrip. The subject was first instructed to produce three maximum voluntary contractions. For the Duration Handgrip, the pointer of the handgrip apparatus was set to one-half of the average of the maximum voluntary contractions, and the subject was instructed to maintain a half-maximum handgrip for as long as he could.

Cold Pressor. For this task the subject was given challenging instructions (Dembroski *et al.*, 1979) that directed him to hold his dominant hand in a bucket of 4°C water for 60 sec.

Following the testing protocol, the physiological recording apparatus was removed and the subject was then debriefed. All experimental sessions were performed in a room in the medical clinic of the subjects' place of employment. The subject was seated in a comfortable chair, and the lights were dimmed throughout the session. The physiological recording apparatus was hidden behind a screen out of view of the subject. A Vita-Stat 900D automatic blood pressure machine was used for all BP recordings. Ag/AgCl electrodes and a Beckman 9857 coupler were used to record HR. Multiple BP measures were taken during each task. Heart rate was scored during 30-sec segments preceding each BP measurement.

Data Analysis

Systolic and diastolic BP and HR responses for each task were analyzed separately by repeated measures analyses of covariance. The covariate consisted of the average of the last two baseline measures preceding each task. The Type A/B behavior pattern distinction was used as a single grouping factor, and the repeated measurements of each dependent variable were used as the trial factor. In addition, for all subjects grouped, the degree to which the responses increased from baseline to task period was analyzed by a t test for each task.

RESULTS

The cardiovascular responses of all subjects to the six tasks are presented in Table I. For all tasks, SBP and HR increased significantly from the pretask

Table I. Cardiovascular Responses to Each Task

Task	Measure[a]	Average response across subjects	Responses by Behavior Type		
			Type A	Type B	F
Hypothesis Testing	SBP	5.1	6.1	2.1	2.90 ($P = 0.01$)
	DBP	2.5	3.3	0.3	2.88 ($P = 0.01$)
	HR	4.7	5.3	2.9	
Reaction Time	SBP	2.8	4.0	−0.9	2.47 ($P = 0.02$)
	DBP	−1.1	−0.9	−1.6	
	HR	3.6	4.7	0.6	3.88 ($P = 0.004$)
Video Game	SBP	8.1	8.5	6.8	
	DBP	1.1	1.3	0.4	
	HR	12.6	13.7	9.1	1.36 ($P = 0.05$)
Mental Arithmetic	SBP	19.4	20.9	14.6	1.36 ($P = 0.05$)
	DBP	7.8	8.0	7.3	
	HR	8.8	9.0	8.3	
Handgrip	SBP	8.4	8.3	8.5	
	DBP	2.4	1.8	4.1	
	HR	13.9	14.0	13.7	
Cold Pressor	SBP	6.0	6.3	5.0	
	DBP	1.2	0.4	3.3	
	HR	5.6	6.0	4.5	

[a]SBP and DBM, mm Hg; HR, beats per minute.

baseline to the measures taken during the procedure. Diastolic BP increased significantly in response to four of the six tasks: Mental Arithmetic, Hypothesis Testing, Video Game, and Handgrip. These results indicate that, with the exception of DBP responses to Reaction Time and Cold Pressor, the increase in cardiovascular responding to the tasks was robust, confirming that all tasks were challenging.

Response Differences by Behavior Pattern

The average of the final three measures of the initial rest period comprised an initial baseline level for SBP, DBP, and HR. No significant differences between Type A's and Type B's were found for these baseline levels of SBP ($t = 1.15$, $P = 0.3$), DBP ($t = -0.24$, $P = 0.8$), or HR ($t = -0.79$, $P = 0.4$). For the Type A's, the initial baseline values for SBP, DBP, and HR were 122.3 mm Hg, 74.2 mm Hg, and 71.4 bpm, respectively. For Type B's the corresponding baseline values were 118.0 mm Hg, 74.9 mm Hg, and 74.1 bpm.

The cardiovascular responses of the Type A's and Type B's in response to the six tasks are also presented in Table I. The Type A subjects exhibited significantly larger SBP responses to Hypothesis Testing, Reaction Time, and Mental Arithmetic than did their Type B counterparts. The Type A's also exhibited significantly larger HR responses than the Type B's to the Reaction Time task and the Video Game. For DBP, the only significant difference between Type A's and Type B's was observed in response to Hypothesis Testing, with Type A's showing the larger responses. No other cardiovascular response differences between Type A's and Type B's was significant.

DISCUSSION

The results of the present study replicate previously reported findings indicating greater cardiovascular responses by Type A's than Type B's during the performance of certain tasks. Moreover, the inclusion of the six tasks permits speculation concerning factors that induce enhanced cardiovascular responses in Type A's. Specifically, Reaction Time and Hypothesis Testing produced the largest difference between Type A's and Type B's, suggesting that Type A's exhibit larger cardiovascular responses, predominantly SBP, than do Type B's in response to tasks that involve time urgency to perform cognitive processing in the form of decision making or problem solving. In contrast, the failure to observe differences in response to Handgrip and Cold Pressor indicates that Type A's and Type B's do not significantly differ in cardiovascular responses to tasks involving passive waiting and endurance of a painful sensation. In addition, these data support Houston's (1983) conclusion that it is only in response to moderately difficult tasks that differences between Type A's and Type B's in cardiovascular responses are found. In particular, those tasks producing the *smallest* average increase across all subjects, as shown in Table I (i.e., Reaction Time and Hypothesis Testing), were more successful in eliciting proportionately larger responses in Type A's than those tasks producing the largest increase in blood pressure (i.e., Mental Arithmetic). Further research is needed that directly manipulates these variables of perception of time urgency, cognitive processing, and perceived challenge and that also examines the corresponding cardiovascular responses in Type A and Type B individuals.

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