A re-examination of the relationship between the Type A behavior pattern and heart rate recovery from a psychosocial stressor

by

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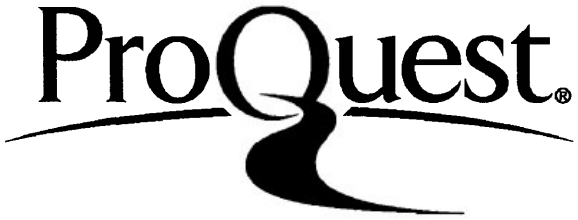

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Abstract

A recent study by Hart and Jamieson (1983) reported that Type A males recover from a psychosocial stressor significantly slower than their Type B counterparts. It is unclear, however, whether this result is a robust one, or the result of an element of social comparison which was present during performance of and recovery from the stimulus task. The present study therefore reexamined this issue. Sixty-one male and 61 female undergraduate university students completed the Jenkins Activity Survey (Form T) and were then randomly assigned to either a social comparison or no social comparison group. Subjects in both conditions performed the Stroop color word task under conditions stressing time urgency and competition. In addition, subjects in the social comparison group were informed that their scores would be compared to the scores of other subjects who had already participated in the study. Heart rate was recorded before, during and after performance of the task. Hart and Jamieson's study was not replicated. The social comparison group which was expecting feedback at the end of the recovery period showed significantly ($p<.Ø25$) less heart rate recovery during this period. No A/B differences were observed either in response to or recovery from the task. The failure to replicate the finding by Hart and Jamieson suggests that the previous report be interpreted with caution until further replications are attempted.

Table of Contents

List of Figures

A recent study has reported that Type A males recover from a psychosocial stressor significantly slower than their Type B counterparts (Hart and Jamieson, 1983). Since this finding may have ramifications with regard to the pathogenic mechanisms linking Type A behavior with coronary heart disease, it is important to determine if this is a robust finding, and not the consequence of specific conditions existing within the study. Specifically, in their study, subjects were awaiting feedback on their performance. Since Type A individuals are noted for being more competitive and achievement oriented, it is possible that they were more anxious and concerned about the feedback than the Type B's. This anxiety and concern might have been the cause of the slower heart rate recovery i.e., slower heart rate recovery might be specific to waiting instructions, and therefore it may not be a general response characteristic of Type A's. Therefore, the purpose of the present study was to attempt to replicate the previous study, including an additional experimental condition to evaluate whether the slower recovery might occur only when subjects are waiting to receive feedback concerning their performance.

The Type A Behavior Pattern

Observations of a relationship between personality and behavioral traits have occurred for centuries (Rosenman and Chesney, 1982). However, a systematic investigation of this relationship was not undertaken until the 195Ø's when

cardiologists Friedman and Rosenman seriously began to consider their coronary patients' personalities (Friedman and Rosenman, 1974).

The Type A behavior pattern has been described as:

> an action-emotion complex that can be observed in any person who is aggressively involved in chronic, incessant struggle to achieve more and more in less and less time, and if required to do so, against the opposing efforts of other things or other persons (Friedman and Rosenman, 1974, p.67).

Among the characteristics of the Type A behavior pattern are competitiveness, achievement striving, aggressiveness (possibly repressed), impatience, restlessness, hyperalertness, and a chronic sense of time urgency which leads to the acceleration of thought and action (Rosenman and Chesney, 1982). An individual who exhibits a paucity of these traits is called a Type B.

It is important that one makes the distinction between the concept of stress and the Type A behavior pattern, for the behavior pattern is neither a stressor situation nor a distressed response. The Type A behavior pattern is a style of overt behavior with which people confront either pleasant or unpleasant situations when a challenge is felt (Jenkins and Zyzanski, 1980).

Rosenman and Chesney (1982) point to the trichotomous character of Type A behavior. The first component relates to the personality and emotional traits of Type A's, i.e.,

competitiveness, aggressiveness, hostility, etc., which emerge only when the second component, environmental stressors, appears. In a sense, Type A behavior is therefore "activated" by the demands and challenges of the environment, and the threat to one's control. This "activation" therefore involves the third component, the individual's perception of the environmental challenges and his/her reactions to that challenge.

The notion of a threat to one's control is highlighted by the work of Glass (1977), who postulates that Type A individuals exert more effort than Type B's in order to master their environment, working harder to succeed and suppressing certain states (like fatigue), which may interfere with their response to a stressor. The Type A behavior pattern is therefore a coping style aimed at asserting and maintaining control over uncontrollable situations (Burnam, Pennebaker and Glass, 1975).

Assessment of Type A Behavior

There are numerous psychometric devices which have been utilized to measure Type A behavior and its correlates, including: the Structured Interview (Rosenman, 1978); the Jenkins Activity Survey (Jenkins, Rosenman and Friedman, 1967); the Bortner test battery (Bortner and Rosenman, 1967); the Bortner scale (Bortner, 1969); Constructed Interview (Papageourgiou, Anthpoulaus, Mitsimbounas, Kontou, Vrouchos, Benrubi and Moulopoulos, 1982); Framingham Type A

behavior scale (Haynes, Levine, Scotch, Feinleib and Kannel, 1978); Coronary Behavior Profile Questionnaire (Rahe, Arajarvi,Arajarvi,Punsar and Karvonen, 1974; Rahe, Hervig, Romo, Siltanen, Punsar, Karvonen and Rissanen, 1978); Ratings of Statements List (van Dijl, 1978, 1982); Gough Adjective Checklist (Ahnve, de Faire, Orth-Gomer, and Theorell, 1979; Chesney, Black, Chadwick and Rosenman, 1981; MacDougall, Dembroski and Musante, 1979; Rahe, Hervig and Rosenman, 1981) ; the Thurstone Temperment Schedule (Chesney et al., 1981; MacDougall et al., 1979; Rahe et al., 1978); California Psychological Inventory (Rahe et al., 1978); Eysenck Impulsiveness scale (Chesney et al., 1981); Symptom Distress Checklist (Chesney et al., 1981); Barratt Impulsiveness Scale (Chesney et al., 1981) and the Smith's Need Achievement Scale (Irvine, Lyle and Allon, 1982). The most frequently utilized methods are, however, the Structured Interview and the Jenkins Activity Survey.

The Structured Interview (SI), was the first formal assessment technique developed to determine the existence of Type A behavior (Rosenman, Friedman, Straus, Wurm, Kositchek, Hahn and Werthessen, 1964). Although the SI is considered the best method of Type A Behavior assessment because of its predictive ability in relation to Coronary Heart Disease, and arousal (Chesney, Eagleston and Rosenman, 1980; Dembroski, Macdougall, Shields, Petitto and Lushene ,1978), there are a number of limitations of this

instrument. First, administration of the Interview is time consuming, complex and subjective (Lovallo, 1978; Rowland and Sokol, 1977). Secondly, it requires the services of an interviewer trained in the SI method (Chesney et al, 1980; Rowland and Sokol, 1977). Many studies therefore use the Jenkins Activity Survey (JAS).

The JAS, the most popular self-report questionnaire for the measurement of Type A behavior, attempts to objectify the Structured Interview by employing items which significantly discriminated between Type A and B individuals during the course of the Structured Interview. Items were also gleaned from clinical observation (Chesney et al., 1981). Refinement of the scale yielded an overall Type A/B score and three subscales : speed and impatience, job involvement and hard-driving (Zyzanski and Jenkins, 1970). Agreement between the JAS and SI classifications are approximately 70 to 73 percent (Jenkins and Zyzanski, 1980). The test-retest reliability of the JAS A/B scale over a one year interval is .66 (Jenkins, Zyzanski and Rosenman, 1971). The "speed and impatience" and "job involvement" scales test-retest correlations over several years range from .64 to .74 (Jenkins, Rosenman and Zyzanski, 1974).

The adult JAS is appropriate for a specific population, reflecting predominantly white-collar, upwardly mobile values (Matthews, 1982). As a result, a different form was created for use within an academic setting, the JAS Form T (Krantz, Glass and Snyder, 1974). Only two items from the

original JAS, referring to job involvement, income and job responsibility were altered to create the student form. Those items were : "In the past three years have you taken less than your alloted number of vacation days" and "My type of job does not provide regular vacations". They were replaced in the student form by "Do you maintain a regular study schedule during vacations such as Thanksgiving, Christmas and Easter?". As a result of these eliminations and alterations, the job involvement subscale was dropped, leaving the speed and impatience and the hard-driving subscales, as well as the overall A/B score. There is little information available with regard to the reliability and validity of the student JAS, but since changes were minimal, it is assumed that these measures are similar to those for the adult JAS (Glass, 1977).

Components of the Type A Behavior Pattern

Time Urgency

Time urgency is an important component of the Type A behavior pattern. Individuals high in Type A are impatient while waiting in lines, are punctual for appointments, and will not wait for a table in a restaurant (Matthews et al., 1977).

Burnam, Pennebaker and Glass (1975) asked introductory psychology students to estimate 1 minute of elapsed time while simultaneously reading a passage aloud. Type A's signalled the passage of time significantly sooner than Type B's. The average deviation from the minute was not different for the two groups, it was just the direction which was significant. Yarnold and Grimm (1982) replicated Burnam et al.'s study while controlling for reading rate, since it was proposed that increasing the number of stimuli or stimulus changes decreases perceived time duration. If this is true, then differential reading rates between A's and B's could account for the differential time estimates. Burnam et al.'s results were replicated, as A's perceived 1 minute to pass more quickly. There was no significant difference in the reading rates of the two groups.

Becker and Suls (1982) administered the student JAS to a social psychology class at the beginning of the school year, ostensibly for the purpose of standardization. In

actuality, the JAS was used for classification in an experiment to determine test performance as a function of various components of the Type A behavior pattern. As the students handed in their first class test of the year, their completion time was noted. It was found that the completion time was negatively related to their score on the subscale speed and impatience of the JAS. That is, the higher their score on the subscale S/I, the faster the students handed in their test papers.

Other studies have shown that male attorneys who experienced greater systolic blood pressure or pulse pressure reactivity to experimental tasks estimated that the task period lasted significantly longer, and therefore perceived the time to progress more rapidly than did physiologically less responsive subjects (Manuck, Corse and Winkelman, 1979). A final piece of data is the re-analysis of the results from the Western Collaborative Group Study. Of the interview variables used to diagnose Pattern A, impatience was one of the two factors associated with the later onset of CHD (Matthews et al., 1977).

Achievement Striving

Another essential component of the Type A behavior pattern is excessive drive and achievement striving. Type A students, as opposed to Type B's, participate in more college extracurricular activities (other than sports), earn more academic honours in college, receive more athletic awards in high school, and spend more time in class and studying. They also report higher career aspirations than Type B's (Pennebaker and Glass, 1979; Ditto, 1982).

Friedman (1969) described the Type A individual's excessive drive to achieve, even in the absence of clearly defined objectives or deadlines. Burnam et al. (1975), tested the hypothesis that this excessive drive to achieve and control their environment should produce high response levels in Type A's, regardless of the goal demands of the situation. Type B's, however, should be more responsive to the goals of the task. Subjects were asked to solve a number of arithmetic problems. Half of the subjects were told that they would be timed, but that there was no time limit in which to solve the problems (the No Deadline Condition). The other half were told that they had exactly 5 minutes in which to solve as many problems as possible (Deadline Condition). All subjects in reality were allowed 5 minutes to solve the problems. Results indicated that A's attempted more problems than B's in the No Deadline Condition, whereas they did not under the Deadline Condition. Therefore, Type A's worked at near maximum

capacity regardless of the specificity of the goal demands of the task. Conversely, Type B's responded more closely to the precise nature of the task requirements.

Manuck and Garland (1979) also showed that Type A's solved more test items than Type B's in a no incentive condition (no monetary reward) while A's and B's performed equally well in the incentive condition (monetary reward). The presence or absence of explicit incentives affected task performance for A's but not B's. A's gave more responses more quickly when offered monetary reward (Blumenthal, Lane, Williams, McKee, Haney and White, 1983).

It has also been shown that Type A's will suppress fatigue in order to continue competing. In a study by Carver, Coleman and Glass (1976), Type A's and Type B's participated in a Balke treadmill test. Subjects were told that the experimenter would terminate the test at a predetermined time, or that they could terminate the test by signalling. In fact, there was no predetermined completion time, and the test was completed when the subjects so desired. Throughout the course of the test, the subjects were to indicate their fatigue level on a scale ranging from "as fresh as I have ever been" (11) to "as tired as I have ever been" (1). Initial levels of fatigue did not differ between A's and B's. However, A's expressed less fatigue overall than B's even though A's worked closer to their maximum capacity.

The public denial of fatigue has instrumental value for A's since it aids in their struggle for attainment of achievement related goals. The acknowledgment of fatigue and symptomotology was also found by Weidner and Matthews (1978). These findings are significant since this may reveal that A's are less perceptive of heart attack or pre heart attack symptoms. If A's are unwilling or unable to acknowledge their symptoms, they will probably continue on as they normally would, thereby delaying seeking medical treatment. This may in turn exacerbate their physical condition and result in a more severe infarction (Carver, Coleman and Glass, 1976).

Further construct validity stems from the use of psychological tests to differentiate responses between A's and B's. van Dijl (1978) found that Type A men as opposed to Type B men showed more "ambition/dominance" on the Ratings of Statements List. The factor "ambition/dominance" contained items such as "achieving a great deal in life is very important" and "achieving success in all sorts of fields is very important." In a similar vein, Chesney et al. (1981) also found that A's scored significantly higher in achievement as measured by the Adjective Checklist.

While Type A's are more competitive (Van Egeren 1979a, 1979b), they also report greater task involvement and less satisfaction with their own performance. They also have a tendency to believe that they cannot be presented with any problems which they could not successfully solve (Manuck and

Garland, 1979).

The above evidence,therefore supports the validity of the hard-driving, achievement orientation of Type A's.

Hostility

Perhaps the most important component of the Type A Behavior Pattern is hostility. In the re-analysis of the Western Collaborative Group data, Matthews et al. (1977) concluded that competitive drive and impatience were associated with the later onset of CHD in that population. Specifically, three items in the competitive drive factor accounted for this significant relationship, those items reflected vigor, drive and hostility ("explosive voice modulation", "potential for hostility" and "subject's answers are vigorous"). The only item with a significant relationship on the impatience factor was one which dealt with irritation at waiting in lines.

Psychological tests have also found the association between Type A behavior and hostility. Chesney et al. (1981) found that aggression, as measured by the Adjective Checklist, was significantly higher ($p<.00\overline{1}$) among Type A than Type B males. "Aggressivity", as measured by the Ratings of Statements List, was also found to be higher among Type A's. Items included "often infuriated", "very quick-tempered" and "often rebellious" (van Dijl, 1979). van Dijl (1982) has also shown that male myocardial

infarction patients are more aggressive and hostile than healthy males.

The aggressivity and hostility of Type A's has also been investigated in the laboratory. Carver and Glass (1977) found that Type A subjects were more willing to shock a confederate following harassment than were Type B's. Competition between Type A's also elicited aggression (Van Egeren, 1979a). Hostility elicited in laboratory settings has resulted in greater increases in systolic blood pressure, heart rate and plasma epinephrine during competition (Glass, Krakoff, Contrada, Hilton, Kehoe, Mannucci, Collins, Snow and Elting, 198Ø).

Type A behavior as assessed by the Structured Interview, and hostility level as assessed by a subscale of the MMPI, were correlated with the amount of artery occlusion in patients who underwent diagnostic coronary arteriography. It was found that the hostility scale was associated more strongly with arteriographically documented atherosclerosis than an overall measure of the Type A behavior pattern (Williams, Haney, Lee, Kong, Blumenthal and Whalen, 198Ø).

It has been suggested that Type A's suppress their hostility (Friedman and Rosenman, 1974; Glass, 1977). However, Hicks and Hodgson (1981), utilizing the Buss-Durkee Hostility Inventory, found that college Type A individuals expressed higher levels of hostility than Type B students.

This difference was due primarily to the relatively greater level of overt hostility of the Type A group. There was no significant difference between A's and B's on measures of covert hostility. Therefore, this supports only half of the hypothesis, namely that Type A individuals are more hostile. However, in this instance the subjects did not suppress their hostility.

In conclusion, time urgency, achievement striving and hostility, as components of the Type A behavior pattern, have received consistent and strong support through both laboratory investigations and psychological testing.

Type A Behavior Pattern
Association with Coronary Heart Disease

Coronary Heart Disease (CHD), is a clinical disorder produced by lesions of the coronary arteries (Glass, 1977). Traditional risk factors such as hypercholesterolema, hypertension, smoking, obesity, sedentary living and being male have predictive ability for approximately 5Ø percent of new cases of coronary disease (Keys, Aravanus, Blackburn, van Buchem, Djordjenc, Fidanza, Kurvonen, Menotti, Paddy and Taylor, 1972; Simborg, 197Ø). Despite improved coronary care and knowledge of these traditional risk factors, CHD still remains the number one cause of premature death in Canada and the United States (Review Panel on Coronary Prone Behavior and Coronary Heart Disease, 1981; Statistics Canada, 1982).

A large body of literature exists linking the Type A behavior pattern and coronary heart disease. There are two methods by which data of this association can be collected, prospectively and retrospectively. The utilization of retrospective data clouds the issue of this association due to issues such as temporality, i.e., is Type A behavior the cause of, or the result of CHD, are the survivors of a cardiac event representative of all individuals with CHD, etc (Steptoe, 1981). As a result, prospective studies in this area have provided more relevant data concerning this relationship.

The Western Collaborative Group Study (WCGS) was initiated in 196Ø-61 as a prospective epidemiological investigation of CHD incidence of 3524 men, aged 39 to 54 at intake. CHD occurred in 257 subjects during the eight to nine years of follow-up (average 8 1/2 years). In the younger group, aged 39 to 49 years at intake, Type A behavior was significantly associated with incidence of both symptomatic and unrecognized infarction. The incidence was approximately twice as high among Type A men. The predictive relationship of the behavior pattern to the CHD incidence could not be "explained away" by the other traditional risk factors (Rosenman et al., 1964; Rosenman, Brand, Jenkins, Friedman, Straus and Wurm, 1975).

A second major prospective study undertaken was the Framingham Heart Study which investigated the prevalence of CHD in 1822 men and women aged 45 to 77. Results indicated that those individuals with CHD scored significantly higher on the Framingham Type A behavior scale than did non-cases. Men over the age 65, and classified as Type A were more than two times more likely to have prevalent angina than their Type B counterparts. In every age group, Type A women were more likely to have angina pectoris. Again, Type A behavior was found to be independent of the other major risk factors (Haynes, Feinleib, Levine, Scotch and Kannel, 1978; Haynes, Levine, Scotch, Feinleib and Kannel, 1978).

Retrospectively, a link has been shown between Type A behavior and the extent of coronary atherosclerosis, a precursor to CHD. Several studies have found a positive relationship between the magnitude of Type A scores and the severity of atherosclerosis (Blumenthal, Williams, Kong, Schanberg and Thompson, 1978; Krantz, Sanmarco, Selvester and Matthews, 1979; Williams, Haney, Lee, Kong, Blumenthal and Whalen, 198Ø; Zyzanski, Jenkins, Ryan, Flessas and Everist, 1976). However, studies have also failed to find this association (Dimsdale, Hackett, Block, and White, 1979; Dimsdale, Hackett, Block, and White, 1979; and Krantz, Schaeffer, Davia, Dembroski, MacDougall and Shaffer, 1981).

There has been some cross-cultural validation of the Type A Behavior Pattern and CHD incidence. The results of the Belgian Heart Disease Prevention Program indicated that Type A behavior, as determined by the JAS, was related to CHD prevalence. The association between the JAS A/B score and CHD was apparent, however, only for subjects with angina or EKG abnormalities who were fully aware of their CHD. Again, this association was independent of other risk factors (Kornitzer, Kittel, DeBacker and Dramaux, 1981). Validation of this association has also been performed in the Netherlands (Verhagen, Nass, Appels, van Bastelaer and Winnubst, 198Ø).

A review panel on Coronary Prone Behavior and Coronary Heart Disease, sponsored by the National Heart, Lung and Blood Institute, has recognized and accepted the evidence associating Type A behavior with increased risk of clinically apparent CHD in employed, middle-aged U.S. citizens. This risk was recognized as being greater than that imposed by age, elevated blood pressure and serum cholesterol levels, and of approximately the same magnitude as the relative risk associated with the other traditional risk factors (Review Panel on Coronary Prone Behavior and Coronary Heart Disease, 1981).

Physiologic Mechanisms

Although the relationship between Type A behavior and coronary heart disease is well documented, the exact pathogenic mechanisms linking the two remain unclear. Current research places individuals in stressful and challenging situations, and records their physiological responses. Two mechanisms which have been proposed to account for this relationship between Type A behavior and CHD are greater reactivity among Type A's as well as slower recovery rates.

The first mechanism proposed is greater sympathetic nervous system activity among Type A's (Williams, 1978). A relatively consistent finding in this area is that Type A's respond to a challenging situation with greater increases in systolic blood pressure than B's (Blumenthal, Lane, Williams, McKee, Haney and White, 1983; Contrada, Glass, Krakoff, Krantz, Kehoe, Isecke, Collins, and Elting, 1982; Corse, Manuck, Cantwell, Giordani and Matthews, 1982; Dembroski, MacDougall, Herd and Shields, 1979; Dembroski, MacDougall and Lushene, 1979; Dembroski, MacDougall and Shields, 1977; Dembroski, MacDougall, Shields, Petitto and Lushene, 1978; Gastorf, 1981; Glass, Krakoff, Contrada, Hilton, Kehoe, Mannucci, Collins, Snow and Elting, 198Øa; MacDougall, Dembroski and Krantz, 1981; Manuck, Craft and Gold, 1979; Manuck and Garland, 1979; Weidner and Matthews, 1978).

A few studies have also shown that Type A's respond with greater diastolic blood pressure increases (Corse, Manuck, Cantwell, Giordani and Matthews, 1982; Dembroski, MacDougall and Lushene, 1979; Glass, Krakoff, Contrada, Hilton, Kehoe et al., Experiment II, 1980; Jorgensen and Houston, 1981; Newlin and Levenson, 1982; Pittner and Houston, 1980; and Schell and Lusche, 1981).

Heart rate has also been shown to differentially increase in response to stress (Blumenthal et al., 1983; Dembroski, MacDougall, Herd et al., 1979; Dembroski, MacDougall and Shields, 1977; Dembroski, MacDougall, Shields et al., 1978; Glass et al., 1980a; Holmes, Solomon and Rump, 1982; Pittner and Houston, 1980; and Van Egeran, 1979a).

Reactions to challenges and stressors have also resulted in increased cortisol excretion in A's (Lundberg and Forsman, 1979), serum cholesterol (Friedman, Rosenman and Carrol, 1958; Lovallo and Pishkin, 1980), plasma epinephrine (Glass et al., 1980, Experiments I and II) and norepinephrine levels (Friedman, Byers, Diamant and Rosenman, 1975) as well as decreased blood clotting time (Friedman et al., 1958).

However, there have been some studies in which the above findings did not appear. There was no differential increase in systolic blood pressure in a study by Pittner and Houston (1980). As well, no significant differences in

dialstolic blood pressure have also been noted (Dembroski, MacDougall, Shields, Petitto and Lushene, 1978; Gastorf, 1981; Glass, Krakoff, Finkelman, Snow, Contrada, Kehoe, Mannucci, Isecke, Collins, Hilton, and Elting, 1980b; Lovallo and Pishkin, 1980; MacDougall, Dembroski and Krantz, 1981, Experiment II; Manuck, Corse and Winkelman, 1979; Manuck and Garland, 1979; and Weidner and Matthews, 1978).

The literature is also not consistent with regard to heart rate responses in Type A and B individuals as there have been several studies in which differential responding did not occur (Dembroski, MacDougall and Lushene, 1979; Glass, Krakoff, Finkelman, Snow, Contrada, Kehoe, Mannucci, Isecke, Collins, Hilton and Elting, 1980b; Hart and Jamieson, 1983; Jorgensen and Houston, 1981; Lovallo and Pishkin, 1980; Lundberg and Forsman, 1979; MacDougall, Dembroski and Krantz, 1981, Experiment II; Manuck, Craft and Gold, 1978, Experiment II; Manuck and Garland, 1979; and Van Egeran, 1979b).

The importance of greater autonomic reactivity in Type A's is not clear. Williams (1978) suggests that the Type A Behavior Pattern might play a role in the etiology of CHD by precipitating acute clinical events in patients with preexisting advanced coronary atherosclerosis or that it may contribute to the atherosclerotic process itself. Increased norepinephrine levels may be responsible for the focal myocardial necrosis that is observed in extreme stresses

(Eliot, 1976). The increased cardiac output could impose additional strain on the cardiac muscles in such a way that the blood supply available by way of presumed atherosclerotic coronary arteries becomes insufficient to meet the needs of that muscle, therefore resulting in a myocardial infarction.

Ross and Glomset (1976) have proposed that the initiating event in the atherosclerotic process involves "injury" to the arterial endothelium. This initial lesion may then be aggravated by increased levels of epinephrine, norepinephrine and serum cholesterol (Lovallo, 1978).

A second mechanism which has been proposed is that Type A's recover from stress more slowly than Type B's. Although there are a myriad of studies dealing with physiological reactions to stress, few have dealt with recovery from stress. Goleman and Schwartz (1976) have noted the importance of recovery from stress stating that "the maintenance of an orienting response, or more appropriately, a defensive arousal to threat, beyond the time required for coping responses - that is, the failure to habituate - represents a dysfunctional mode" (p. 464-465). For example, slower autonomic habituation has been found to be associated with anxiety symptoms and poor prognosis among psychiatric patients (Stern, Surphlis and Koff, 1965).

Hart and Jamieson (1983) monitored the heart rate responses of male subjects before, during and after the performance of the Stroop color-word interference task. They reported that Type A subjects recovered significantly slower than Type B's after completion of the task. A recovery difference was also observed in a study by Jorgensen and Houston (1981). Male and female A's and B's were stressed under three different conditions, a Stroop task, a mental arithmetic task and a shock avoidance task. No significant differences in pulse rate recovery were found after the first two tasks, however, there was a significant difference in recovery following the shock avoidance task. A's tended to recover more slowly than B's.

However, the findings in this area are not consistent as some studies have also failed to find this differential recovery. Holmes, Solomon and Rump (1982) found no significant difference among A's and B's between 90 and 120 seconds into the rest period, after performing the digit subtest from the WAIS. Glass et al. (1980b), using measures recorded at 2 minute intervals and averaged over a 15 minute recovery period, failed to observe any significant differences on measures of heart rate and systolic blood pressure. Therefore, the results in this area are far from consistent.

A factor which may have confounded the results of one of the above-mentioned studies is the influence of impending social comparison. Hart and Jamieson (1983), in order to increase the stressfulness of their task, informed their subjects prior to the performance of the Stroop task, that their scores would be compared with the scores of the other subjects. The influence of these social comparison instructions should not be ignored.

Festinger (1954) proposed that within each individual there exists a drive to evaluate his opinions and abilities. Further, if objective, non-social means are not available for this evaluation, people evaluate their opinions and abilities by comparison with the opinions and abilities of others. Evans (1974) found that informing subjects who were peforming modified forms of the Digit Symbol task from the WAIS that they would be given the opportunity to compare their score with the other subjects participating in the study, affected their results. Heart rate differences between the basal period and the trial produced an average change score of 12 beats per minute for the subjects in the social comparison group and an average of only 1.13 beats per minute in the control group. As well, performance scores for the social comparison group were significantly higher than for the control group. Therefore, simply informing subjects that they would be able to engage in social comparison can increase a subject's heart rate. This may have implications for Hart and Jamieson's (1983) study.

As a result of the impending social comparison in their study, all subjects may have experienced prolonged physiological arousal because they were awaiting feedback regarding their performance. Since one of the defining characteristics of a Type A individual is competitiveness and achievement striving (as was previously outlined), the A's may have valued the social comparison more, more eagerly anticipated the feedback and thus evidenced the prolonged physiological arousal. If the prolonged physiological arousal in A's is a result of impending social comparison, then the results are not generalizable and arguably not a factor to explain CHD since few stressful situations involve such opportunity for social comparison.

Present Study

In light of the conflicting results in the area of recovery from stress, and the possible confounding effects of the impending social comparison in Hart and Jamieson's study, a re-examination of this issue was undertaken. Subjects in this experiment again performed the Stroop color-word task. Subjects in Group one received the same experimental manipulation as Hart and Jamieson's subjects (social comparison group). Group two also performed the Stroop task, but with the removal of all references to social comparison (no social comparison group). Therefore, for this group, the recovery period was simply to be a "rest" period, as opposed to a "waiting" period.

Additionally, both males and females were included in this study.

While it is plausible that social comparison may result in prolonged physiological arousal, especially in those subjects for whom social comparison is particularly important, it should be noted that there is no evidence of the effects of social comparison on physiological recovery. Therefore, another purpose of the present study is to examine whether social comparison has any effect on physiological recovery, i.e., do subjects awaiting feedback show prolonged physiological arousal, relative to subjects not awaiting feedback?

Method

Subjects

The subjects were 122 undergraduate students (61 male and 61 female) volunteering to participate in a "personality and physiology" experiment. The mean age of the subjects was 23.1 (SD=6.95). Those subjects enrolled in an Introductory Psychology course received one bonus credit towards their final mark in the course.

Apparatus

The Jenkins Activity Survey (JAS Form T) (Krantz et al., 1974) was used as the measure of Type A behavior. The JAS is a 44 item self-report questionnaire modified from the

adult version and specifically designed for a university population. The JAS is comprised of 3 scales: an overall A-B scale (JAS A/B), a speed and impatience scale (JAS S/I), and a hard-driving competitive scale (JAS H/C). The median A/B score for college age males usually falls between 7 and 8 with a possible range from Ø to 21. For each of the 21 items of the A/B scale, the A responses receive a score of 1, and the B responses, a score of Ø. Higher scores indicate the presence of more Type A behavior.

Hostility was assessed by means of the hostility scale of the Multiple Affect Adjective Checklist (Zuckerman and Lubin, 1965). The hostility scale is comprised of 28 adjectives either positively or negatively keyed i.e., angry or agreeable. The subject marks an "X" in the boxes beside the words which describe how they feel at that time. The total score is equal to the number of positive items checked and the number of negative items not checked. Hostility was assessed as it is perhaps the most important component of the Type A behavior pattern.

A post-experimental questionnaire was administered measuring cognitive, and affective reactions, as well as personal history data (Appendix I).

A photoplethysmographic transducer was placed on the first phalanx of the left hand middle finger. This provided continuous monitoring of heart rate. It was connected to a voltage pulse pressure coupler of a Beckman polygraph (Type

RS).

The task stimulus was a modified Stroop color-word conflict chart (Stroop, 1935). A 24" X 29" chart had the names of colours printed in conflicting colours of ink, i.e., the word blue may be printed in red ink. The subjects task was to respond with the word "red". There were seven different names of colours (black, blue, brown, green, orange, red and yellow) printed in seven different colours (black, blue, brown, green, orange, red and yellow). Each word was printed in 1/2 inch script. The stimulus chart with 126 colour words (6 columns of 21) was taped to the wall in front of the subject at eye level. Total score on the Stroop test was the number of color words correctly recited.

Procedure

The subject, upon arrival at the lab, completed the JAS Form T. He/she was then randomly assigned to one of two conditions : social comparison or no social comparison. The polygraph was explained to the subject, and then the photoplethysmographic transducer was attached.

Group 1: Social comparison

After the transducer was attached, the subject was asked to close his/her eyes and relax for a few minutes. At the conclusion of this six minute adaptation period, the

subject was instructed to open his/her eyes and was told : "In a minute you will be presented with a difficult intellectual task. In order for you to achieve a high score, you will have to think quickly and concentrate. When you finish the task, I will compare your score with the scores of the other students , tell you how you scored in comparison with most of the students and what percentage of the students scored worse than you".

The Stroop task was then explained: "This chart contains practice examples of the intellectual task which you will do next. Your task is to look at each of the words listed and say out loud the correct colour of ink. The correct response to the first word is brown. Do you understand? Read through the rest of the examples".

"You will now be tested on how well you can do on the actual task. On the next wall chart is a list of words in columns. Start reading on the left-most column and read downwards. When you finish the first column, go on to the next one. When you finish the entire chart, start over. If you make a mistake, you must correct it before continuing. For every mistake you make, five points will be deducted from your final score. There is a six minute time limit, therefore it is important that you concentrate and read quickly if you are to obtain a high score. Remember, your task is to say out loud the correct colour of ink. Any questions? When you finish, I will compare your score with the scores of the other students who have previously

completed the task and tell you how you stand in relation to them. Are you ready? Close your eyes while I remove the cover, and when I tell you to, open your eyes and begin reading".

The task stimulus was uncovered and a Gralab Model 300 darkroom timer was placed in the subject's view to heighten any sense of time urgency that the individual may possess. The subject was then asked to open his/her eyes and to begin reading.

The timer rang at the end of 6 minutes, and the subject was told to stop reading, close their eyes and relax for a few minutes (this recovery period lasted six minutes). The subject was also told that his/her results would be computed during the next few minutes and that he/she would be informed about the score and its relationship to those of the other subjects at the end of the recovery period. After the end of the recovery period the subject was asked to fill out the questionnaires. After completing the questionnaires, the subject was told that his/her score would not be compared with those of the other students. The reason for this deception was explained, the subject was thanked and asked not to reveal anything about the experiment.

Heart rate (HR) was measured by counting the number of beats that occurred on the polygraph output in each minute. The last minute of the initial six-minute adaptation period

was used as the baseline measure of HR. A single stress HR was calculated by averaging the six one minute HR's as the subject performed the Stroop test. A single recovery HR was calculated using the identical procedure.

Group 2: No social comparison

The procedure for Group Two was identical to that of Group One with one exception. There was no reference made about the comparison of subject's scores with those of the other participants.

Results

The mean A/B score for the subjects was 7.Ø5, with a standard deviation of 2.73Ø. There was no significant group differences in AB scores. The scales of the JAS were highly intercorrelated. The overall A/B scale was correlated with the H/C scale ($r=.7ØØ$, $p<.ØØ1$) and the S/I scale ($r=.599$, $p<.ØØ1$). The H/C and the S/I scales were significantly correlated ($r=.489$, $p<.ØØ1$).

The application of the stressor was effective in increasing HR, as the difference between the base HR and HR during the first minute of stress was significant, $t(121)=-18.75$, $p<.ØØ1$. The mean baseline HR for the subjects was 75.36, while the mean HR for the first minute of stress was 96.87. This base to stress difference can be seen in Figure 1.

Data were analyzed using hierarchical multiple regression in order that the A/B score could be utilized in the analysis, without the loss of power that results from dichotomization. Analysis of the single stress HR, with the variablility of base HR removed, revealed no significant A/B

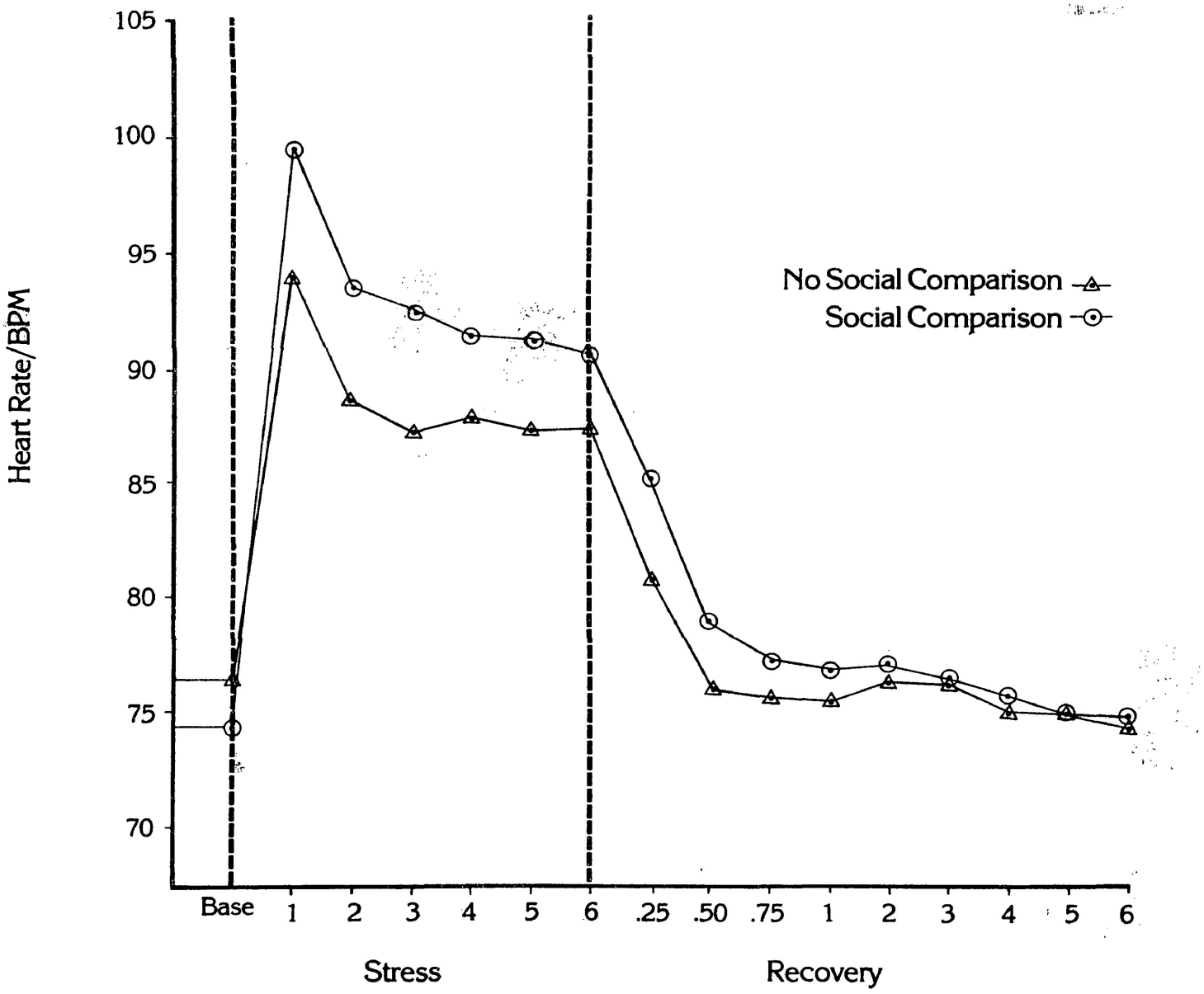

Figure 1. Heart rate for the social comparison group (n=61) and the no social comparison group (n=61) during the three phases of the experiment.

effect in response to stress. Base HR contributed significantly to stress HR $F(1,117)=170.01$, $p<.001$, as did the effect of group, $F(1,117)=12.19$, $p<.001$; the HR of the subjects in the social comparison group increased significantly more than that of the subjects in the no social comparison group. There was no sex effect (Appendix II).

Analyses of each of the six minutes of stress, using hierarchical multiple regression, again revealed no A/B or sex effect, but the continued significance of base HR and Group. These data are presented in Appendix III. Analyses using the H/C and S/I subscales in place of the A/B score did not reveal significant effects of these scales.

Analysis of the average recovery HR, with the variability of base HR and the final minute of stress HR removed, revealed no significant A/B effect (nor with the H/C or S/I scales). The variability associated with base HR, $F(1,116)=1870.1$, $p<.001$ and stress HR, $F(1,116)=91.48$, $p<.001$ were significant. The social comparison/no social comparison group assignment was also significantly associated with recovery HR, $F(1,116)=5.42$, $p<.025$ (Appendix IV). Further multiple regression analyses were conducted in which the interactions among A/B, Group and Sex were also entered into the equation. None of these interactions reached significance (Appendix V).

Analysis of the successive minutes of recovery also failed to reveal any A/B, H/C, S/I or sex effect. Base HR and stress HR continued to account for significant amounts of the variablity in recovery HR. The group effect was significant during the first, fourth and sixth minutes of the recovery period (Appendix VI).

T-tests performed comparing the HR during the fourth and sixth minutes of recovery to the base HRs for each group revealed that at the fourth minute of recovery, subjects in the social comparison group were still evidencing significantly higher HRs from baseline, $t(60)=-2.17$, $p<.05$, while subjects in the no social comparison group evidenced significantly lower HRs than baseline, $t(60)=2.80$, $p<.01$. At the sixth minute of recovery, there was no significant difference from baseline for the social comparison group, $t(60)=-.96$, n.s., while the subjects in the no social comparison group continued to show a significant decrease in HR from baseline, $t(60)=3.60$, $p<.001$.

Since these findings do not replicate those of Hart and Jamieson, a further analysis was undertaken to correspond more closely to the conditions of their experiment. For this analysis, only males in the social comparison group were considered. Again, multiple regression showed that the effect of A/B did not reach significance $F(1,27)<1$ during the first 30 seconds of recovery, the point at which Hart and Jamieson found the largest difference (Appendix VII).

Appendix VIII presents the data for the number of colour words attempted during the stress period across A/B and Group. There were no significant differences.

There was a significant Group X Sex interaction for errors, $F(1,112)=6.196$, $p<.015$. Errors were defined as the number of stimulus words incorrectly read which the subject failed to correct. Females in the social comparison group made fewer errors than their male counterparts, while females in the no social comparison group made more errors than their male counterparts (Appendix IX).

Analyses of the self-report questionnaire indicated that the JAS A/B scale was associated with self-reported task involvement, $r=.208$, $p<.025$. The JAS H/C scale was associated with frustration, $r=.196$, $p<.03$, perceived HR increase, $r=.218$, $p<.025$, and time pressure, $r=.220$, $p<.025$. The JAS S/I scale was associated with perceived HR increase, $r=.236$, $p<.009$, and impatience, $r=.198$, $p<.03$.

Scores received on the MAACL were not significantly associated with either the AB, H, or S scales of the JAS. The MAACL was also not significantly associated with either response to or recovery from stress.

Drugs, smoking, exercise and parental history of CHD did not explain a significant amount of the variance associated with either response to or recovery from stress. The amount of caffeine ingested (in the form of tea or coffee) did explain a significant amount of the variance

associated with response to stress, $F(1,112)=4.12$, $p<.05$.

Discussion

The main question posed in this study was whether slower recovery among Type A's might occur only when subjects are waiting to receive feedback concerning their performance. The findings do not support differential recovery as the Type A's did not recover more slowly. No A/B differences appeared in either response to or recovery from stress. However, the results supported part of the hypothesis in that the subjects awaiting feedback of their performance (social comparison group) showed significantly less HR recovery following the stressor.

When only male subjects in the social comparison condition are considered, a population similar to those used in Hart and Jamieson's study, the differential recovery between A's and B's again fails to emerge. Further, HR during the first 30 seconds of the recovery period, the time interval within which Hart and Jamieson found the greatest discrepancy between A's and B's, also failed to reveal the A/B difference.

In light of this non replication, it is important to consider the validity of this study. The present study was carried out in the same experimental room as the Hart and Jamieson study, using the same apparatus. Considering only the males on the social comparison group, a similar sample

size was employed, 32 subjects previously, and 31 subjects in the present study. The mean A/B score is comparible, 7.53 for Hart and Jamieson's group, and 7.48 for the present one. The mean HR change scores are comparable, approximately 25 for Hart and Jamieson and 28.68 for the present experiment.

Therefore it appears that the conditions of the present experiment provided an adequate opportunity for the Type A effects on HR recovery to appear. The failure of this to appear raised the question of whether any procedural differences between the present study and that of Hart and Jamieson can be identified which may account for this difference.

One difference between the two experiments was the age of the participants. Although almost all of the the subjects for this study were Introductory Psychology students, the average age of the male social comparison subjects was 23.9 compared with 2Ø.7 in the previous study. Another difference is the sex of the experimenter, a male in the previous experiment and a female in the present one. There was also an added emphasis placed on the social comparison in this experiment by repeating the comparison instructions once more prior to the task and once at the completion of the task at the start of the "waiting" period. This should have increased a Type A's tendency to maintain physiological arousal as the subjects are reminded that they have the opportunity to engage is social comparison.

However, a high incentive to perform has been observed in a previous study to obscure physiological or performance differences between A's and B's (Manuck and Garland, 1979). Perhaps this is what happened in the present study; both the Type A's and B's worked so hard as to obscure any differences.

It is certainly not clear which, if any, of these minor differences served to mask or eliminate the effect reported by Hart and Jamieson. However, the finding of no differential recovery rate between A's and B's is consistent with the results of Holmes, Solomon and Rump (1982) and Glass et al. (198Øb) as well as the first two stressor conditions in the study by Jorgensen and Houston (1981). Therefore, it seems appropriate to advise caution in generalizing from the Hart and Jamieson study until evidence is obtained to indicate whether slower recovery in Type A's is a robust or reliable phenomenon.

The finding in this study of no differential A/B HR increase in response to stress is consistent with some other reports. Holmes (1983) cited 29 experiments in which Type A and B individuals were compared while performing various tasks. Of the 24 experiments listed in which a measurement of HR was recorded, only six revealed reliable differences in that measure. Among those that did not reveal reliable differences were : Dembroski, MacDougall and Shields (1979); Lovallo and Pishkin (198Ø); MacDougall, Dembroski and Krantz (1981) (Experiment 1); Manuck and Garland (1979)

and Van Egeren (1979b).

A secondary purpose of the present study was to test whether social comparison has any effect on physiological response to and recovery from a stressor. First, it was found that subjects in the social comparison group had significantly higher heart rates in response to the stressor than those in the no social comparison group. The mean HR increase (base to the first minute of stress) in the social comparison group was 25.29, while the mean HR increase was only 17.72 for the no social comparison group. This is similar to the results obtained in Evan's (1974) study, except that the magnitude is greater. Second, subjects in the social comparison group showed less recovery from the stressor than those subjects in the no social comparison group. Significant differences were present during the first, fourth and sixth minutes of recovery. This confirms the hypothesis that social comparison, in this instance waiting to be informed of their results in relation to those of the other subjects, can have an effect on HR recovery from a stressor. The significant difference in heart rate which is present at the fourth and the sixth minutes of recovery seem to indicate the prolonged influence of waiting to receive social comparison.

Results from the post-experimental questionnaire lend validity to the concept of Type A subjects as being time pressured and impatient,as Type A's responded that they were more time pressured and impatient than Type B's. However,

one finding is contrary to results previously reported in the literature. Those individuals scoring high on the JAS H/C and S/I scales perceived their HR to increase to a greater extent than low scorers. Holmes, Solomon and Rump (1982) reported that although their Type A subjects showed greater cardiac response to the test situation than Type B's, this arousal was not reported by the subjects. Carver et al (1976) reported that Type A subjects suppressed their fatigue while performing on the Balke treadmill test and even though the Type A subjects exerted greater efforts than Type B's, they did not report a greater feeling of fatigue. Why the Type A's in this instance reported higher arousal than B's is unknown. This is an unexpected finding, and while it was not a major focus of the present study, it suggests that the claim that Type A's underreport their autonomic arousal should be examined further in future research.

Results from the other data from the post-experimental questionnaire revealed that drugs, smoking, exercise and parental history of CHD did not explain a significant amount of the variance associated with either response to or recovery from stress. As well, scores on the MAACL were not associated with either response to or recovery from stress. The ingestion of caffeine prior to the experiment did, however, explain a significant amount of the variance associated with response to stress. As caffeine is a stimulant, this may be expected.

It is evident therefore that more investigation is required in the area of Type A and recovery from stress, as the research to date remains divided in its findings. Of note is the finding in this study of the significant effect that social comparison has on response to and recovery from stress. This study failed to replicate the Hart and Jamieson finding, thereby precluding a test of the hypothesis that their finding was an artifact of social comparison. Since a significant effect of social comparison on recovery was demonstrated, however, it remains possible that this hypothesis is correct. In view of this failure to replicate the Hart and Jamieson finding using almost identical procedures, it may be concluded that caution should be used in drawing conclusions about differential rates of recovery from stress in Type A's and B's until more research is conducted.

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List of Appendices

APPENDIX I

Self-report Questionnaire

Name:_____

Age: ____

Sex:_____

Circle one: Full-time, part-time or casual student.

CHECK THE BOX WHICH BEST DESCRIBES HOW YOU FELT WHILE PERFORMING THE COLOUR-WORD TASK. BE AS ACCURATE AS POSSIBLE.

	NOT AT ALL	SOME-WHAT	MODER-ATELY	VERY MUCH SO
1) Do you think your performance was better than other students?				
2) If you were given a second chance on the task, how much better would your performance be?				
3) How involved or engaged were you in the task?				
4) Generally, how stressful did you find it?				
5) Did you feel frustrated?				
6) How much did your heartbeat increase?				
7) Did you feel angry?				
8) Did you feel impatient?				
9) How challenging did you find the task?				
10) How "time pressured" did you feel?				

How tall are you? _____
How much do you weigh? _____
Do you smoke?____. If so, how many per day usually ? _____

Are you presently under the influence of any drugs or medication? _____. If so, what drug (medication)?_____
How many cups of coffee have you had today?_____
The hour before coming to this experiment, did you engage in vigourous physical exercise? _____
If so, Approximately how many hours did this take? _____

On a weekly basis, how much do you exercise?
Please specify the exercise engaged in, and the amount of time spent in that activity/week?

	exercise	time spent
1.		
2.		
3.		
4.		
5.		

Is there any history of parental coronary heart disease in your family? _____

Appendix II

Table 1

Multiple regression summary table with the average stress HR as the dependent variable

Variable	RSQCH	F
Base HR	.56133	170.1 ***
Group	.04025	12.2 ***
Sex	.00382	1.16
AB	.00384	1.05

df=(1,117)

$p < .001$ ***

Appendix III

Table 2

Multiple regression summary table with the first minute of stress HR as the dependent variable

Variable	RSQCH	F
Base HR	.43946	102.2 ***
Group	.04775	11.1 ***
Sex	.00231	<1
AB	.00849	1.97

df=(1,117)

Table 3

Multiple regression summary table with the second minute of stress HR as the dependent variable

Variable	RSQCH	F
Base HR	.52976	146.74 ***
Group	.04155	11.51 ***
Sex	.00453	1.25
AB	.00216	<1

df=(1,117)

Table 4

Multiple regression summary table with the third minute of stress HR as the dependent variable

Variable	RSQCH	F
Base HR	.54140	157.84 ***
Group	.05040	14.69 ***
Sex	.00510	1.49
AB	.00171	<1

df=(1,117)

Table 5

Multiple regression summary table with the fourth minute of stress HR as the dependent variable

Variable	RSQCH	F
Base HR	.56996	168.13 ***
Group	.02945	8.69 **
Sex	.00196	<1
AB	.00122	<1

Table 6

Multiple regression summary table with the fifth minute of stress HR as the dependent variable

Variable	RSQCH	F
Base HR	.56322	169.64 ***
Group	.03594	10.82 ***
Sex	.00553	1.67
AB	.00686	2.07

df=(1,117)

Table 7

Multiple regression summary table with the sixth minute of stress HR as the dependent variable

Variable	RSQCH	F
Base HR	.57029	169.26 ***
Group	.02646	7.83 **
Sex	.00316	<1
AB	.00213	<1

df=(1,117)

p<.001 ***
p<.01 **
p<.05 *

Appendix IV

Table 8

Multiple regression summary table with the average recovery HR as the dependent variable

Variable	RSQCH	F
Base HR	.89765	1870.1 ***
Stress HR	.04391	91.48***
Group	.00257	5.42 **
Sex	.00029	<1
AB	.00017	<1

df=(1,116)

$p<.001$ ***

$p<.01$ **

$p<.05$ *

Appendix V

Table 9

Multiple regression summary table with the first minute of recovery HR as the dependent variable

Variable	RSQCH	F
Base HR	.80829	1128.89 ***
Stress HR	.10149	141.74 ***
Group	.00698	9.75 **
Sex	.00054	<1
AB	.00076	1.06
AB X Group	.00027	<1.
AB X Sex	.00004	<1

df=(1,114)

p<.001 ***

p<.01 **

Appendix VI

Table 10

Multiple regression summary table with the first minute of recovery HR as the dependent variable

Variable	RSQCH	F
Base HR	.80829	1138.44 ***
Stress HR	.10149	142.94 ***
Group	.00698	9.83 **
Sex	.00065	<1
AB	.00065	<1

df=(1,116)

Table 11

Multiple regression summary table with the second minute of recovery HR as the dependent variable

Variable	RSQCH	F
Base HR	.87163	1320.65 ***
Stress HR	.04872	73.82 ***
Group	.00171	2.59
Sex	.00141	2.13
AB	.00029	<1

df=(1,116)

Table 12

Multiple regression summary table with the third minute of recovery HR as the dependent variable

Variable	RSQCH	F
Base HR	.87815	1428.57 ***
Stress HR	.03924	56.06 ***
Group	.00051	<1
Sex	.00053	<1
AB	.00037	<1

df=(1,116)

Table 13

Multiple regression summary table with the fourth minute of recovery HR as the dependent variable

Variable	RSQCH	F
Base HR	.88675	1343.56 ***
Stress HR	.03333	50.5 ***
Group	.00284	4.3 *
Sex	.00061	<1
AB	.00010	<1

df=(1,116)

Table 14

Multiple regression summary table with the fifth minute of recovery HR as the dependent variable

Variable	RSQCH	F
Base HR	.90307	1411.05 ***
Stress HR	.02111	32.98 ***
Group	.00138	2.16
Sex	.00004	<1
AB	.00023	<1

df=(1,116)

Table 15

Multiple regression summary table with the sixth minute of recovery HR as the dependent variable

Variable	RSQCH	F
Base HR	.87702	1082.74 ***
Stress HR	.02458	30.34 ***
Group	.00344	4.25 *
Sex	.00047	<1
AB	.00057	<1

df=(1,116)

p<.001 ***
p<.01 **
p<.05 *

Appendix VII

Table 16

Multiple regression summary table using data from the males in the social comparison group with the first 30 seconds of recovery HR as the dependent variable

Variable	RSQCH	F
Base HR	.71281	170.94 ***
Stress HR	.17337	41.57 ***
AB	.00112	<1

df=(1,27)

p<.001 ***

Table 17

Means and standard deviations of the performance data (number in brackets is the SD)

Social Comparison

Type [1]		males	females
	A	297.44 (62.94)	320.77 (42.57)
	B	301.92 (54.28)	300.13 (35.15)

No Social Comparison

Type		males	females
	A	283.55 (56.05)	316.64 (59.81)
	B	283.74 (45.30)	286.06 (40.37)

1. A/B groups obtained through a median split.

Appendix IX

Table 18

Means and standard deviations of the number of errors on the Stroop color word task by Group and Sex
(number in brackets is the SD)

GROUP	SEX: male	SEX: female
social comparison	3.74 (4.94)	1.96 (1.87)
no social comparison	2.33 (2.37)	4.03 (5.50)