TYPE A BEHAVIOUR AND PRESSOR RESPONSE
IN A REPRESENTATIVE SAMPLE OF MIDDLE-AGED MEN*

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Abstract—The hypothesis that type A behaviour is associated with greater pressor response to stress was tested in a representative sample of 114 men aged 30-65 yr. Jenkins Activity Survey, Framingham and Bortner type A scores were related to blood pressure and heart rate under rest, serial reaction time, mental arithmetic, and noise conditions. Type A scores were modestly intercorrelated (r = 0.59 to r = 0.67). Type A scores were inversely related to age and resting systolic pressure and were independent of smoking history, social class, marital status, and task performance parameters. Type A scores were not related to pressor or heart rate response to stress under any of the stress conditions. These findings do not support the importance of physiological response as an explanation of the association between type A and heart disease.

INTRODUCTION

Pressor response, defined as the difference in blood pressure between resting and stimulus conditions, is of interest as an index of the mechanism by which type A behaviour may cause heart disease. It has been hypothesised that type A behaviour is positively associated with greater elevation in blood pressure under stress. This plausible hypothesis has proven difficult to substantiate and a clearly reproducible relationship remains to be demonstrated for any combination of stimulus condition and type A measurement in any defined population group.

A population of particular interest in identifying the mechanism underlying heart disease are asymptomatic middle-aged men who are likely to lead lifestyles relevant to, but not affected by, the onset of disease. One of the most widely used measures of type A behaviour is the Jenkins Activity Survey (JAS). The JAS has been used in conjunction with a variety of laboratory tasks to study type A and pressor response in asymptomatic middle-aged men. Manuck et al. [1] recruited 45 attorneys of mean aged 35 yr to complete a concept formation task finding no association between JAS score and pressor response. Steptoe et al. [2] with 36 industrial workers aged under 56 yr used the stroop test and a computer game to induce greater diastolic pressor response in low JAS scorers. This unexpected result was also found by Goldstein et al. [3] who studied 11 men of mean age 44 yr. JAS scores were inversely related to diastolic pressor response during a paced arithmetic task but not during a reaction time task. Harbin and Blumenthal [4] report on 34 men aged 26 to 74 yr (x = 44 yr) who completed mental arithmetic and a ‘matching familiar figures’ task. No association was found between JAS score and pressor response. Finally, Corse et al. [5] recruited 34 men of mean age 49 yr to complete concept formation, mental arithmetic and picture completion tasks. Although no association

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was found between JAS score and pressor response, if type A was assessed by the Structured Interview, type A subjects showed greater pressor response than type B.

A conclusion which might be drawn from these studies is that the JAS does not predict greater pressor response in asymptomatic middle-aged men. The interpretation of the results of any of these studies is difficult, however, due to their small size and volunteer sampling. The largest of the studies reviewed [1] recruited 45 subjects. This number allows only a 65% chance of detecting ($p < 0.05$) a one standard deviation difference in pressor response between type A groups [6]. The difficulty with inadequately small studies is that their power to detect genuine differences is low. Little confidence can be had, therefore, in the studies reviewed here which have not detected an association of JAS score with pressor response [1, 4, 5].

All the studies reviewed used volunteer samples. This procedure will recruit highly selected samples by virtue of their compliance, and as such will impart major limitations on the resulting data. First, the factors affecting compliance will be unidentifiable and cannot be accounted for in the analysis or interpretation of results. Second, these unidentifiable factors will vary between studies according to the recruitment procedures and the demands of the study and will greatly reduce comparability between studies. Third, the variety of selection factors which may be operating reduces confidence in which results in this area may be extrapolated beyond the original sample to a wider population. These limitations are particularly important in experimental studies on type A. Where type A itself is not manipulated in a controlled manner, associations with the behaviour pattern are essentially of observational character and vulnerable to confounding. Poor sampling, with the consequential reduction in control, reduces the likelihood that spurious associations with type A will be identified as such.

Possible effects of sample selection are shown by the two studies of asymptomatic men in which an inverse association was observed between pressor response and JAS score. Steptoe et al. [2] show how selection for pressor response in relation to type A can occur when not specifically intended and can produce what could be construed as the result of confounding. Mild hypertensives, transient hypertensives, and age matched controls were compared and showed that pressor response increased with the consistency of hypertension. Hypertensive subjects were not made aware of their diagnosis until after the study. A consistent and marked trend of lower JAS scores with greater consistency of hypertension was shown. This trend was not statistically significant but the power of this comparison was not great. A similar case for inadvertent confounding of hypertension and type A effects could be made for the study by Goldstein et al. [3]. In this study five of the 11 subjects were diagnosed as mild hypertensives. Although no difference in type A scores was reported between hypertensives and normotensives the power of this comparison was also not great. Given this context, it is not necessarily surprising that these studies report an inverse association between JAS score and pressor response, but the finding is of little value.

A further difficulty in the interpretation of the results from studies of asymptomatic middle-aged men is the selection of tasks used to elicit pressor response. Different tasks may elicit different physiological reactions and the variety of tasks used may be irrelevant to type A behaviour. That is to say they may not provoke type A
behaviour, as measured by the JAS, and so may not provoke the physiological response associated with type A. Tasks used in the studies reviewed include reaction time [3] various forms of arithmetic [3-5] and the stroop test [2]. Similitudes of these tasks have been shown to elicit a greater pressor response with higher scores in other populations [7-11] although results can also be found showing no association [12-15]. No conclusions can be drawn, therefore, on the relevance of these types of task for inducing a type A response with respect to the JAS.

It may be concluded that for reasons of sample size and selection, for asymptomatic middle-aged men, there is no interpretable evidence on the association between JAS score and pressor response. Evidence is needed, therefore, to show whether the JAS can be used to predict pressor response in this population. The study reported here was conducted to investigate the relationship between JAS score and pressor response in a representative sample of asymptomatic middle-aged men.

METHOD

A random sample of 225 males was drawn from the electoral roles for three wards in Cardiff. Power calculation of sample size could not be made as no estimate of variance of pressor response was available. It was hoped that a sample of over 200 men would be sufficient to provide an adequate study given the high attrition rate likely from using the electrol register as a sampling frame. All men aged 30-65 yr were invited to attend a blood pressure screening clinic. Upon attending the clinic subjects provided a short medical history and completed the London School of Hygiene Chest Pain Questionnaire [16] the 21 item Jenkins Activity Survey [17] and Bortner [18] and Framingham [19] type A scales. Subjects with angina or a history of myocardial infarction or under treatment for hypertension were omitted from further study. To allow an extreme groups analysis of the data, eligible subjects were allocated to either high, middle, or low scoring groups according to Jenkins Activity Survey score. Cut off points for type A score were derived from a previous study on a similar population and were designed to divide the sample into tertiles [20]. To allow for the possibility of residual effects between experimental conditions, within each type A group, subjects were randomised to an order of experimental conditions according to a balanced latin square design [21].

After the interview subjects entered another room for blood pressure measurement which was conducted blind to type A score. Blood pressure was measured using a Copal UA-231 automatic sphygmomanometer which measured systolic and diastolic pressure and heart rate [22]. Blood pressure was measured in each of four conditions comprising rest, reaction time, mental arithmetic, and noise. The rest condition provided baseline levels and comprised relaxing in a seated position for five minutes, after which blood pressure was measured. A five choice serial reaction time task was used in which subjects had to press one of five buttons in response to one of five light signals [23]. The mental arithmetic condition was a serial subtraction task requiring subjects to call out the results of continually subtracting the number 7 from the number 901. In the reaction time and mental arithmetic conditions subjects were asked to work as quickly and accurately as they could. Noise exposure comprised intermittent noise within the frequency band 2-4 KHz, and was transmitted via headphones at 90 dB(A) [112 dB(A) peak]. Blood pressure was measured two minutes after the beginning of the stimulus conditions. The reaction time and mental arithmetic conditions were chosen as examples of tasks which have been shown to produce differential pressor response between high and low scoring JAS groups [7-10] and which require different forms of response. The reaction time task principally requires a perceptual-motor response whereas the mental arithmetic task primarily requires a cognitive response. The noise condition was chosen as an example of a stimulus requiring no specified form of response. The comparison between conditions requiring a response and not is of interest as there is evidence that active response to stress is more relevant to magnitude of pressor response than passivity [24]. This may also be true for the elevation of pressor response with high JAS score [7].

RESULTS

Sample

Of the 225 male electors originally identified 150 were within the required age range of 30-65 yr, of which 17 were found either to have had a heart attack, or
have angina, or to be under treatment for hypertension, and were omitted from the study. Of the remainder, 114 men, (86% of those eligible) completed the study, 19 refused to participate.

**Preliminary analyses**

Table I gives mean and standard deviation values for each type A score, and for resting levels of blood pressure and heart rate. Jenkins Activity Survey scores were marginally positively skewed but this was judged not to require transformation. The distribution of the Framingham and Bortner scales did not differ significantly from normal according to the Kolmogorov–Smirnov test. Each of these mean values were similar to those found in other U.K. studies [25–26]. The allocation of subjects to high, middle, and low scoring type A groups according to Jenkins Activity Survey score produced 29 subjects in the high scoring group (score > 240), 56 subjects in the middle group, and 29 subjects in the low scoring group (score < 140). This was the result of a slightly less dispersed distribution of scores than was expected but served to provide two extreme quartile groups. The mean values for resting systolic and diastolic blood pressure for all 114 subjects were 132 mm/Hg and 83 mm/Hg respectively, and the mean resting value for heart rate was 72 beats/min; these being within the range that might be expected for a sample of comparatively healthy men in this age group given the unusual context of participating in a scientific study.

**TABLE I. — MEAN VALUES AND STANDARD DEVIATIONS FOR TYPE A SCORES AND FOR RESTING BLOOD PRESSURE AND HEART RATE LEVELS FOR ALL 114 SUBJECTS**

<table>
<thead>
<tr>
<th>Type A scales</th>
<th>Jenkins Activity Survey (21 items)</th>
<th>Framingham type A Scale (10 items)</th>
<th>Bortner type A Scale (14 items)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>196</td>
<td>0.4</td>
<td>183</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>77.9</td>
<td>0.23</td>
<td>49.9</td>
</tr>
<tr>
<td>Cardiovascular indicators</td>
<td>Systolic pressure (mmHg)</td>
<td>Diastolic pressure (mmHg)</td>
<td>Heart rate (bts/min)</td>
</tr>
<tr>
<td>Mean</td>
<td>132</td>
<td>83</td>
<td>72</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>18</td>
<td>10</td>
<td>13</td>
</tr>
</tbody>
</table>

Changes in blood pressure and heart rate were examined with respect to order of experimental condition. Latin squares were constructed for each of the type A groups using subjects selected at random; 28 from each of the extreme JAS score groups and 52 from the middle JAS score group. Analysis of variance for residual effects, which might be attributable to the order of experimental conditions, was conducted for systolic and diastolic pressure, and for heart rate. This analysis detected no significant residual effect for any parameter in any group. It may be concluded that the order of experimental condition is unlikely to be of importance in these data, and that the latin square design need not be considered in further analyses.

Pearson correlation coefficients between type A scores showed the Jenkins Activity Survey to be moderately correlated with each of the other type A scores ($r = 0.67$). The Framingham and Bortner scales were less well associated
Type A and pressor response in middle-aged men (r = 0.59). The moderate strength of these associations confirm the general view that different procedures appear to assess different aspects of type A behaviour and cannot be considered to be wholly comparable. Consequently, all three type A scores were used in the main analysis of this study.

**Regression analysis**

The main analysis was the regression of blood pressure on type A and covariates. The strategy of this analysis was first to investigate an effect of type A on pressor response and then to show the extent of pressor response in each condition. To show a difference in pressor response with type A score the slopes of the regression (regression coefficients) in the stress conditions were compared with the slope of the regression in the rest condition. If there was no difference in slopes between conditions this would indicate no association between type A score and pressor response to stress. If an association of type A with pressor response is found the difference in pressor response between conditions would be assessed after adjustment for type A score. If no association between pressor response and type A is found the difference in pressor response between conditions would be assessed by fitting a common slope for all conditions and comparing intercept values.

Relations between type A, blood pressure response and heart rate response were examined for all 114 subjects by regression analysis. To select potential confounders, covariates with type A behaviour and cardiovascular response were identified. Type A scores were independent of reaction time, accuracy of serial subtraction, smoking habit, and marital status. Type A scores showed slight variation with social class. For the 33 men in classes I and II the mean score was $\bar{x} = 218$ (S.D. = 100), for the 22 men in class III (non-manual) the score was $\bar{x} = 185$ (S.D. = 56), for the 45 men in class III (manual) the score was $\bar{x} = 190$ (S.D. = 67), and for the 14 men in classes IV and V the score was $\bar{x} = 181$ (S.D. = 80). These differences were not statistically significant \(F(3,110 \text{ df}) = 1.28\). Framingham and Bortner scores were found to be inversely associated with age \(r = -0.22\) and \(r = -0.19; p < 0.05\) respectively. All type A scores were found to be inversely associated with resting systolic blood pressure \(r = -0.24\); Framingham \(r = -0.25\); Bortner \(r = -0.24; p < 0.01\). Less marked inverse associations were shown for diastolic pressure \(r = -0.13\); Framingham \(r = -0.28, p < 0.05\); Bortner \(r = -0.13\). Therefore age was considered further as a possible confounder.

To assess whether age should be included in the analysis as a covariate the association between age and cardiovascular response was investigated using the regression strategy described previously. The effect of age on cardiovascular response, blood pressure and heart rate were regressed on age for each experimental condition. The regression lines for systolic pressure are presented in Fig. 1. There is no evidence that these lines differ from having a common slope \(F(3,448 \text{ df}) = 0.5\). If a common slope is fitted to these data they show the expected increase in blood pressure with age \(b = 0.712, t (452 \text{ df}) = 7.32; p < 0.001\). However, this increase with age must be attributed to an increase in resting level as the common slope of the regressions between conditions indicate no change in pressor response with age. This lack of effect cannot be attributed to a limited range of pressor response as the intercepts between conditions differed by up to 25 mm/Hg \(F(3,451 \text{ df}) = 37.2; p < 0.001\). Closely similar results were found for diastolic
pressure and heart rate. From these analyses age is unlikely to affect cardiovascular response in these data and need not be considered further as a possible confounder between cardiovascular response and type A behaviour and so no covariates were included in the analysis.

As resting blood pressure level may be associated with pressor response [27, 28] the inverse association between resting blood pressure and type A complicates the analysis. If type A is associated with the regulation of blood pressure, to control for an association with resting level may be to control out a legitimate effect. If, however, type A is spuriously related to resting level, not to control for this association may serve to reduce the observed effect of type A on pressor response. Therefore, both analyses were conducted. To show the effect of type A on cardiovascular response without controlling for resting level, blood pressure and heart rate were regressed on each type A score for each condition. Figure 2 shows the regression lines for systolic pressure on Jenkins Activity Survey score. The regression lines show no evidence of differing slopes \( F(3,448) = 0.1 \) and reflect an inverse association between type A and systolic pressure \( (b = -0.054, t = -4.08; \).
**Type A and pressor response in middle-aged men**

**Table II.** Regression coefficients and significance tests for the regression of cardiovascular level on type A score for the difference of slope between conditions \([F(slopes)]\), the slope of the regressions for all conditions when a common slope \((b)\) is fitted, and for the difference between intercepts when a common slope if fitted \([F(\text{intercepts})]\).

<table>
<thead>
<tr>
<th>Type A scale</th>
<th>Cardiovascular response</th>
<th>(F(\text{slopes}, 3,448 \text{ df}))</th>
<th>(b(t^2, 452 \text{ df}))</th>
<th>(F(\text{intercepts}, 3,448 \text{ df}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jenkins Activity</td>
<td>Systolic pressure</td>
<td>0.1</td>
<td>-0.054 ((-4.08))†</td>
<td>34.4‡</td>
</tr>
<tr>
<td></td>
<td>Diastolic pressure</td>
<td>0.8</td>
<td>-0.007 ((-0.92))‡</td>
<td>21.7‡</td>
</tr>
<tr>
<td></td>
<td>Heart rate</td>
<td>0.2</td>
<td>-0.023 ((-2.48))‡</td>
<td>47.7‡</td>
</tr>
<tr>
<td>Framingham scale</td>
<td>Systolic pressure</td>
<td>0.1</td>
<td>-0.023 ((-5.22))‡</td>
<td>35.1‡</td>
</tr>
<tr>
<td></td>
<td>Diastolic pressure</td>
<td>0.1</td>
<td>-0.011 ((-4.00))‡</td>
<td>22.4‡</td>
</tr>
<tr>
<td></td>
<td>Heart rate</td>
<td>0.3</td>
<td>-0.010 ((-3.20))†</td>
<td>48.2‡</td>
</tr>
<tr>
<td>Bortner scale</td>
<td>Systolic pressure</td>
<td>0.1</td>
<td>-0.103 ((-5.06))‡</td>
<td>35.0‡</td>
</tr>
<tr>
<td></td>
<td>Diastolic pressure</td>
<td>0.1</td>
<td>-0.025 ((-2.05))‡</td>
<td>21.8‡</td>
</tr>
<tr>
<td></td>
<td>Heart rate</td>
<td>1.5</td>
<td>-0.037 ((-2.60))†</td>
<td>43.9‡</td>
</tr>
</tbody>
</table>

*\(p < 0.05\).
†\(p < 0.01\).
‡\(p < 0.001\).
\(t\) test two tailed.

*For regression analyses Framingham scores multiplied by 1000 to produce a more convenient scale.

An effect of type A on pressor response would be indicated by a difference in slope between rest and stress conditions. Therefore these results indicate that no effect of type A on systolic pressor response occurred under conditions eliciting a substantial increase in blood pressure \([F(3,448 = 34.4; p < 0.001]\). Table II gives the regression coefficients and the appropriate significance tests for the regression of blood pressure and heart rate on each type A score in each condition. Table II shows that for each type A measure there is no detectable difference in slope between experimental conditions \([F(\text{slopes})]\) and that the negative association of cardiovascular level with type A, shown when a common slope \((b)\) is fitted, is due to resting level. That a highly significant difference in cardiovascular level occurred between conditions is also indicated \([F(\text{intercepts})]\).

To test for the effect of type A on pressor response after controlling for resting blood pressure level, change in blood pressure between resting and each stress condition was regressed on each type A score and on the mean of resting and stress blood pressure levels. This transformation of the resting levels was to achieve mathematical independence between dependent and independent variables in the regression equation \([29, 30]\). No regression coefficient for any type A score under any condition achieved statistical significance, confirming the results of the previous analysis.

**Extreme groups analysis**

To examine whether cardiovascular response might be an indicator of cardiac risk only for those who are extremely type A, high and low scoring type A groups were compared. Groups were identified according to Jenkins Activity Survey score, as unlike the other type A scores, this did not covary with age allowing a straightforward comparison between groups. For convenience, the subjects selected in this
TABLE III. - MEAN VALUES (STANDARD DEVIATIONS) OF BLOOD PRESSURE (mm/hg) AND HEART RATE (bts/min) FOR HIGH AND LOW JENKINS ACTIVITY SURVEY SCORE GROUPS FOR EACH CONDITION, AND FOR THE DIFFERENCE BETWEEN EACH CONDITION AND REST

<table>
<thead>
<tr>
<th>Condition</th>
<th>High score (&gt;240)</th>
<th>Low score (&lt;140)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n = 28)</td>
<td>(n = 28)</td>
</tr>
<tr>
<td></td>
<td>Systolic pressure</td>
<td>Diastolic pressure</td>
</tr>
<tr>
<td>Reaction time</td>
<td>151 (19.7)*</td>
<td>89 (10.0)</td>
</tr>
<tr>
<td>Mental arithmetic</td>
<td>147 (20.0)†</td>
<td>90 (10.5)</td>
</tr>
<tr>
<td>Noise</td>
<td>134 (16.5)*</td>
<td>84 (8.4)</td>
</tr>
<tr>
<td>Rest</td>
<td>126 (13.4)*</td>
<td>81 (9.6)</td>
</tr>
<tr>
<td>Difference</td>
<td>24.8 (10.1)</td>
<td>8.6 (6.9)</td>
</tr>
<tr>
<td>Reaction time</td>
<td>21.1 (12.6)</td>
<td>9.3 (6.3)</td>
</tr>
<tr>
<td>Mental arithmetic</td>
<td>7.8 (6.5)</td>
<td>1.8 (5.2)</td>
</tr>
</tbody>
</table>

Comparison between type A groups:
* p < 0.05 (two tailed).
† p < 0.01.

analysis were those representing high and low scoring groups in the test for residual effects described earlier in the latin squares analysis (n = 28 in each group). Table III gives mean and standard deviation values for blood pressure and heart rate for each condition, and the absolute difference between each condition and rest. Mean values for systolic pressure at rest were for the high type A group 126 mm/Hg, and for the low type A group 140 mm/Hg (p < 0.01). For diastolic pressure the mean values at rest were 81 mm/Hg for the high type A group and 86 mm/Hg for the low type A group. Although the difference between groups only reached statistical significance for systolic pressure, these values reflect the negative association between blood pressure and type A described earlier.

The reaction time and mental arithmetic conditions stimulated substantial increases in all the cardiovascular indices. The greatest increase occurred in the reaction time condition which was close to 25 mm/Hg (p < 0.001) for systolic pressure in each group, and close to 8 mm/Hg (p < 0.001) in diastolic pressure in each group whilst heart rate increased by 18 bts/min (p < 0.001) in the high type A group and 24 bts/min (p < 0.001) in the low type A group. A similar but less pronounced pattern was shown in the mental arithmetic condition. Although no difference in pressor or heart rate response was shown between type A groups this might have been due to a masking of an effect by the different resting levels of the groups as these were used as baselines for the calculation of change. To overcome this problem proportional (percent) changes were calculated for each condition. Proportional changes in blood pressure were closely similar between groups for each condition. However, in the noise condition, increase in heart rate was significantly greater for the low type A score group (p < 0.05), although this may have been a chance effect given the number of comparisons that were made. Of passing interest are the differences in systolic pressure and heart rate change between reaction time and mental arithmetic conditions. These were consistently greater in the reaction time condition for each group and may reflect an effect of the greater
physical activity of the reaction time condition. The noise condition provoked a slight increase in systolic pressure for each group of around 7 mm/Hg ($p < 0.001$), but had no effect on diastolic pressure or heart rate. Given this modest effect it would have been unlikely that any difference between type A groups would have occurred and none was detected.

**DISCUSSION**

The findings of this study are of particular interest due to the sampling procedure that was used. The sample was chosen to be typical of men in South Wales (an area with a prevalence of heart disease amongst the highest in the world), who had lifestyles most relevant to, and not affected by, the onset of coronary heart disease. The 86% response rate of a proper random sample reduced the likelihood of any significant effects of selection bias. These data, therefore, are likely to reflect relationships as they occur in men at risk from heart disease.

This study detected no evidence of support for the hypothesis that type A is related to increased cardiovascular response, under any of the experimental conditions, either in the entire sample or in high type A scorers. If these findings are taken at face value they provide a challenge to the hypothesis as it is currently stated. Either cardiovascular response is not an important indicator of the mechanism relating type A to heart disease, or the hypothesis must be reformulated more closely, describing the conditions under which this effect is likely to occur. However, before this may be concluded several factors must be considered.

It is possible that genuine relationships between type A and cardiovascular response were masked by factors that were not controlled for. In a study of this design the possibility of masking cannot be eliminated, although steps were taken to reduce this likelihood. However, as type A was found to covary only with age and resting cardiovascular level, and as these factors were not related to cardiovascular response, if masking is used as an explanation of results reported here the nature of these confounding relationships remains obscure, and doubt is cast on results (positive as well as negative) from studies in which no account of confounding is taken.

A limitation in this study was that type A was not measured using the Structured Interview [31] as this technique has shown greater consistency in detecting an association between type A and physiological response. Nevertheless, the measures that were used have each been shown to be independently related to incident coronary heart disease [32–34] and may each be considered to be a valid measure of aspects of behaviour which are similarly related to increased coronary risk. It is reasonable, therefore, to examine the possible mechanisms by which the behaviour assessed by these questionnaires is related to coronary risk. It is also reasonable to expect the mechanisms involved to be similar between methods of assessing type A behaviour, including the Structured Interview.

A variety of stimuli were used in this study to provoke cardiovascular response. It could be argued that these experimental conditions were not sufficiently relevant to the type A behaviour pattern to provoke a differential response between high and low scoring type A groups. This type of criticism is difficult to refute as environmental determinants of type A are not sufficiently known to allow opera-
tional definition. In the reaction time and mental arithmetic conditions used in the present study, the nature of the tasks and the instructional set of encouraging speed and accuracy, was an attempt to provide competitive and challenging conditions, which are generally understood to be relevant to type A [35, 36]. The substantial pressor and heart rate response found in these conditions suggest this attempt was successful. Nevertheless, relevance of stimulus condition is perhaps the most uncertain and least understood aspect of the design of psychophysiological type A studies. Until the critical components of stimuli for type A can be operationalised in a consistently reproducible manner, it is reasonable to suspect that greater consistency of results in this area will not occur, and that little secure progress will be made.

The noise condition was included in this study as a control condition to allow a comparison of relations of type A with cardiovascular response between 'passive' (noise), and 'active' (reaction time and mental arithmetic) conditions. In the event the lack of a type A effect made this comparison of little value.

On the basis of sample alone this study represents a more rigorous test of the hypothesised increase of cardiovascular response with type A behaviour than has previously been conducted. However, representative sampling was combined in this study with tests of the hypothesis using a variety of type A measures and stimulus conditions. The lack of consistent association between any measure of type A behaviour and pressor or heart rate response under any of the conditions add to the uncertainty surrounding this hypothesis. Although the hypothesis cannot be refuted on the basis of this evidence, this study confirms that a consistent association of type A behaviour with increased pressor and heart rate response remains to be demonstrated for any defined population, and that no good evidence is available on the importance in general population terms of physiological response as a mechanism by which type A behaviour may cause heart disease.

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