Social identity influences stress appraisals and cardiovascular reactions to acute stress exposure

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Abstract

Objectives: This study tested a recent theoretical development in stress research to see whether group membership influenced cardiovascular reactions following exposure to acute stress.

Methods: Participants (N=104) were exposed to a message in which a maths test was described as stressful or challenging by an in-group member (a student) or out-group member (a stress disorder sufferer). Systolic (SBP) and diastolic (DBP) pressure and heart rate (HR) were monitored throughout a standard reactivity study.

Results: As expected a significant interaction was found; relative to those who were told that the task was challenging, ingroup members reported more stress and had higher DBP and HR reactivity when told by an in-group member that the maths task was stressful; task information did not have the same effect for outgroup members.

Conclusion: These results indicate that informational support is not constant but varies as a function of group membership. Finally, this recent development in stress research may prove useful for those interested in investigating the interactions between social, psychological and physiological processes underlying health disparities.

Key words: Blood Pressure; Reactivity; Social Support; Social Identity; Stress

Introduction

The focus on individual differences approaches (such as Hostility; Type D behaviour characteristics) that give rise to cardiovascular disease (CVD) and other health indices has emphasised the relevance of psychology to health (Segerstrom & O'Connor, 2012). And the extension of research that uses social psychological paradigms has the potential to demonstrate that particular social contexts can be associated with increased risk of CVD (Christenfeld & Gerin, 1997, 1998; Christenfeld & Gerin, 2000). For example those with low social support (Gallagher & Whitely, 2012) or from lower socioeconomic groups are at elevated risk of CVD (Uchino, Carlise, Birmingham, Vaughn, 2011). It has also been argued that shifting the focus from an individual difference perspective to one that identifies psychological circumstances and exposure that put social groups at risk may open up a fruitful line of enquiry, as social contexts can be more amenable to change than personality and disposition (Carroll & Sheffield, 1998). Further, variations in well-being and cardiovascular indices between different social groups remain under explored and poorly understood (Carroll et al. 1998; Christenfeld & Gerin, 1998; Christenfeld & Gerin, 2000; Jetten, Haslam & Haslam, 2012).

Stress is a common and independent risk factor for cardiovascular disease (CVD; Dimsdale 2008; Chida & Steptoe, 2010). Recent theoretical developments in stress research suggest that social identity processes, which are linked to social contexts may be an important psychological dimensions of stress. This theoretical emphasis comes at a time where fuller exploration of the impact of social contextual variables on cardiovascular health, including recipient and providers factors, has been called for (Uchino, Carlise, Birmingham, Vaughn, 2011). Social identity has been defined as the portion of an individual's self-concept derived from perceived membership of a relevant social group (Tajfel & Turner 1979); and these groups have emotional and value significance for those people. In fact, the social identity approach is a psychological metatheory incorporating social identity theory (SIT) and self categorization theory (SCT) (Haslam, Reicher & Platow, 2011). The SIT approach is unique because it rather than analysis starting with 'the individual in the group' it proceeds from the understanding that one must begin with a consideration of how the group influences the individual (Reicher, Spears & Haslam, 2010). In fact, it focuses on the 'we's' people ascribe to and how when 'we' self-categorise as a group member 'we' interact with 'others'. Thus, it has a focus on the shift behind people's self categorization from idiosyncratic individuals to individuals as members of collective groups.

Although most of us are members of a variety of groups, only those groups that are meaningful to our self-concept result in important social identities. These social identities are associated with shared values and characteristics (e.g. if you are a health psychologist then you share not only categorical membership with other health psychologists but core values such as a belief in the value of the speciality). In order to better understand the associations between stress, social identity and blood pressure this study will apply the social identity model of stress (ISIS; Haslam et al. 2004; Haslam and Reicher 2006) model to a laboratory-based acute psychological stress and blood pressure reactivity study. In particular, the present work explores and how, group membership influences stress appraisal processes and their implications for blood pressure responses.

According to ISIS model social identity processes, in particular group memberships, are critical to understanding the stress process (Haslam et al. 2005, Haslam et al. 2004). In part this is attributable to the important social aspects of stress. The ISIS model then considers how identities influence the multiple components of stress. By placing social identities at the centre of the stress process, it considers how valued group memberships structure adaptation to stress (Muldoon et al. 2009) and recovery from stress (Jones, Williams, Jetten et al., 2012). For this reason, the ISIS model suggests that identities occupy a more central role with (a) variations in the levels of stress experienced and reported being related to group membership and (b) evidence of identity mediating the stress–well-being relationship. This mediating relationship demonstrates that when social identity is salient, group experiences operate through the individual as a group member.

A number of studies provide considerable support for this contention. For example, experimental evidence has found that when female physical education students were threatened by the stress of facial scarring it was perceived as less threatening when their student, rather than their gender identity, was made salient (Levine et al. 2002), implying that their group membership shaped their response to this stressor.   In terms of social support, where individuals share group membership they are more likely to provide to each other, and receive support and interpret it in the manner in which it is intended, compared to those where shared membership is absent (Reicher et al. 2006). Moreover, because the capacity for this social support to affect appraisal depends on the match between group membership of the support provider and recipient, informational support does not always have the same or equivalent impact (Haslam et al. 2005). Rather we suggest it is likely to vary systematically as a function of the group membership of the support provider. For example, university students who were informed that a task was challenging rather than stressful appraised the

task more positively when the information provided came from an ingroup member rather than an outgroup member (Haslam et al. 2004).   Thus it appears that stress related information is not only socially mediated, but interacts with message content to influence stress appraisals. This is congruent with self-categorisation theory (Turner et al. 1987, Turner et al. 1994), which suggests that legitimacy of informational exchanges are shaped by a perceiver's belief that it originates from a relevant ingroup member who has direct personal experience and is therefore qualified to comment on the particular event (Haslam et al. 1996, Levine 1999). Therefore, it is possible that information exchanged between shared ingroup members will have greater implications for task appraisals and cardiovascular reactions compared to information shared between outgroup members.

Taking these previous findings as a whole, we conducted a study that tested not only the influence of appraisal on cardiovascular reactions but also the role of context in determining this appraisal. Based on the Haslam et al., (2004) findings, we predicted that participants will appraise a task as more stressful when it is identified as stressful rather than challenging. We also predicted that where an ingroup member informs participants that the task is stressful rather than challenging higher blood pressure and heart rate reactions to the task will also be evident. Identical messages from an outgroup member are predicted to have less of an impact on participants' perceptions of stress and as a consequence their cardiovascular reactions. Ultimately the effect of the task on appraisal and blood pressure and heart rate should be contingent on both the content of the message and the degree to which membership is shared with the informational source. In this way we tested the influence of shared group membership on cardiovascular reactions to acute psychological stress.

Method

Participants

Participants were 104 healthy undergraduate students (65 women). Their mean (SD) age was 21.4 (3.51) years, and mean (SD) body mass index (BMI) was 25.3 (4.34) kg/m^2. Participants were excluded if they were suffering from an acute illness, taking any prescription medication (excluding the contraceptive pill) or suffering from any long standing cardiovascular disease. Prior to testing participants were instructed in advance not to consume alcohol or exercise vigorously 12 hours prior to the study and not to smoke tobacco, caffeine or food 2 hours prior to the study. The study was approved by the Research Ethics Committee of the university and all participants gave informed consent.

Design

The study employed a between-subjects' factorial design. The study tested two independent variables and their interaction in a 2 x 2 between subjects design: message source (information from an informant with shared group membership, information from an informant with no shared membership) and message content (task described as stressful or challenging), thus yielding four distinct conditions. These were 1) shared/ stressful, 2) shared /challenging, 3) non-shared/stressful and 4) non-shared/challenging. Participants were randomly allocated by numbers drawn from a hat prior to attending the lab. There were 26 participants per condition. The dependent variables were blood pressure and heart rate reactivity and subjective ratings of task difficulty.

Apparatus and Measures

Psychological Stress Task

The 4-minute version of the paced auditory serial addition test (PASAT) (Gronwall 1977) was used as the psychological stress task. The PASAT has been shown in numerous studies to consistently perturb the cardiovascular system (e.g. Phillips et al. 2009, van Zanten et al. 2009) and to demonstrate good test-retest reliability (Willemsen et al. 1998). Briefly, single digit numbers were presented by audio CD player. Participants were asked to add together each pair of numbers and say the answer out loud, while retaining the previous number in order to add it to the next number presented. The presentation of numbers got faster as the test progressed and were presented at rates of 2.4, 2.0, 1.6, and 1.2 seconds apart during each minute, respectively, with a 5 second break at the end of each minute. A false leader board was in view of the participant and was added to create an element of competition and participants were instructed to try to beat the scores on the board. The experimenter wore a white laboratory coat and scored the answers overtly while sitting on a high stool at a distance of 1m facing the participant, and the laboratory was in semi-darkness, with a desk lamp focusing on the participant. These conditions were engineered to add to the psychological separation between the experimenter and the participant. Moreover, participants were also informed that they were being video taped and their videos were to be assessed by "independent body language experts". For this, while seated they could see themselves live on a computer screen and were instructed to look at the screen at all times;

but no such video assessments were actually made.   Participants began the test with a score of over 110 points; for every incorrect answer 1 point was deducted from their score.

Stress Task Measures

Participants were asked task specific questions before and after the testing. These consisted of six questions, three before and three after, which were rated on 7-point Likert scales (0 = 'not at all' to 6 = 'extremely'). Questions prior to stress task included; 'How difficult do you expect to find the task?', 'How stressful do you expect to find the task?' and 'How anxious do you feel right now?, higher scores indicated more distress. On completion of the stress task, participants completed the same items but in this case they reported on the psychological impact of stress task (e.g. 'How difficult did you find the task?' and 'How anxious are you feeling right now?'). We also asked "How credible they found the advice given by the person in the video"? Scored from, 0 = 'not at all', to 6 = 'extremely'.

Cardiovascular Functioning

Systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were measured using a GE Dinamap Pro 300 series blood pressure monitor. The cuff was placed over the brachial artery on the non-dominant arm.

Manipulation and Procedure

Participants were told that they were taking part in an experiment to assess the relationship between social factors and cardiovascular reactions to acute stress. On arrival, participants gave informed consent, were then weighed and measured using standardised scales for BMI calculations. The blood pressure cuff was then attached and a reading taken to acquaint participants with the sensation of cuff inflation. There was then a 15-min formal baseline rest period, after 14 minutes of which, they completed the pre-test questionnaires. They were then informed that in relation to the upcoming task they might find it helpful to watch a video in which a previous participant discussed her impression of the PASAT that they were just about to complete. Following this, the task was explained to the participant and a 20-s practice task was allowed, during which they responded as they would in the actual task. Participants then underwent the 4-min task and following this they completed the post-task rating scales. SBP, DBP, and HR readings were initiated at the start of the 8th, 10th, 12th, and 14th minute of baseline rest and the second and fourth minute of the task.

For our video manipulation, we adopted the procedure by Haslam et al (2004). In brief, before watching the video, participants were given one of two cue cards; although the video was actually identical in both ingroup and outgroup conditions, the cue cards informed them that the previous participant they would see on the video was either 1) a psychology student (ingroup: like them) or 2) an stress disorder sufferer (outgroup: unlike them). They then watched the video which presented the female actor discussing her reaction to the task, including her feelings about her performance on the task, the difficulty of the task, and her experience of stress. Here the message content was manipulated with the same actor used in both videos, but in one interview, in response to a question "How stressful did you find the task?", the actor gave responses that described the test as stressful while in the other it was described as challenging.

Finally, to ensure the manipulation of group identification, several weeks prior to the experiment, a pre-test was undertaken. Here the same female actor used in the "challenging" and "stressful" video clips reported on a neutral topic. This was to ensure that participants would actually identify with the actress as an ingroup member before undertaking the real study. Sixteen participants watched this video and were informed that it was either 1) a student like them or 2) a stress disorder sufferer and then completed the 4-item Social Identification Scale (Doosje et al. 1995). This assessed the strength of identification with the actor in the video with scores on a 5-point Likert type scale ranging from, 1= Strongly disagree to 5 = Strongly agree. Examples of items include 'I identify with other students' with high scores indicating stronger identification. Those informed that the person was a student had stronger identification than those who were informed that it was a stress disorder sufferer, t (14) = 19.91, *p* <.001.

Data Reduction and Analytic Strategy

The four resting baseline measures were averaged to yield a baseline value for each of the cardiovascular parameters. The two task measures were similarly averaged to yield a task value. For each parameter, blood pressure and heart rate reactivity was calculated as the simple arithmetic difference between baseline and task values. The data were interrogated using analysis of variance (ANOVA). A simple repeated-measures (baseline, task) ANOVA was undertaken to determine whether, irrespective of condition, the stress task perturbed cardiovascular activity. Analyses then shifted to the baseline cardiovascular values and a series of 2 (message source: ingroup/outgoup) ×2 (message content: stressful/challenging)

ANOVAs were undertaken to see if groups differed at baseline or on task rating before and after testing PASAT performance. In order to test the main hypotheses, a further series of 2×2 analysis of covariance (ANCOVA) were conducted on the reactivity values. The appropriate baseline cardiovascular value was entered as a covariate in each of these analyses to control for baseline effects on reactivity (Hayes, 1988). Where appropriate, post hoc tests were undertaken using simple effect tests. A subsequent ANCOVA was undertaken to discount the possibility that any effects were the result of confounding (e.g., BMI). Similar analyses focused on the influence of the subjective stress ratings on cardiovascular reactivity. Partial eta- squared (η^2_p) is reported as a measure of effect size.

Results

Manipulation Checks

Table 1 contains the means and standard deviations (SD) of the pre-PASAT and post-PASAT ratings and cardiovascular responses. A repeated measures ANOVA revealed that, irrespective of condition, the PASAT perturbed cardiovascular activity: for SBP, $F(2,102)$ =127.27, $p < 0.001$, η^2_p =.71; for DBP, $F(2,102) = 103.89$, $p < 0.001$, η^2_p =.67; and for HR, $F(2,102)$ =84.76, $p < 0.001$, $\eta2=0.62$. One-way ANOVAs confirmed that the conditions did not differ from each other on pre-test task ratings of difficulty, $F(3, 100) = 1.39$, $p = .24$, stress $F(3, 100) = .07$, $p = .78$ and anxiety $F(3, 100) = .10$, $p = .74$. Moreover, there were no significant main or interaction effects for message source or message content on SBP, $F(3, 100) = 1.68$, $p = .20$; DBP, $F(3, 100) = .69$, $p = .40$ and HR, $F(3, 100) = .01$, $p = .91$ at baseline. Further, there were no differences in allocation of males and females between conditions, $\chi^2 (3) = 1.90$, $p = .59$.

[Insert Table 1 about here]

Shared Group Membership and Cardiovascular Reactivity

Participants demonstrated greater SBP reactivity where they believed the informant shared a group membership with them, $F(1,99) = 13.45$, $p < .001$, η^2_p =0.12. Whether the task was articulated as stressful or challenging did not appear to have an effect. Those in the shared membership or ingroup (student) condition had higher reactions compared to those in the non-shared group membership or outgroup (stress disorder sufferer) (M= 19.3 $\pm$ 10.53 vs

M = 12.3 $\pm$ 11.41). There was no interaction between message source and message content. In the case of DBP, again there was a main effect for message source, $F(1,99) = 13.66$, $p <$ 0.001, $\eta^2_p = 0.14$, with those who shared membership with the source (M= 10.5 $\pm$ 7.18 vs M = 6.7 $\pm$ 5.55) having higher reactions to the task. There was no main effect for message content.

However, there was a significant two-way interaction between shared ingroup versus non-shared outgroup and whether they were told the task was stressful or challenging, $F(1,99) = 8.47$, $p = .004$, $\eta^2_{p =} 0.08$. Simple effects analysis showed that where participants believed they shared group membership with the informant they had higher DBP reactivity in the stressful rather than challenging condition, $p = .003$. More importantly, there were no differences in the non-shared condition, p = .09. This interaction effect is illustrated in Fig. 1. For HR, an identical pattern emerged with a main effect for message source, $F(1,99) = 8.00$, $p = .006$, $\eta^2_p = 0.08$, (M= 14.6 $\pm$ 10.31 vs M = 9.2 $\pm$ 7.90), but not message content. The two-way interaction was also significant, $F(1,99) = 4.15$, p=.04, $\eta^2_{p =} 0.04$ (see Figure 2). Simple effects revealed that this was attributable to significant differences in HR between those who believed they shared group membership with the informant. In this participant group, labelling the task as stressful rather than challenging resulted in higher HR, $p = .02$.

[Insert Figure 1 and 2 about here]

Subjective Impact of Task and Task Performance

Although there were no significant main effects for message source or message content on rating of task difficulty post task, a significant interaction effect was observed $F(1,99) = 4.29$, $p = 0.04$, $\eta^2_p = 0.04$; the task was rated more difficult by those allocated to the shared group and stressful condition compared to other conditions (See Table 1). For ratings of task being stressful, no main effects for message source was evident. There was a main effect for message content, $F(1,100) = 6.68$, $p = 0.01$, $\eta^2_p = 0.06$, with those informed that the task was stressful having reporting higher stress compared to those informed that is was challenging (M= 4.4 $\pm$ 1.19 vs M = 3.8 $\pm$ 1.33). There was also a two-way interaction between message source and message content, $F(1,99) = 4.60$, $p = .03$, $\eta^2_p = 0.04$; this reflected significantly higher reporting of stress in the shared/stressful condition compared to those in other conditions. A broadly analogous picture emerged for rating of anxiety following the task.

Again there was a main effect for message content, $F(1,100) = 5.00$, $p = .03$, $\eta^2_p = 0.60$ (M= 4.2 $\pm$ 1.27 vs M = 3.7 $\pm$ 1.32) and a significant interaction, $F(,100) = 5.72$, $p = .019$, $\eta^2_p = 0.05$; and simple effects revealed that the shared/stressful condition reported significantly more anxiety after the task compared to both the shared/challenging and non-shared /stressful condition, but not the non-shared/challenging (see Table 1); all significant simple effect p's reported above were <.05). In terms of actual task performance scores, no main effect for message source was found. A main effect for message content was found, $F(1,100) = 12.38$, $p <.001$, $\eta^2_p = 0.11$, with those informed that the task was stressful having a poorer performance than those told it would be challenging (M= 66.3 $\pm$ 14.07 vs M = 76.1 $\pm$ 14.43). The two-way interaction was also significant, $F(1,100) = 5.72$, $p = .01$, $\eta^2_p = 0.05$ and this reflected a non-significant trend between the shared/challenging condition performing much better than the shared/stressful condition (see Table 1); there was no difference between the non-shared/stressful and non-shared/challenging condition.

Post hoc analyses: are the associations between social influences and blood pressure responses influenced by task stress appraisals?

A series of one-way analyses of covariances were conducted using subjective task appraisals as covariates and DBP and HR as dependent variables. In these analyses the above DBP findings withstood adjustment for post task ratings of difficulty, stressfulness, anxiety and performance. However, in the case of HR the interaction between message source and message content became non-significant when controlling for difficulty, $F(1,98) = 2.10$, $p = .15$, $\eta^2_p = 0.02$; stressfulness, $F(1,98) = 2.68$, $p = .10$, $\eta^2_p = 0.03$, anxiety, $F(1,98) = 2.52$, $p = .12$ $\eta^2_p = 0.03$, and performance, $F(1,98) = 2.84$, $p = .09$ $\eta^2_p = 0.03$, providing evidence for mediation of HR by perceived stress-task appraisals and performance; a Sobel test confirmed mediation for task appraisals ($z = 1.97$, $p =.04$) and a trend for task performance ($z = -1.85$, $p =.06$) respectively. Further, it is possible that the results could be affected by our outgroup comparison being seen as less than an ideal comparison due to the label as stress sufferer doing a stress task; even after controlling for our question on credibility of advice given by the person in the video the interactions above remained the same; DBP, $F(1,98) = 8.35$, $p = .005$ $\eta^2_p = 0.08$ and HR, $F(1,98) = 4.01$, $p = .04$ $\eta^2_p = 0.04$. Finally, analysis of covariance was conducted to test whether the main findings above withstood adjustment for BMI; the results remained unchanged.

Discussion

The results of the study are the first to support the application of the ISIS model in relation to cognitive stress appraisal and its influence on cardiovascular responses to acute psychological stress. In line with expectations, stress appraisals were influenced by group membership; in particular, participants who were informed by an ingroup member that the task was stressful rather than challenging rated it as being more stressful, and this same group had higher blood pressure and heart rate responses to the task as well as having a poorer performance. These patterns were observed in the shared group membership condition (students). The effect of labelling a task as stressful or challenging by someone participants do not see themselves as sharing group memberships with (i.e. stress sufferer) had very little effect on either reactivity or appraisals. Thus, by focussing attention on shared social identity it is apparent that social identities are influential in terms of cognitive stress appraisals. Further the exchange of the same information across two groups where identities cannot be assumed to be shared has very different consequences for our participants' appraisals and cardiovascular reactivity. The effect sizes (η^2_p) found for cardiovascular reactivity in the present study ranged from .08 and .14 which signify medium to large effects (Cohen, 1988; Pierce et al., 2004) and are similar in size to other stress and cardiovascular reactivity studies (Gallagher & Whiteley; Phillips et al., 2009).

The patterns evident in this study whereby stress appraisals were influenced by social identities is congruent with other studies. Haslam and colleagues (2004) found that information exchanged by an outgroup member is less influential on student stress appraisals after they complete a stress task compared to information provided by another student. The results also concur with other research linking social identities with other health outcomes including cardiovascular functioning (Brondolo et al., 2008; Scheepers et al., 2009). The significant effects on pulse rate were abolished when ratings of task difficulty, anxiety and stress were included in analysis of covariance, implying that the 'group in the individual' not only influenced primary stress appraisals but that these subjective appraisals were, in part, driving subsequent cardiovascular responses. Moreover, when one considers that the associations between social factors and cardiovascular health in some social groups remain poorly understood (Carroll et al. 1998; Christenfeld & Gerin, 1998; Christenfeld & Gerin, 2000; Jetten, Haslam & Haslam, 2012); this ISIS model may be a stronger framework for understanding this process. For example, the transactional model of stress (Lazarus & Folkman 1984), argues that social factors play an important role in buffering stress reactions

but fundamentally sees the stress process as a transaction at the level of the individual (Folkman & Moskowitz 2007; Segerstrom & O' Connor, 2012). As such, groups play a role in moderating the impact of cardiovascular reactions by facilitating individual coping; therefore analysis is always at the level of the individual. However, even though social ISIS model (Haslam et al. 2004,) sees groups as being integral to the experience and perception of stress, as collective resources that can alter the meaning and experience of stress as well as providing social support to buffer stress (Haslam & Reicher 2006; Muldoon & Lowe, 2012). The data from the present study appears to support this notion.

Consistent with this position (Festinger 1954) social comparison theory has often been cited to explain the influence of social relationships on psychophysiology (Gerin et al. 1992, Phillips et al. 2009). In brief, the social comparison theory states that individuals have a drive to evaluate their opinions and abilities, and that objective non-social methods are used as markers for evaluation. However, in the absence of this objective information individuals would look to others, preferentially similar others in which to evaluate themselves (social reality testing). Nonetheless, it is often the case that this evaluation may be negative or positive as a consequence of upward or downward comparison with others. In fact, one psychophysiological stress reactivity study found that the strength of the relationship that exists between a pair tested together was the important element and not provision of social support *per se* (Mendes et al. 2001). The strength of this relationship was enhanced when the psychological characteristics and attributes of the support provider and recipient are matched. Taken together these studies indicate that the social identity processes act to structure psychological and physiological adaptations to stressful events. We therefore join the recent, call for researchers to explore more fully the impact of contextual variables on the social support cardiovascular functioning relationship made (Uchino et al. 2011), especially the psychological circumstances and exposure that put whole social groups at risk (Carroll & Sheffield, 1998).

The present study has extended previous work and opens up an important potential avenue of future research. We have hinted at one mechanism through which social identities may exert their influence and tested a precise method of how this is mostly likely to occur through the influence of group membership on stress appraisal. The results of this study may have important implications for the area of health promotion and networks of health communication. The epidemiological evidence that marginalised groups are more at risk of poor health outcomes, including CVD (e.g. African Americans, lower socioeconomic groups, and populations living HIV) is widely acknowledged. Further, minority stress as a

consequence of prejudice and discrimination has been proposed as one hypothesis (Clark, Anderson, Clark, & Williams, 1999) and our findings suggest that where a stressor is onerous in nature, the barriers to action may be reduced where if the person encouraging action is perceived as sharing group membership with those at whom the message is targeted.

It is important to acknowledge our study limitations. First, our outgroup comparison manipulation was purposively at two extremes. Participants were informed that the person in the video was someone who was a 'stress suffer'. This comparison made it very easy for our student participants not to identify strongly with this group, effectively ensuring our manipulation was solid. Future studies could perhaps try and vary the types of groups making them more realistic to real life or to add a control group whereby a no categorisation condition provides information; this would allow one to infer more accurately whether ingroup sources are driving the observed effects. Similarly, strength of identity with the in-group member could also be assessed more precisely during the session. Moreover, attitudes toward mental health sufferers are often observed and having a stress disorder sufferer as a comparison was probably not ideal. Second, our sample though of similar magnitude to other similar studies (Haslam et al 2004; Phillips et al., 2009) could be considered small. Third, we only examined cardiovascular reactivity to the stress task, in part due to its association in predicting future hypertension (Carroll, Ginty, Painter, et al., 2012) but it must be acknowledged the cardiovascular recovery from stress tasks are equally important for cardiovascular health (Steptoe, Donald, O' Donnell, Marmot & Deanfield, 2006); future studies could explore this aspect of the stress process. Finally, as the actor in the video was female it could also have been that gender identity may have a factor; although we found no three-way interactions when sex was included in the analyses. However, testing gender effects were not our main aim future studies could usefully investigate this further.

In summary, the results from this study suggest that social identity may play a central role in stress appraisals and responses. Moreover, social identity is important in terms of the extent of respondents' experience of stress and its impact on their cardiovascular functioning. In fact, the ISIS model is a relatively recent advancement in stress research that is potentially one approach that could be extended to perhaps explain the variations in health disparities, including CVD, among certain at risk populations (e.g. African Americans, lower socioeconomic groups). Further, social identity played an important role in mediating between the experience of stress and cardiovascular functioning. Finally, this pattern of findings is supportive of the ISIS model (Haslam & Reicher 2006) which argues that groups are both a source of stress and a key to understanding and overcoming it.

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Table 1: Subjective mean and standard deviations (SD) for task ratings and cardiovascular responses for each condition

	Ingroup/Stressful	**Ingroup/Challenging**	**Outgroup/Stressful**	**Outgroup/Challenging**
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Pre-PASAT ratings				
Difficulty	2.5 (0.94)	2.8 (1.03)	2.7 (0.93)	2.5 (1.07)
Stressful	2.7 (1.23)	2.5 (1.24)	2.8 (0.83)	2.6 (1.03)
Anxiety	2.4 (1.02)	2.6 (1.06)	2.5 (1.06)	2.8 (1.13)
Post-PASAT rating				
Difficulty	4.9 (0.95)	4.1 (1.39)	4.4 (1.32)	4.6 (0.98)
Stressful	4.9 (0.90)	3.7 (1.51)	3.9 (1.28)	3.8 (1.15)
Anxiety	4.6 (1.68)	3.5 (1.47)	3.8 (1.26)	3.9 (1.14)
Performance	63.1 (9.94)	78.4 (14.65)	69.6 (16.80)	73.7 (14.10)
Baseline				
SBP	108.9 (16.51)	114.6 (15.94)	109.5 (15.08)	107.4 (14.06)
DBP	69.7 (7.87)	70.7 (6.94)	70.6 (5.54)	69.3 (8.28)
HR	76.2 (12.49)	76.6 (13.06)	79.2 (10.4)	79.1 (11.11)
PASAT responses				
SBP	128.8 (13.90)	133.4 (18.34)	119.4 (15.25)	122.1 (16.85)
DBP	82.8 (7.86)	78.6 (8.51)	76.3 (7.08)	77.1 (8.91)
HR	92.8 (9.65)	89.4 (17.25)	86.7 (10.69)	89.9 (14.04)

Figure Captions

Figure 1. DBP reactivity as a function of message source and message content

Figure 2. HR reactivity as a function of message source and message content