Received: 13 February 2023 | Revised: 24 March 2023 | Accepted: 5 May 2023

DOI: 10.1002/casp.2712

RESEARCH ARTICLE

WILEY

Institutional status and identity dimensions to cardiovascular stress responses

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Funding information
European Research Council

Abstract

This study aimed to examine the effect of shared social identity (i.e., whether the source of information about a stressor comes from an ingroup vs. outgroup member) and message content (i.e., whether people were informed that the task is stressful vs. challenging) on cardiovascular reactivity to stress (CVR) across two higher education institutions differing in status (University vs. Institute of Technology [IoT]). The study employed a quasi-experimental $2 \times 2 \times 2$ design. 80 healthy undergraduate students (38 female, 47.5%) were recruited from two institutions—a University ($n = 40$) and an IoT ($n = 40$). All students underwent a standardised cardiovascular stress testing protocol (i.e., baseline rest period, manipulation, stress task). Blood pressure and heart rate were continuously monitored throughout. Results indicated that IoT students who were informed that the task would be stressful by an outgroup member (a University student) displayed relatively higher SBP reactivity ($M = 17.53$, $SD = 4.72$). Interestingly, those from the University who were informed that the task would be stressful by an ingroup member (also a University student) similarly displayed high level of reactivity ($M = 19.45$, $SD = 4.33$). It appears that being told the task is stressful had different effects depending on what institution the person was in, and who provided the information. These findings provide preliminary evidence to suggest that cardiovascular responses to stress may not simply be impacted by the source or content, but also the status or social position of the informants group.

KEYWORDS
cardiovascular reactivity, social identity, status, stress

1 | INTRODUCTION

1.1 | Stress and health

The negative impact of stress on psychological and physiological health is well established (DeLongis, Folkman, & Lazarus, 1988; Lovallo, 2015; Thoits, 2010). Within the stress and coping literature, individualised theoretical frameworks have received considerable attention for how we understand the mechanisms through which stress can influence health. For example, the transactional model of stress (Lazarus & Folkman, 1984) claims that stress is a system of appraisals, responses, and adaptations, and views the stress process as a transaction at an individual level; that is, an individual's capacity to cope with challenges as a result of interactions between a person and their environment. It has been argued, however, that moving from a focus on individual differences towards a view that accounts for group-based identities contextualises the stress-health relationship (Gallagher, Meaney, & Muldoon, 2014; Jetten, Haslam, & Haslam, 2012). The social identity approach (SIA), in particular, speaks to the importance of group resources on influencing stress (Haslam, Jetten, O'Brien, & Jacobs, 2004). Although evidence for how social identity processes are implicated in stress responsivity is growing (e.g., Haslam et al., 2004), investigations that implicate identities in biological responses to stress remain relatively sparse. Here, we aim to address this gap in research.

1.2 | Social identity approach

The social identity approach, which consists of social identity theory (SIT; Tajfel & Turner, 1979) and self-categorisation theory (SCT; Turner, Hogg, Oakes, Reicher, & Wetherell, 1987) focuses on how people think of themselves and others as 'group members'. Social identity is defined as the part of individuals self-concept that originates from perceived membership of a relevant social group (Tajfel & Turner, 1979), and these groups can have great significance for people. Indeed, belonging to a group provides individuals with the emotional, intellectual, and material resources to cope with stress (Haslam et al., 2004). The social identity model of stress (ISIS; Haslam et al., 2004, Haslam & Reicher, 2006) argues that social identity processes, and the resources we acquire from our group memberships are critical to individuals experience and perception of stress, and therefore important in understanding the stress process (Haslam, Jetten, Cruwys, Dingle, & Haslam, 2018; Haslam & Reicher, 2006). For instance, people are more likely to provide and receive social support and also interpret support in the way in which it is intended when they share a valued group membership (Reicher, Cassidy, Wolpert, Hopkins, & Levine, 2006). So, as the transactional model of stress points to personal resources that can help individuals cope with stress, social identity work highlights how social identity processes embedded in group memberships can alter stress responses.

1.3 | Source of information

In fact, some research findings have demonstrated how social identities matter in appraising and responding to a stressful situation by manipulating the source of information (ingroup versus outgroup member). For example, Haslam et al. (2004) showed that when university students were told that a task was 'stressful' instead of 'challenging' by an ingroup member (fellow student) they perceived the task to be more stressful, as you would expect. In contrast, this was not evident when the same information was shared by an out-group member (a stress sufferer). This finding is consistent with self-categorisation theory (Turner et al., 1987), where information is seen to be more legitimate and impactful when it is received from an ingroup member because they are presumed to share a similar perspective and are viewed as someone with personal experience who is sufficiently capable to comment on the event (Turner et al., 1987). It appears that not all informational support has the same effect, and its impact can vary based on whether group membership is shared by the support provider and recipient (Haslam, O'Brien, Jetten, Vormedal, & Penna, 2005).

Building on these findings, Gallagher et al. (2014) demonstrated that both stress appraisals and cardiovascular reactivity (CVR) were influenced by social identity. Specifically, they found that participants who were told by an ingroup member that the task was 'stressful' instead of 'challenging' perceived it to be more stressful; similar to Haslam et al. (2004). In extending these findings to biological health outcomes, Gallagher et al. (2014) also noted that this same group (those who were informed by an ingroup member that the task was stressful) had higher blood pressure and heart rate (HR) responses to a stress task. In contrast, when a task was described as either stressful or challenging by an outgroup member (again, depicted as a stress sufferer), there was little effect on both cardiovascular responses and appraisals of stress. As such, it appears that the information given by the ingroup member had more of an influence on self-reported stress and indices of physiological stress compared to the same information but by an outgroup member. Overall, this research suggests that appraisals and responses to stress can be shaped by relevant social identities and can influence cardiovascular functioning.

1.4 | Cardiovascular reactivity

The fact that social identity processes were seen to influence CVR— that is the extent to which an individual physiologically responds to a stressor (calculated as a change from rest to during the presence of a stressor)—has relevance for long-term physical health. The well-established CVR hypothesis (Obrist, 1981) states that exaggerated or prolonged cardiovascular responses (e.g., blood pressure and HR) to stress are associated with increased risk of cardiovascular disease (CVD) development; an argument support by decades of research (for a review see Chida & Steptoe, 2010). While the impact of acute psychological stressors on the body might only be temporary (e.g., a short rise in blood pressure), if these stressors occur regularly or individuals do not have adaptive coping mechanisms to overcome such stress, it can consequently result in adverse physiological health outcomes. Indeed, longitudinal research suggests that individuals who show greater physiological responses to stress in the laboratory are more likely to develop negative physical health and disease outcomes in the longer-term, particularly CVD (e.g., Lovallo & Gerin, 2003; Steptoe & Ayers, 2004; Steptoe & Kivimäki, 2012). Therefore, when people perceive or expect a task to be stressful, it can trigger a cascade of effects where their body demonstrates exaggerated, or heightened, responses to the stressor, which in turn can have adverse effects on future cardiovascular health.

1.5 | Status

Moreover, such heightened reactions may be amplified by social contexts (e.g., Scheepers, Ellemers, & Sintemaartensdijk, 2009). For instance, previous research has demonstrated that in a virtual reality, experimental manipulation of conditions of inequality affected CVR across high and low-status income groups (Ryan, Muldoon, Gallagher, & Jetten, 2021). Disparities in perception of higher education institutions offer a more naturally occurring status differential. Indeed, a recent report from the Higher Education Authority (O'Shea, 2020), which analysed the socio-economic profile of 94% of the student population, shows that students from more affluent backgrounds predominantly attend universities rather than IoT's. By contrast, those from lower socio-economic status (SES) backgrounds are more likely to be attending IoT's. Indeed, Higher Education in Ireland has been described as a binary system, with the top tier comprising of universities and more prestigious colleges, while the second tier includes Institutes of Technology[1] (Hazelkorn & Moynihan, 2010; McCoy & Smyth, 2011) that typically focuses on vocationally oriented education. As such, IoTs have been described as the 'poor relation' in Ireland's binary higher education system in terms of research outputs and funding, as well as status and societal esteem (Hazelkorn & Moynihan, 2010 in Houghton, 2020).

Given that universities are typically seen as more 'academic', a comparison of these two educational contexts is appropriately suited to the use of a stress task such as the Paced Auditory Serial Addition Task (PASAT) given its reliance on mental arithmetic to invoke perturbation of the cardiac system (e.g., by Gallagher et al., 2014). This task, therefore, is particularly fitting for examining the effects of these perceived status differentials on CVR.

In highlighting the implications of status for CVR, Scheepers (2009) demonstrated that members of a low-status group displayed maladaptive or damaging cardiovascular responses (a 'threat response' was demonstrated by lower levels of cardiac output and higher levels of vascular resistance) while members of a high-status group displayed a more adaptive or healthy response (a 'challenge was demonstrated by higher levels of cardiac output and lower levels of vascular resistance) under stable inequality conditions. Scheepers argues that such findings can be explained by social identity threat, which comes about when positive group distinctiveness (and is indicative of a positive social identity) is undermined (i.e., when a group has a relatively low status). In fact, social identity threat has been associated with a myriad of negative outcomes including decreased psychological and physical wellbeing (e.g., Major, & O'brien, L. T., 2005; O'Brien & Major, 2005), undermined performance (Steele, 1997), and avoidance of tasks where the group is threatened (Major, Spencer, Schmader, Wolfe, & Crocker, 1998; Steele, Spencer, & Aronson, 2002). Social context and status disparities have been shown to affect stress responses, however, we aim to extend this research to examine if a naturally occurring perceived status differential (University vs. IoT) has similar effects when the information source (as well as the information content) is manipulated. As such, it is reasonable then to assume that social context and the perceived status disparities between types of educational institutions could provide further understanding of how the source and content of informational support can impact stress responsivity.

1.6 | Present study

Given the implications of social contexts and group identities for stress appraisal, and in parallel, the importance of examining objective, biological measures of stress responsivity within an social identity perspective, this study aims to conceptually replicate and extend the findings from Gallagher et al. (2014). In doing so, we will contribute to research examining social identity and biological health parameters. Specifically, this study will examine the effect of shared social identity (i.e., if the source of the message is from an ingroup vs. outgroup) and message content (stressful vs. challenging) on cardiovascular (blood pressure and heart) responses to stress; using a similar methodology to Gallagher et al. (2014) However, we extend this research by recruiting participants across two different institutions (a University and an Institute of Technology). This will provide a pilot test of ingroup/outgroup effects across higher and lower-status groups. The findings from Gallagher et al. (2014) might lead us to anticipate that when participants are informed that a task is stressful (as opposed to challenging) they will report greater stress appraisal and show greater CVR when this message comes from an *ingroup member* rather than an outgroup member. Integrating evidence from the status literature, however, we hypothesise that a lower-status group (IoT students) will demonstrate heightened (i.e., maladaptive) levels of CVR when the task is described as more stressful (as opposed to challenging) by a member of a perceived higher status group (a University student).

2 | METHODS

2.1 | Participants

Participants were 80 healthy undergraduate students (38 female, 47.5%) recruited from two higher education institutions. Forty participants were recruited from a University (21 [52.5%] females), and 40 from an IoT (17 [42.6%] female). Based on post-hoc power calculations, the sample had sufficient power (0.80) to detect a medium to large effect ($p = .05$, $F^2 = 0.35$). The samples average age was 22.4 years ($SD = 3.41$), with a mean body mass index (BMI) of 25.01 ($SD = 5.00$) kg/m^2. Table A1 displays full participant demographics. In line with previous research (e.g., McMahon, Creaven, & Gallagher, 2020) participants were excluded based on illness, medication use, and diagnosis of CVD. Similar to McMahon et al. (2020, p.3) participants were notified of restrictions pertaining to alcohol, exercise, smoking and caffeine consumption in advance of the testing session. It is standard practice to control for these variables in reactivity research, as they are known to affect cardiovascular responding (see also; Griffin & Howard, 2022; McMahon, Creaven, & Gallagher, 2021). We received ethical approval from the Research Ethics Committee at the university to conduct this research.

2.2 | Design

The present study employed a quasi-experimental 2 × 2 × 2 design with three independent variables: (1) institution/status (if they were enrolled in a University or IoT), (2) message source (information on the stress task came from an ingroup or outgroup member), and (3) message content (information that the task would be stressful or challenging). Participants were randomly assigned to message source and message content conditions before entering the laboratory. Institution/status was based on the institution the participants were recruited from—a University and an IoT based in the same city. The dependent variables were systolic blood pressure (SBP) reactivity, diastolic blood pressure (DBP) reactivity, and HR reactivity measured as the change from baseline to task (i.e., mean blood pressure during Task—mean blood pressure during Baseline).

2.3 | Assessments and measures

2.3.1 | Stress task

The paced auditory serial addition test (PASAT, Gronwall, 1977) is used in the current study the invoke psychological stress. The PASAT has been extensively used in similar research due to its ability to consistently impact the cardiovascular system (McMahon et al., 2020; Phillips, Gallagher, & Carroll, 2009) as well as having good test–retest reliability. Details of the methodology of the PASAT are reported elsewhere (Gallagher et al., 2018).

2.3.2 | Cardiovascular functioning

Blood pressure (SBP and DBP) and HR were measured using a General Electric Dinamap Pro 300 series blood pressure monitor (GE Medical Systems, Freiburg, Germany). A brachial cuff was placed on the non-dominant arm. Details on timings of physiological measures are included in the procedure section below.

2.3.3 | Psychological stress appraisals

To examine if participants perceived the task to be stressful, they completed a one-item stress measure immediately before, and after, completing the stress task indicating how stressful they anticipated the task would be, and how stressful they actually found it. This measure has been used in previous studies (e.g., Gallagher et al., 2014; McMahon et al., 2020).

2.4 | Manipulation and procedure

Participants were invited to partake in a study to assess the association between social factors and physiological responses to stress. The experimenter greeted participants in a white laboratory coat. On arrival at the laboratory, participants provided informed consent and their height and weight were recorded using standardised methods for BMI calculations. A blood pressure cuff was then placed on the participant's non-dominant arm and an initial reading was obtained in order to familiarise participants with the inflation of the cuff. A 14-min baseline rest period followed, after which participants then completed a pre-test questionnaire. Five cardiovascular readings were taken during this baseline period at minutes 6, 8, 10, 12, and 14.

Participants were then informed that they would soon complete a task, but that they might benefit from watching a video of a previous participant discussing their thoughts on the PASAT task. Adapting a manipulation protocol from Haslam et al. (2004), participants were given a cue card before watching a video which told them that the participant in the video was either (1) a University student (from the university in the city) or (2) an IoT student (from the IoT in the city). As such, this would be an ingroup member or an out-group member depending on the institution that they were recruited from. In the video, a female actor talked about her reaction to the task, which included how she felt about her performance on the task, how difficult it was, and her experience of stress. In order to then manipulate the content of the message, they were either presented with a video where the actor described the test as stressful, or a video where the actor described it as challenging.

Following this, the task period commenced and 20-second practice task was allowed. Participants were told that their performance on the task would be assessed and a maximum score of 110 points was possible. 1 point was deducted from their score for each incorrect answer. To create the illusion of a competition, participants were shown a false leader board and were encouraged to try to defeat their colleagues. To further enhance the framing and to emphasise the higher status of the University compared to the Institute of Technology, the leader board made it apparent that the University students scored higher on average. Researchers recorded the scores while facing the participant from approximately 1 metre away. To enhance the stressfulness of the situation for the participant, the main laboratory light was switched off and only a desk lamp focused on the participant. Participants then completed the 4-min task. SBP, DBP, and HR readings were taken at 2 points throughout the task, at minutes 2 and 4. After the task, participants completed post-task rating scales.

2.5 | Data reduction and analytic strategy

An average of the five resting baseline measures was calculated to generate a baseline value for each cardiovascular parameter. The two task measures were also averaged to generate an overall task value. Cardiovascular reactivity was calculated as the difference between baseline and task values (i.e., task–baseline) for each parameter. A repeated-measures (baseline, task) *t* test was also conducted in order to determine if the stress task influenced cardiovascular activity, irrespective of condition. To test the main hypotheses, a series of 2 × 2 × 2 analyses of covariance (ANCOVAs) were conducted on the reactivity values. Main effects and two-way interaction effects are also reported. Baseline cardiovascular values, as well as BMI, were entered as covariates in each of these analyses (consistent with previous research, Matthews, Woodall, & Allen, 1993; McMahon et al., 2020).

3 | RESULTS

3.1 | Preliminary analyses

Results from a series of repeated measures t tests showed an increase in cardiovascular responses from baseline to task across each cardiovascular parameter, SBP: $t(7) = -17.80$, $p < .001$, $d = 1.39$; DBP: $t(79) = -13.35$, $p < .001$, $d = 1.76$; HR: $t(79) = -10.03$, $p < .001$, $d = 0.68$, confirming that participants demonstrated a physiological response to the stress task. The task also elicited a psychological stress response, as self-reported stress increased from pre- to post-task, $t(79) = -6.67$, $p < .001$, $d = 0.85$. Participant characteristics, including mean CVR, and perceived stressfulness, are presented in Table A1.

3.2 | Social identity, status, and CVR

A series of three-way ($2 \times 2 \times 2$) factorial ANOVAs were conducted to examine the effect of message source, message content, and institution/status on SBP, DBP, and HR reactivity, respectively.

For SBP reactivity, there was a statistically significant message source × message content × status interaction (F [1, 70] $= 5.61$, $p = .021$, $\eta_p^2 = 0.07$). Figure A1 shows that when participants from the IT were informed that the task would be stressful by a member of an outgroup (i.e., a University student), they displayed relatively higher SBP reactivity ($M = 17.53$, $SD = 4.72$). Interestingly, those from the University who were informed that the task would be stressful by an ingroup member (i.e., also a University student) similarly displayed high levels of reactivity ($M = 19.45$, $SD = 4.33$). Table A2 displays all means and standard deviations across each condition.

It is also worth noting that there was a significant institution × message source interaction effect (F [1, 70] $= 11.77$, $p < .001$, $\eta_p^2 = 0.14$) which demonstrated that students from both the IT ($M = 14.11$, $SD = 5.77$) and the University ($M = 16.80$, $SD = 5.93$) displayed higher levels of CVR when it came from a member of the University/higher-status group, than when it came from the IoT/lower-status group (IoT/ingroup: $M = 10.13$, $SD = 5.73$; University/outgroup: $M = 11.69$, $SD = 7.35$). Finally, in terms of SBP reactivity, a significant main effect of message content (F [1, 70] $= 5.94$, $p = .017$, $\eta_p^2 = 0.08$) was also evident, such that those who were informed that the task was stressful ($M = 14.75$, $SD = 6.27$) displayed higher levels of CVR than those were informed that it would be challenging ($M = 11.61$, $SD = 6.66$). For HR, there was a statistically significant message source × message content interaction (F [1, 70] $= 4.43$, $p = .039$, $\eta_p^2 = 0.06$), however, no other main or interaction effects were statistically significant across all parameters. Table A3 presents full statistical analyses.

4 | DISCUSSION

The results of this study highlight the significance of status, as well as the source (ingroup/outgroup) and content of a message, for stress appraisal and cardiovascular reactions to acute stress—extending the literature to date relating to the implications of social identity processes on stress responsivity. Specifically, the results demonstrate that when students from a lower-status institution (i.e., an IoT) were informed that the task would be stressful by an outgroup member (i.e., a University student), they displayed relatively higher levels of SBP reactivity. Interestingly, however, those in the higher status group who were informed that the task would be stressful by an ingroup member (i.e., also a University student) similarly displayed higher levels of SBP reactivity. Overall, these findings suggest that cardiovascular responses to stress are not just influenced by the source of task information (ingroup vs. outgroup member) or the content (stressful vs. challenging), but responses can also be explained by the status or social position of the group from which it comes from (as measured by University and IoT).

Based on the findings from past research (e.g., Gallagher et al., 2014; Haslam et al., 2004), it would be reasonable to expect that all individuals who were told by an ingroup member (i.e., from the same institution) that the task was stressful would have displayed higher CVR to the stressor, perhaps because of their shared perspective, and the credibility of their evaluation. While this is the case for those in the University group, the opposite is true for those attending the IoT: for those in the IoT, when the stressful message came from an outgroup member, they showed greater SBP reactivity. In fact, since both groups displayed heightened SBP reactivity when a stressful message came from (what in this case may be considered by comparison) the higher status group, the findings suggest that the social context, and indeed, the status of the group may play an important role in physiological stress appraisal. Further supporting this argument, the significant two-way interaction between message source and institution also showed that regardless of the message content (stressful or challenging) individuals from the IoT showed greater CVR when this came from an outgroup member, while individuals in the University showed greater CVR when it came from an ingroup member. In other words, both sets of participants displayed heightened stress responses when they were told the task would be stressful by a student from the University; with the hierarchical status of the University providing one potential explanation for the findings.

While it could be speculated that those in a higher status group are perceived to have the experience and knowledge on an academic-oriented task and may be more qualified to comment on this type of stressor, these results are in line with findings from Scheepers et al. (2009) who highlights the importance of social identity threat in similar contexts. Indeed, social identity threat develops when this positive group distinctiveness or positive social identity is undermined, and therefore evident when one's group has a relatively low status. In the context of this acute psychological stressor, social identity threat may arise, particularly for those in the IoT group, as any potential advantage they hold by comparison, or the positive distinction from the University group, is undermined. As such, this extends to the findings from Gallagher et al. (2014), to highlight the value that the status a group holds in comparison to the other relevant groups can shape how we appraise and respond to stress.

While it is clear the institution mattered, it is worth noting that in terms of the main effect of message content on SBP reactivity, we replicate past research in this area (e.g., Gallagher et al., 2014) showing that those who were told that the message was ‘stressful’ in comparison to ‘challenging’ displayed higher levels of CVR. Moreover, contradictory to past research (e.g., Haslam et al., 2004; Scheepers et al., 2009; Turner et al., 1987) we did not find main effects of institution or message source on stress responsivity. However, the lack of statistical significance does not necessarily impact the interpretation of the three-way crossover interaction effect. Indeed, it may be that such main effects may only be evident alongside other factors, as discussed above.

While this study shows the interplay between message source, content, and institution there are a few things worth noting when interpreting the observed results. First, it is important to highlight the academic nature of the task used in the current stress paradigm which could influence findings. The stress task used (the PASAT) is a mathematical, cognitive task that requires verbal responses. Students may view someone from a University (in comparison to an IoT) as more qualified and experienced to comment and provide information on a mathematical or academic task. To further explore if such effects are attributable to status, rather than confounded by the academic nature of the stress tasks, future research should examine if such effects are evident when using different types of stress-inducing tasks, including passive tasks, or more practical and less academic tasks.

Second, there may be other explanations for the institutional differences observed other than ‘status’. Although our interpretation that status plays a role is, to a degree, supported by the two-tier binary education system (Houghton, 2020) and HEA statistics showing that students from more affluent backgrounds predominantly attend Universities rather than IoT's- and by contrast, those from lower SES backgrounds are more likely to be attending IoT's - it is worth noting this study did not subjectively or objectively measure status explicitly. Instead, we are putting forward this rationale as a potential explanation of the findings based on previous empirical and theoretical evidence. Future research, however, is required to fully disentangle the implications of social and group-based status within social identity and biological processes. In fact, it may be that education is disproportionately stressful for students from lower-income background, and this should be considered in future research.

Third, in terms of the biological outcomes, the absolute CVR values (or actual change in blood pressure from baseline to task) displayed in the current sample are similar to existing research described as a heightened response (Carroll et al., 2012); however, the CVR literature has yet to reach a definite consensus on a threshold for what constitutes an exaggerated versus a 'healthy' response (in terms of changes in mmhg). For this reason, we have referred to the CVR response throughout this manuscript as a 'heightened response' and are conscious of the limitations this may have on the generalisability of the findings. Moreover, the generalisability is also limited by the sample size of the current study. Although significantly large sample sizes are uncommon in physiological research, the cell size within this study is admittedly small. Despite this, however, the findings from this preliminary pilot study provide a valuable foundation for further exploration of the role of status and social identity processes on physiological stress responsivity.

Indeed, this research builds on prior studies by Haslam et al., (2004) and Gallagher et al. (2014) to utilise objective and biological indicators of health within a social paradigm, using rigorous and controlled laboratory experiment. Moreover, it extends these findings by recruiting a sample from two different institutional organisations. Overall, this research 1) provides evidence for the fact that heightened reactions can be amplified in certain social contexts, 2) highlights the potential role of institutional status, as well as the source and content of a message, to be implicated in stress appraisal and cardiovascular reactions to acute stress, and 3) extends the literature examining the influence of social identity processes on biological indices of stress and health.

ACKNOWLEDGEMENTS

OM, SG, and GMcM are funded by the European Research Council (ERC) under an Advanced Grant (Grant agreement No. 884927) awarded to Prof Orla Muldoon. Open access funding provided by IReL.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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ENDNOTE

[1] Following the merging of multiple IoT's along with the expansion of research focus and funding, many are now referred to as Technical Universities. See Technical University Act, 2018, for more details.

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How to cite this article: McMahon, G., Walsh, T., Griffin, S. M., Houghton, F., & Muldoon, O. T. (2023). Institutional status and identity dimensions to cardiovascular stress responses. *Journal of Community & Applied Social Psychology*, 1–13. https://doi.org/10.1002/casp.2712

APPENDIX A

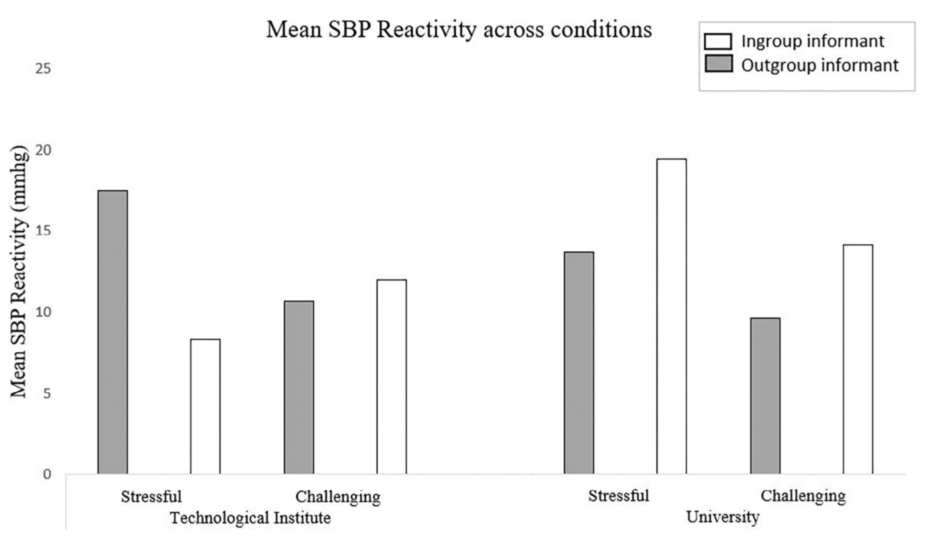

FIGURE A1 Mean SBP scores across conditions.

TABLE A1 Participant characteristics.

	N (%)	*M*	*SD*
Gender			
Male	42 (52.5)		
Female	38 (47.5)		
BMI		25.01	5.00
SBP baseline		118.63	8.55
SBP task		131.81	10.34
DBP baseline		66.24	7.51
DBP task		73.94	8.03
HR baseline		76.00	10.24
HR task		83.88	12.92
SBP reactivity		13.18	6.62
DBP reactivity		7.70	5.16
HR reactivity		7.87	7.02
Pre-task perceived stressfulness		3.45	1.05
Post-task perceived stressfulness		4.49	1.37

TABLE A2 CVR scores by condition.

	Technological institute				University			
	Outgroup		Ingroup		Outgroup		Ingroup	
	Stressful *M* (*SD*)	Challenging *M* (*SD*)	Stressful *M* (*SD*)	Challenging *M* (*SD*)	Stressful *M* (*SD*)	Challenging *M* (*SD*)	Stressful *M* (*SD*)	Challenging *M* (*SD*)
SBP	17.53 (4.72)	10.69 (4.71)	8.30 (4.08)	11.96 (6.73)	13.73 (5.67)	9.65 (8.53)	19.45 (4.33)	14.15 (6.31)
DBP	10.25 (2.40)	7.40 (3.52)	4.72 (4.07)	8.75 (5.20)	5.22 (5.85)	7.86 (7.70)	7.91 (5.27)	9.49 (4.67)
HR	9.15 (4.52)	4.95 (4.71)	5.97 (1.26)	5.81 (3.25)	13.78 (15.47)	6.26 (4.52)	8.10 (5.62)	8.96 (4.88)

TABLE A3 Statistical summary of all ANOVA analyses.

	SBP reactivity			DBP reactivity			HR reactivity		
	F	*p*	η_p^2	*F*	*p*	η_p^2	*F*	*p*	η_p^2
Intercept	4.45	.04	0.06	10.14	.00	0.13	1.13	.29	0.02
Covariates									
BMI	0.25	.62	0.00	0.47	.49	0.01	0.60	.44	0.01
Baseline	0.29	.59	0.00	5.89	.02	0.08	0.17	.68	0.00
Main effects									
Institution	1.64	.20	0.02	1.48	.23	0.02	2.25	.14	0.03
Message source	0.22	.64	0.00	0.01	.91	0.00	0.70	.41	0.01
Message content	5.94	.02	0.08	1.64	.21	0.02	3.30	.07	0.05
Two-way interaction effects									
Institution × message source	11.78	.001**	0.14	3.64	.06	0.05	0.01	.91	0.00
Institution ×message content	1.09	.30	0.02	0.13	.72	0.00	0.07	.79	0.00
Message source ×message content	3.40	.07	0.05	2.04	.16	0.03	4.43	.04*	0.06
Three-way interaction effects									
Institution × message source × message content	5.61	.02*	0.07	1.56	.22	0.02	0.35	.56	0.01

Note: Baseline refers to the mean of each cardiovascular parameter taken at rest, respectively.
*** *p* < .001,
***p* < .01,**p* < .01.