Abstract

Cardiovascular reactivity (CVR) to stress has been found to be an important indicator of future ill-health, and individual differences in personality have been posited to explain disparities in outcomes. Dominance is associated with forceful persons who desire hierarchy in social interactions. This study investigated dominance and CVR during social or asocial stressors. Sixty-one women, categorised as low, moderate or high in dominance using the Jackson Personality Research Form completed a Social or Asocial Stressor while undergoing cardiovascular measurement during Baseline, Stressor and Recovery phases.

A 3 × 2 × 3 ANCOVA revealed a significant Phase by Stressor by Dominance interaction for systolic blood pressure (SBP). Women with lower and moderate dominance – but not women with higher dominance – exhibited greater SBP responses to stress in the Social compared to Asocial condition. No significant difference was found for women with higher dominance, indicative of blunted SBP during the Social Stressor. During Recovery, women with lower dominance had marginally elevated SBP in the Social compared to Asocial condition.

The current study extends prior knowledge of the association between dominance and CVR, such that greater dominance was associated with blunted SBP and lower dominance was associated with attenuated recovery to social stress.

*Keywords*: trait dominance; cardiovascular functioning; social stress

Trait Dominance and Cardiovascular Functioning During Social Stress

A wide body of research originating with the cardiovascular reactivity (CVR) hypothesis (Obrist, 1981) suggests that exaggerated physiological responses to psychological stress are consistent with long-term negative cardiovascular health consequences (Chida & Steptoe, 2010). The current understanding is that several patterns of maladaptive physiological responding may be indicative of long term health risks including blunted responses to (Phillips, 2011) and delayed recovery from stress (Panaite, Salomon, Jin, & Rottenberg, 2015). These characteristic responses to stress can persist over the course of a lifetime and are associated with future cardiovascular pathogenesis (Treiber, Kamarck, Schneiderman, Sheffield, Kapuku, & Taylor, 2003). Individual differences in personality have been posited as a way of understanding and explaining some of the variations in physiological responses to stress.

Reliable associations between personality and cardiovascular functioning during stress have been demonstrated in the literature, with the strongest evidence available for traits with particular social resonance such as anger and neuroticism amongst others (e.g., Krantz & Manuck, 1984; Pedersen & Denollet, 2006; Phillips, Carroll, Burns, & Drayson, 2005; Suls & Bunde, 2005). Dominance, a personality trait associated with an innate desire to exert a dominant position in one’s social group (Pratto, Sidanius, Stallworth, & Malle, 1994) has long attracted attention in both human and animal studies. A robust association between dominance and cardiovascular disease risk in primates has been identified, such that adverse physiological outcomes were particularly pronounced amongst animals exposed to the most physical and psychological stressors (Sapolsky, 2005). In humans too, trait dominance has been found to be positively and significantly associated with adverse cardiovascular health outcomes, such as increased risk of post-myocardial infarction morbidity and mortality (Helgeson, 1990) and increased odds of combined fatal and non-fatal cardiovascular events (Siegman, Townsend, Civelek, & Blumenthal, 2000). Further, a significant prospective relationship was observed between psychometrically-assessed dominance and coronary heart disease in older men (Siegman, Kubzansky, Kawachi, Boyle, Vokonas, & Sparrow, 2000).

Relatively few experimental studies have examined the relationship between CVR to stress and trait dominance in humans. While broadly positive associations between dominance and CVR to stress have been identified (e.g., Gramer, 2003; Gramer & Huber, 1997; Hughes & Callinan, 2007), similar to some animal studies (e.g., Kaplan, Manuck, Clarkson, Lusso, & Taub, 1982), gender and stressor differences in CVR add to the complexities of understanding this relationship. A meta-analysis of CVR to acute stress manipulations concluded that socially-relevant stressors (such as speech tasks), were associated with larger overall blood pressure responses than asocial stressors (such as mental arithmetic or Stroop tasks; Brindle, Ginty, Phillips, & Carroll, 2014). This finding was supported by a review which revealed positive associations between trait dominance and acute cardiovascular responses to social stressors (Newton, 2009).

Much of the research looking at CVR and trait dominance has concentrated on men with less attention given to women in experimental studies. Of the work that has been conducted, there is not yet a clear understanding of the interaction between gender, dominance and task type on CVR. Observed trends in studies with male participants higher in dominance largely reflect a pattern of greater CVR to social compared to asocial stress (e.g., Gramer, 2003). Results observed in relation to dominance and reactivity to asocial stressors (such as mental arithmetic) have largely found no significant effects for women (e.g., Hughes & Callinan, 2007; Lee & Hughes, 2014), but some indication of a positive trend in systolic blood pressure (SBP) reactivity for men (Gramer, 2003; Gramer & Huber, 1997). However, as Newton (2009) suggests, instructions for some of these tasks which were considered to be asocial in nature were delivered verbally, and this may have skewed the orientation of the task to be more social in nature than might otherwise have been intended by the researchers.

Interestingly, Gramer and Berner (2005) found that while SBP reactivity to a mixed gender dyadic interaction task was greater for men than for women, more pronounced diastolic blood pressure (DBP) was observed during the same task for women, with greater DBP increases for low compared to high dominant women. This could point to differing mechanisms underlying blood pressure responses between men and women on the dominance continuum, with low dominant women exhibiting greater DBP reactivity, but lower SBP reactivity. Gramer and Schon (2015) suggested that responses of low dominant individuals could reflect enhanced vascular (alpha-adrenergically mediated) reactivity. However, not all studies involving dominance and CVR have supported this interpretation. Hughes and Callinan (2007) found that in response to a public speaking task, a positive association between dominance and SBP reactivity was found for women, with a corresponding inverse association reported for men, and no differences in DBP reactivity for either gender.

While the mechanisms of mounting an increased physiological response to stress have typically been concentrated on in research in this area, findings relating to dominance and cardiovascular recovery following stress have been somewhat inconsistent. Some studies have suggested that social stress might be associated with less complete DBP recovery for high dominant men (Gramer, 2003; Gramer & Schon, 2015), while other research has reported no significant associations between dominance and recovery from social or asocial stress for men or women (e.g., Gramer & Berner, 2005; Hughes & Callinan, 2007). One study which examined exposure to repeated stressors in women found that greater dominance was associated with a sustained vascular pattern of CVR and attenuated habituation to repeated social stress (Lee & Hughes, 2014).

Whether or not subjective differences in task appraisal and engagement may account for differences in dominance and cardiovascular functioning during stress is yet unclear. Several studies have assessed self-reported post-task state anxiety and stress, but despite some work showing increased CVR to stress by participants with higher levels of dominance (predominately in relation to men), previous work has not consistently found any significant differences between dominance and subjective reporting of the task experience, even when physiological differences were observed (e.g., Hughes & Callinan, 2007; Lee & Hughes, 2014). In her review, Newton (2009) notes that the pattern of post-task assessments of state anxiety and stress suggest differences following exposure to either asocial or social stressors. For asocial stressors, results have shown either no significant associations with post-task rating of emotions (Gramer, 2003; Gramer & Huber, 1997), or an inverse association (Hughes & Callinan, 2007), but only for men. In contrast, it was found that when women were exposed to socially-oriented stressors, *low* trait dominance was associated with more emotional reactivity to acute stressors than high trait dominance (Newton, 2009).

Taken together, the results pertaining to dominance and CVR to stress appear to indicate that CVR during social stress may be typified by more cardio-active responses for dominant men (driven by increased CVR, specifically SBP), with less coherency on the nature of this relationship for women, given that both exaggerated patterns of SBP (e.g., Hughes & Callinan, 2007) and more pronounced DBP relative to SBP patterns (e.g., Gramar & Berner, 2005) have been observed for women higher in dominance. However, as fewer studies have concentrated on women, an understanding of the role of both dominance and the nature of the stressor experienced needs to be further developed to elucidate potential differences in cardiovascular functioning during and after stress for women.

The current study wished to examine the relationship between trait dominance and cardiovascular functioning during and after social or asocial forms of stress. The researchers hypothesise that greater dominance will be associated with more maladaptive cardiovascular functioning generally, but particularly in relation to social stress. Further, subjective task ratings will be examined to determine if subjective experiences of experimental stress vary as a function of level of trait dominance.

**Method**

**Sample**

Ethical approval for the research study was granted by an institutional review board at the second author’s University, and all participants provided informed, written consent prior to participation. Data were collected for 67 undergraduate women, with sample characteristics provided in the results section below.

**Measures**

**Cardiovascular measurement.** Cardiovascular parameters of SBP, DBP, and heart rate (HR) were assessed using a Dinamap Pro 100 Vital Signs Monitor (GE Medical Systems, Tampa, Florida). This sphygmomanometer uses the oscillometric method to return blood pressure readings from a cuff attached to the participant's upper non-dominant arm. The Dinamap apparatus has been found to provide accurate readings of cardiovascular functioning in healthy adults (Ni et al., 2006), and has been used widely in previously published scientific studies (e.g., Hughes & Callinan, 2007; O'Donovan & Hughes, 2008).

**Trait dominance.** Trait dominance was measured using the Jackson Personality Research Form (JPRF) social dominance subscale (Jackson, 1999). Sixteen items assessed trait dominance, with scores ranging from 0-16. Sample items include *I feel confident when directing the activities of others,* and *I would make a poor military leader* (reverse scored). High scorers on the trait dominance subscale of the JPRF attempt to control their environments and influence or direct other people; they are forceful, decisive, authoritative, and domineering (Jackson, 1999). Reliability in the current study was good for dominance (α = .81).

**Subjective task ratings.** Participants were asked *how stressful/ interesting/ difficult did you find the task* following their completion of the stressor. Answers were obtained using a five-point Likert response scale with possible scores ranging from 0 (not at all; stressful, interesting or difficult) to 4 (extremely; stressful, interesting or difficult).

**Social stressor**. In the social stressor condition, participants were presented with a set of cards, each of which had a different word printed on it. Participants were instructed to speak for as long as they could about the word on the top card, saying whatever came to mind. If they could not think of anything more to say, they could move on to the next card, repeating the procedure. The words printed on the cards were chosen from the MRC Psycholinguistic database ([www.psy.uwa.edu.au/mrcdatabase/mrc2.html](http://www.psy.uwa.edu.au/mrcdatabase/mrc2.html)), with the number of letters per word ranging from five to nine and the number of syllables from two to four. As in a previous study, the words chosen were intended to serve as prompts for wide-ranging commentary, and so consisted of relatively high-frequency generic nouns (Hughes & Callinan, 2007). Participants were instructed to speak clearly into the microphone provided, and their attention was drawn to a television screen where they remained visible to themselves. They were informed that their speeches were being video-recorded and would later be evaluated by the research team for overall content, clarity and delivery style.

**Asocial stressor**. The asocial stressor chosen was a mental arithmetic task, performed via a computer program. Task instructions appeared onscreen for participants to follow to minimise social interaction with the researcher in relation to this task. Subtraction problems appeared on-screen and participants were required to input the correct solution within 10 seconds. The task was performance-adjusted, such that difficulty was contingent on accuracy. Accurate responses led to more difficult problems (i.e., problems involving larger numbers), whereas incorrect answers led to less difficult problems.

**Procedure**

The research took place in an on-campus laboratory. On arrival, participants were invited to be seated and relax for 10 minutes while completing some psychometric measures. The Dinamap apparatus was attached to their non-dominant upper arm after these 10 minutes had elapsed, and participants subsequently were invited to relax for a further 10 minutes while reading a nature magazine. Measurement of cardiovascular parameters commenced during this reading period, with assessments of blood pressure and HR taken at 1, 4, 6 and 8 minutes into the 10 minute period.

Participants were randomly assigned to one of two experimental stressor conditions, whereby they completed a six-minute stressor that was either social or asocial in nature, followed by a six-minute recovery period. During the six-minute stressor and six-minute recovery period, blood pressure and HR were assessed at 30 seconds, 2 minutes 30 seconds, and 4 minutes 30 seconds intervals. During the post-task resting phase, participants were asked firstly to complete post-task assessments of stressfulness, interest and difficulty related to the task they completed and then to revert to reading the nature magazine they had previously been provided with during baseline measurement.

**Results**

**Sample characteristics**

To control for demographic characteristics known to effect blood pressure, the data were limited to younger women aged less than 35 years of age without a personal history of hypertension, with normal levels of blood pressure (< 140/90 mmHg), and with a body mass index (BMI) of less than 30. Reactivity to laboratory stressors has been shown to vary as a function of age (see Uchino, Birmingham, & Berg, 2010), and BMI has also been previously shown to be positively associated with resting SBP and DBP (Carroll, Phillips & Der, 2008) and impaired post-stress blood pressure recovery (Steptoe & Wardle, 2005).

The final sample (*N* = 61) was comprised of undergraduate women who had a mean age of 20.984 years (*SD* = 3.935), with an average BMI of 21.819 (*SD* = 2.449). The sample included eight smokers, who reported smoking between one and 13.50 cigarettes daily (*M* = 1.008, *SD* = 3.048). No significant associations between number of cigarettes smoked per day and dominance (*r =* .027, *p* = .95), or baseline levels of SBP (*r* = -.181, *p* = .668), DBP (*r* = -.383, *p* = .348) or HR (*r* = -.460, *p* = .252) were identified. An equivalence check showed no significant differences in age, *t*(52.239) = -0.817, *p* = .420, *d* = 0.209, or BMI, *t*(59) = 0.070, *p* = .944, *d* = 0.018, between women randomly assigned to social or asocial stress conditions.

**Dominance**

Mean dominance (*M* = 7.066, *SD* = 3.737) was similar to that observed in other studies with similar samples. For example, Hughes and Callinan (2007) reported similar mean scores (*M* = 7.83, *SD* = 3.29) for women using the same psychometric instrument. In the current study, mean levels of dominance were comparable for women assigned to the social stressor (*M* = 7.600, *SD* = 3.811) and the asocial stressor conditions (*M* = 6.548, *SD* = 3.650). In order to use the dominance information as a between groups factor in statistical analyses, tertiles were derived from the continuous dominance scores to categorise each participant as either low (*M* = 2.733, *SD* = 1.223, *n* =15, range = 0 – 4.999), moderate (*M* = 6.192, *SD* = 1.266, *n* = 26, range = 5.000 – 8.329) or high in trait dominance (*M* = 11.450, *SD* = 2.188, *n* = 20, range = 8.330 – 16.000).

**Data reduction and preparation**

Epochs of cardiovascular measurement were averaged to produce mean SBP, DBP or HR responses for each experimental phase (Baseline, Stressor, and Recovery). Internal consistency for cardiovascular parameters was found to be excellent for SBP (Cronbach’s α = .96), DBP (Cronbach’s α = .97) and HR (Cronbach’s α = .98). Repeated measures analysis of variance (ANOVA) with each of the three experimental phases as a datum point revealed significant quadratic trends for each of SBP, DBP, and HR collapsed across both conditions and for participants in the Asocial and Social stressor conditions separately (all *p*s <.001), indicating successful experimental manipulation. Baseline values were significantly lower than Stressor values (all *p*s <.001), Recovery values were significantly lower than Stressor condition values (all *p*s <.001), and post-stress Recovery values not significantly different from Baseline values (all *p*s >.14).

To assess independence of groups, a Chi square analysis showed that the grouping of participants by the three group dominance tertile variable and stressor condition was not statistically different to what might be expected by chance, χ2(2, 61) = .784, *p* = .676.

An examination of the correlations between the main experimental variables, demographic information and cardiovascular functioning at baseline revealed a significant inverse association between participant BMI and Dominance, *r* = -.255, *p* = .048 (see Table 1). As a result of this significant association, BMI was included in subsequent analyses as a continuous covariate.

To examine cardiovascular functioning over successive experimental phases the data were analysed using 3 (Phase; baseline, stressor or recovery) × 2 (Stressor condition; social or asocial) × 3 (Dominance; low, moderate or high) mixed factorial analyses of covariance (ANCOVAs), with BMI included as a covariate for SBP, DBP, and HR parameters separately. Violations of Sphericity were corrected using Huynh-Feldt corrections as per Girden’s (1992) recommendation for instances when epsilon is greater than .75. Follow up t-tests were conducted were appropriate with corrections where necessary for violations of the assumption of homogeneity of variance. Baseline descriptive statistics can be found in Table 2.

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**SBP**

A 3 (Phase) × 2 (Stressor condition) × 3 (Dominance) ANCOVA with BMI revealed a significant Phase × Stressor interaction effect, *F*(1.857, 96.576) = 6.720, *p* = .002, partial η2 = .114, such that SBP during the Stressor phase was significantly greater for women in the Social Stressor condition (*M* = 122.423, *SD* = 16.421) compared to the Asocial Stressor condition (*M* = 112.850, *SD* = 14.911), *t*(48.865) = 2.539, *p* = .014, *d* = 0.667. No significant differences between Stressor conditions at Baseline or Recovery phases were found.

A significant Phase × Stressor × Dominance interaction was also observed, F(3.714, 96.576) = 2.531, p = .049, partial η2 = .089. Follow-up tests to examine this interaction revealed significantly different patterns of SBP functioning across experimental phases between Stressor conditions, dependent on the level of dominance (see Figure 1). Women with moderate levels of dominance in the Social Stressor condition had significantly greater SBP relative to similarly moderate levels of dominance women in the Asocial Stressor condition during the Stressor phase, *t*(23) = 2.173, *p* = .04, *d* = 0.825. While SBP for participants lower in dominance reflected this trend of greater SBP in the Social Stressor condition compared to Asocial Stressor condition in the Stressor phase, the observed difference only approached statistical significance, *t*(23) = 2.031, *p* = .063, *d* = 1.035. Interestingly, for participants higher in dominance, levels of SBP during the Stressor phase of the Social Stressor condition were not significantly greater when compared to the Asocial Stressor condition, *t*(17) = 0.333, *p* = .743, *d* = 0.167, illustrating no differences in SBP between conditions at the Stressor phase.

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The effects of the interaction appeared to be primarily concentrated on the Stressor phase, as no significant differences in SBP between Social and Asocial Stressor conditions were observed overall at Baseline (*p*s > .384) or during the Recovery phase for participants with moderate and high levels of dominance (*p*s > .407). However, for women lower in dominance, a trend towards elevated SBP during Recovery following the Social Stressor condition (*M* = 114.889, *SD* = 7.271) was observed, compared to SBP following the Asocial Stressor condition (*M* = 107.315, *SD* = 6.627), but this difference only approached statistical significance, *t*(13) = 2.088, *p* = .057, *d* = 1.089.

No significant within-Stressor differences were observed for women with varying levels of dominance during the Stressor phase for either the Social Stressor condition, *F*(2, 28) = 1.325, *p* = .284, partial η2 = .096, or the Asocial Stressor condition, *F*(1, 28) = .154, *p* =.858, partial η2 = .011. Further, no significant differences were observed within the Social or Asocial Stressor conditions for low, moderate or high levels of dominance in at either Baseline or Recovery phases (*p*s > .239).

The results of the ANCOVA did not reveal any significant main effects for Phase, F(1.857, 96.576) = 0.442, p = .629, partial η2 = .008; the BMI covariate *F*(1, 52) = 0.922, *p* = .341, partial η2 = .017; Dominance, *F*(2, 52) = 0.317, *p* = .730, partial η2 = .012; or Stressor condition, *F*(1, 52) = 2.965, *p* = .091, partial η2 = .054. Additionally, no significant Phase × BMI, *F*(1.857, 96.576) = .855, partial η2 = .003, or Stressor condition × Dominance, *F*(2, 52) = 0.266, *p* = .768, partial η2 = .010, interactions were observed.

**DBP**

A Phase × Stressor condition interaction was found to be significant, *F*(3.831, 99.597) = 7.647, *p* = .001, partial η2 = .128, whereby DBP was greater during the Stressor phase for women in the Social (*M* = 74.030, *SD* = 9.275) compared to Asocial (*M* = 68.710, *SD* = 8.468) Stressor condition, *t*(57) = 2.303, *p* = .025, *d* = 0.574. Across conditions, and similar to findings for SBP, no significant differences in DBP were observed for Baseline or Recovery phases.

A three way Phase × Stressor condition × Dominance interaction approached but did not quite reach statistical significance, *F*(3.831, 99.597) = 2.222, *p* = .075, partial η2 = .079, but trends observed reflected those reported above for the three way interaction for SBP.

No further significant interaction effects for Phase × BMI, *F*(1.915, 99.597) = 0.177, *p* = .829, partial η2 = .003; Phase × Dominance, *F*(3.831, 99.597) = 1.554, *p* = .195, partial η2 = .056; Dominance × Stressor condition, *F*(2, 52) = 0.236, *p* = .791, partial η2 = .009 were found. No significant main effects for Phase, *F*(1.915, 99.597) = 0.265, *p* = .758, partial η2 = .005; Dominance, *F*(2, 52) = 0.495, *p* = .613, partial η2 =.019; BMI, *F*(1, 52) = 0.162, *p* = .689, partial η2 = .003; or Stressor condition, *F*(1, 52) = 1.968, *p* = .167, partial η2 = .036, were observed either.

**HR**

A significant main effect for Phase was found, *F*(1.856, 96.499) = 4.691, *p* = .013, partial η2 = .083, such that regardless of Stressor condition or Dominance, HR was significantly greater at Stressor (*M* = 60.000, *SD* = 12.236) than at Baseline, *t*(58) = -13.043, *p* < .001 (see Table 2), or Recovery (*M* = 74.771, SD = 10.333), *t*(58) = 12.149, *p* < .001, with no significant difference between Baseline or Recovery phases, *t*(60) = -0.757, *p* = .452.

Similar to significant trends observed for both SBP and DBP, a Phase × Stressor condition interaction was found which approached significance, *F*(1.856, 96.499) = 3.131, *p* = .052, partial η2 = .057, with slightly greater HR observed during the Stressor Phase for women in the Social (M = 89.006, SD = 10.473) compared to the Asocial Stressor (M = 83.403, SD = 13.242) condition. However, in contrast to the significant effect observed for SBP and the trend towards significance for DBP, no significant Phase × Stressor condition × Dominance interaction was found *F*(3.712, 96.499) = 1.306, *p* = .275, partial η2 = .048.

No further significant main or interaction effects were observed for Phase × BMI, *F*(1.856, 96.499) = 0.881, *p* = .441, partial η2 = .017; Phase × Dominance, *F*(3.712, 96.499) = 1.034, *p* = .391, partial η2 = .038; Dominance × Stressor condition, *F*(2, 52) = 0.523, *p* = .596, partial η2 = .020; Dominance, *F*(2,52) = 2.327, *p* = .108, partial η2 = .082; BMI, *F*(1,52) = 0.512, *p* = .478, partial η2 = .010; or Stressor condition, *F*(1, 52) = 1.636, *p* = .207, partial η2 = .031.

**Subjective task ratings of stress, difficulty and interest**

The results of a series of separate 2 (Stressor condition) × 3 (Dominance) ANCOVAs, with BMI, for subjective ratings of stressor interest, stressfulness or difficulty revealed no significant main or interaction effects (*p*s > .192). Regardless of level of dominance or stressor condition, women did not rate their subjective experience of the Stressors differently.

**Discussion**

Cardiovascular trends showed that women with moderate or lower levels of dominance had significantly (or approaching significantly) greater SBP in the social stressor compared to the asocial stressor condition. Surprisingly, in this study women with greater levels of dominance, exposed to the social stressor condition, had blunted SBP compared to similarly dominant women exposed to the asocial stressor condition. Further, women with the lowest levels of dominance showed a trend toward higher levels of SBP in the recovery phase of the social stressor condition, but not the asocial stressor condition. No significant differences in subjective ratings of task experience for either condition or dominance level were found.

While some results from previous studies have reported exaggerated responses to social stress for women with greater dominance (e.g., Gramer, 2003; Gramer & Berner, 2005; Hughes & Callinan, 2007), the present study did not find such a trend, and rather it was women with lower and moderate levels of dominance who had greater reactivity to the Social Stressor condition. In the current study, women higher in dominance manifested similar cardiovascular responses to social or asocial stress. Given that socially-relevant stress typically results in more potent cardiovascular responses (Brindle et al., 2014), this was somewhat surprising but the results complement work by Lee and Hughes (2014) who reported that greater dominance was associated with a tendency for diminished cardiovascular functioning following repeated presentations of a social stressor.

While an emphasis might be given to the apparent supernormal elevation in cardiovascular responses among women with moderate and lower levels of dominance, an alternative explanation is that the findings for women higher in trait dominance reflect a pattern of blunted CVR to stress. This could reflect a failure to physiologically discriminate between two qualitatively different forms of stress that have in the past been shown to elicit marked differences in the intensity of the cardiovascular response (c.f., Brindle et al., 2014). A number of studies have found blunted cardiovascular responses to be associated with maladaptive mood and mental health statuses (e.g., Neumann et al., 2011; Phillips, Hunt, Der, & Carroll, 2011). In recent years, some work suggests that blunted patterns of stress responsivity may reflect similarly negative health consequences as those associated with exaggerated stress responding (e.g., Hughes, Lü and Howard, 2018; Lovallo, 2011; Phillips, Ginty, and Hughes, 2013).

Interestingly, this study did observe a trend towards significance for women lower in dominance to have elevated levels of SBP during the recovery phase of the Social Stressor condition, when compared with equivalently low dominant women exposed to the Asocial Stressor condition. Poorer recovery from laboratory stress has been found to be associated with risk of adverse cardiovascular outcomes (Panaite et al., 2015), so the response of low dominant women during recovery phases following the cessation of stress warrants closer attention in future work. Given that in the Stressor phase levels of both SBP and DBP were generally greater for women in the Social compared to Asocial Stressor conditions, it is interesting to note that no significant (or approaching significant) differences in recovery were observed for women with higher or moderate levels of dominance. This could be suggestive of a trend for lower dominant women to recover less completely from social stress. While some results from previous work have reported greater dominance to be associated with both increased DBP reactivity and impaired DBP recovery in women (e.g., Gramer & Berner, 2005), in this study the results pertaining to potential impairments in recovery were confined to SBP. Although past work has also shown that greater dominance is associated with diminished habituation to social stress (Lee & Hughes, 2014), to our knowledge no other studies have reported greater levels of SBP at recovery following social stress for women lower in dominance.

For women lower in dominance, the findings suggest that social stress may have been particularly taxing given observed trends towards significance for exaggerated reactivity and delayed recovery following social stress when compared with similarly dominant women exposed to asocial stress. In contrast, high dominant women did not have increased cardiovascular functioning during the stressor phase of the social stressor condition compared to similarly dominant women in the asocial stressor condition, indicative of blunted reactivity to (what the literature suggests) should be a more challenging type of task (Brindle et al., 2014). Carroll, Lovallo, and Phillips (2009) characterised the relationship between physiological reactivity to stress and health as an inverted-U model. In this model, a continuous relationship between reactivity and health outcomes is conceived of, whereby both exaggerated *and* diminished responses to stress are maladaptive (depending on the health outcome in question). This could also apply to individual differences in personality, which may be said to essentially reflect a body’s characteristic response to a situation. In this light, women with moderate levels of dominance demonstrated the most adaptive profile of stress responding, such that they mounted a successful physiological response to the social stressor and returned to baseline levels of physiological functioning following the cessation of the stressor.

Interestingly, no differences in the subjective experience of either stressor condition were reported by women with lower, moderate or higher levels of dominance, suggesting that the physiological differences observed were not attributable to perceptions of stressor interest, stressfulness, or difficulty. This finding reflects findings by Lee and Hughes (2014) which showed no significant interaction between subjective task ratings and dominance, but is in contrast to previous work which found increased CVR for high dominant participants and this increase was interpreted as indicative of greater effortful coping attempts (see Gramer & Berner, 2005). Previous work has reported that individuals with characteristically blunted stress responses do not report significantly different subjective stress or task difficulty from those with exaggerated stress responses (Brindle, Whittaker, Bibbey, Carroll, & Ginty, 2017). This lends some support to an explanation of the results as not being due to diminished task effort or reduced engagement by those higher in dominance and attributes the source of difference between groups to their differential, characteristic cardiovascular responses.

Anderson, Hildreth, and Howland (2015) reported that while individuals who are considered to be of higher status (i.e., higher in dominance) may engage in effortful coping to maintain their position and exert influence in a situation, this effort may require less exertion to achieve success. It could be that women with greater dominance simply had to expend less cardiovascular effort to cope with the social stressor. A recent review (Cundiff & Smith, 2017) argued that individuals with an awareness of lower status (but not higher status) may be more reactive to particular forms of stress, such as those associated with threat of losing status and social‐evaluative threat, and this has been found to be associated with the evocation of momentary increases in psychophysiological stress responses. Thus, social situations may not exert as high a physiological toll for individuals with greater dominance as it might for individuals lower in dominance. While in this study participants were not given feedback on their level of dominance, as it is a trait variable it is likely that it is something which each participant was aware of in relation to their everyday life experiences and social interactions, and this may have had an effect on their reactivity (or lack thereof) to the social stressor particularly.

Mean levels of trait dominance as measured by the JPRF (Jackson, 1999) were found to be similar to levels observed by Hughes and Callinan (2007) and slightly higher than dominance levels observed by Lee and Hughes (2014). The relative parity of mean dominance scores suggested that the differences between the direction of the results observed in the current study, and that observed previously (e.g., Hughes & Callinan, 2007), could in part be attributed to differences in procedural characteristics rather than features of the sample. While the current study was limited by small sample size in the eventual dominance tertile comparison groups, it does compare to other previously published work in the area (e.g., O’Súilleabháin, Howard, & Hughes, 2018).

Future directions for research may wish to consider the underlying haemodynamic profile which can elucidate physiological differences that may not be apparent when considering SBP, DBP, or HR. Future studies should also ensure that tasks are sufficiently interesting for all participants to ensure engagement with the experimental process by perhaps using behaviourally stimulating tasks to correspond with an individual’s level of dominance, such as social and asocial tasks with an active evaluation component (see Gramer, Haar & Mitteregger, 2018). Additionally, while the present study employed a between-subjects design work in this area would benefit from the use of a counter balanced repeated measures design with a longitudinal follow-up to examine if these effects persist over time and across stressor for individuals.

The results point to the value of pursuing an investigation of the consequences of exposure to socially-oriented stress in particular, in line with much of the previous research in the area (see Newton, 2009). The current study extends prior knowledge that dominance is related to cardiovascular responding to social forms of stress, such that blunted cardiovascular responses to the protocol by women with greater dominance and attenuated recovery for women lower in dominance were observed. The findings further highlight that that the relationship between trait dominance and stress is not linear, but multi-factorial and merits further investigation.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 1  *Table of correlations with age, BMI, Dominance, subjective task ratings and baseline SBP, DBP and HR for women in the social (below the diagonal; n = 30) and the asocial (above diagonal; n = 31) stressor conditions.* | | | | | | | | | | | | | | | | | |
|  | | Age | BMI | | Dominance | | Stressfulness | | Interest | | Difficulty | SBP | | | DBP | | HR |
| Age | | - | -0.06 | | 0.16 | | -0.18 | | 0.09 | | -0.08 | -0.11 | | | 0.08 | | -0.05 |
| BMI | | 0.06 | - | | -0.07 | | -0.15 | | 0.13 | | -0.31 | -0.06 | | | -0.07 | | 0.03 |
| Dominance | | 0.06 | -0.43\* | | - | | 0.17 | | -0.32 | | 0.20 | -0.15 | | | -0.05 | | 0.34 |
| Task Stressfulness | | 0.01 | 0.15 | | -0.22 | | - | | -0.09 | | .55\*\* | -0.16 | | | -0.12 | | 0.18 |
| Task Interest | | 0.10 | 0.16 | | -0.21 | | -0.21 | | - | | -0.21 | -0.18 | | | -0.17 | | -0.10 |
| Task difficulty | | -0.18 | 0.16 | | -0.17 | | .75\*\* | | -0.04 | | - | -0.27 | | | -0.19 | | -0.22 |
| Baseline SBP | | 0.26 | 0.31 | | -0.04 | | 0.21 | | 0.28 | | 0.27 | - | | | .78\*\* | | 0.12 |
| Baseline DBP | | 0.19 | 0.12 | | 0.12 | | 0.14 | | 0.11 | | 0.15 | .71\*\* | | | - | | 0.18 |
| Baseline HR | | 0.10 | 0.25 | | -0.08 | | .38\* | | -0.13 | | 0.16 | .49\*\* | | | .66\*\* | | - |
| *Note*. \*\* p <.01; \* p < .05  BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate. | | | | | | | | | | | | | | | | | |
| Table 2  *Mean (standard deviation) baseline cardiovascular and demographic results stratified by stressor and level of dominance, with no statistically significant stressor condition by dominance differences evident at baseline.* | | | | | | | | | | | | | | | | | | |
|  | Low Dominance | | | | |  | | Moderate Dominance | | | | |  | High Dominance | | | | |
|  | Social (n = 6) | | | Asocial (n = 9) | |  | | Social (n = 13) | | Asocial (n = 13) | | |  | Social (n = 11) | | Asocial (n = 9) | | |
| SBPa | 108.83 (5.03) | | | 110.19 (7.90) | |  | | 106.33 (10.75) | | 105.44 (11.97) | | |  | 109.20 (10.31) | | 105.64 (6.63) | | |
|  |  | | |  | |  | |  | |  | | |  |  | |  | | |
| DBPa | 64.96 (2.72) | | | 65.11 (5.68) | |  | | 62.04 (5.40) | | 63.98 (10.66) | | |  | 66.79 (9.02) | | 62.69 (7.07) | | |
|  |  | | |  | |  | |  | |  | | |  |  | |  | | |
| HRb | 79.75 (6.96) | | | 74.65 (6.94) | |  | | 71.71 (7.91) | | 69.75 (7.72) | | |  | 76.83 (11.77) | | 77.86 (13.76) | | |
|  |  | | |  | |  | |  | |  | | |  |  | |  | | |
| BMI | 23.27 (2.34) | | | 22.71 (2.04) | |  | | 22.00 (2.76) | | 21.13 (1.89) | | |  | 20.87 (2.37) | | 21.84 (3.01) | | |
|  |  | | |  | |  | |  | |  | | |  |  | |  | | |
| Age | 19.00 (2.19) | | | 19.00 (2.45) | |  | | 21.31 (3.45) | | 23.15 (5.43) | | |  | 20.55 (2.91) | | 21.22 (4.35) | | |
|  |  | | |  | |  | |  | |  | | |  |  | |  | | |
| Dominance | 2.83 (0.98) | | | 2.67 (1.41) | |  | | 6.38 (1.33) | | 6.00 (1.22) | | |  | 11.64 (2.46) | | 11.22 (1.92) | | |
| Note. SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate. ammHg; bbpm. | | | | | | | | | | | | | | | | | | |