



Type D personality and hemodynamic reactivity to laboratory stress in women

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ABSTRACT

The Type D personality (identified by high levels of both negative affectivity and social inhibition) has been associated with negative health consequences in cardiac patients. However, few studies have explored whether the Type D personality is associated with particular patterns of cardiovascular responses to stress. In the present study, cardiovascular reactivity to psychological stress (CVR) was examined as a possible mediating mechanism by which Type D personality may affect cardiovascular health, with specific focus on hemodynamic profile. Eighty-nine female university students completed a mental arithmetic stressor while undergoing hemodynamic monitoring. Blood pressure, heart rate, cardiac output, and total peripheral resistance in response to the stressor were examined. Type D personality was assessed using the 16-item Type D scale. Results indicated that there were no between-group differences in magnitude of blood pressure increase, with both Type D and non-Type D individuals demonstrating myocardial response profiles. However, Type D individuals were less “myocardial” than non-Type D individuals. This indicates that a weak myocardial response to an active stressor in Type D individuals may be indicative of hemodynamic maladaptation to stress, implicating CVR as a possible mechanism involved in Type D-cardiovascular health associations.

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1. Introduction

Characterized by high scores for both negative affectivity (NA; the propensity to experience negative emotions) and social inhibition (SI; the tendency to inhibit emotions in social situations), the so-called “distressed” or Type D personality has been shown to be statistically associated with health outcomes in coronary patients. Studies have linked Type D personality with cardiac and all-cause mortality (e.g., Denollet et al., 1996, 2000) and increased cardiac morbidity (Denollet and Brutsaert, 1998). Furthermore, the Type D personality has been shown to be a predictor of patient adjustment to disease interventions (e.g., Pedersen et al., 2007a,b). While Type D cannot be said to encompass all psychological risk factors involved in coronary heart disease (CHD; Denollet and Van Heck, 2001), its association with negative clinical outcomes appears to be on par with established biomedical risk factors such as smoking, older age, and poor exercise tolerance (e.g., Denollet et al., 1996, 2000; Denollet and Brutsaert, 1998).

The precise mechanism by which Type D may influence health-related outcomes is unclear. Although indirect mechanisms have been proposed (e.g., Thomas et al., 2006; Brostrom et al., 2007; Schiffer et al., 2007; Williams et al., 2008; Hausteiner et al., 2010), it is possible that psychophysiological pathways involving Type D's affect dimensions

might be implicated in Type D-health relationships. The separate components of the Type D personality have shown associations with biological indices of health; NA has been linked to higher levels of cortisol during the day (Van Eck et al., 1996; Miller et al., 1999) and cortisol reactivity to laboratory tasks (Phillips et al., 2005; Sher, 2005), while behavioral inhibition has been associated with a larger cortisol awakening response and larger response to stress in young children (Kagan et al., 1987) and with mechanisms of behavioral inhibition in a small sample of healthy female adults (Tops and Boksem, 2011). In terms of an NA–SI synergy (i.e., Type D), Whitehead et al. (2007) found that the interaction term of NA and SI (computed by multiplying NA scores with SI scores, thereby representing Type D as a continuous measure) was positively related to the magnitude of cortisol awakening response in a sample of 72 patients with acute coronary syndrome, adjusting for age, gender, and body mass index (BMI). In addition, there have been independent reports of a link between Type D personality and elevated levels of cytokines implicated in CHD progression (e.g., Denollet et al., 2003; Conraads et al., 2006). Together, these studies point to the existence of a direct psychosomatic pathway implicated in Type D-health associations.

Given the nature of the links between cardiac disease outcomes and the Type D personality, the cardiovascular system appears to be a likely source of a direct psychosomatic pathway. Exaggerated cardiovascular reactivity to psychological stress (CVR) as measured in healthy adults is believed to lead to an increased risk of eventual cardiac disease (Kamarck and Lovallo, 2003) through a number of physiological mechanisms (Lovallo, 2005). However, as yet, very few

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studies have explored whether Type D personality is associated with particular patterns of cardiovascular responses to stress. In one laboratory study involving 173 college students, Habra et al. (2003) found both SI and NA subscores to be separately associated with differences in CVR among males, but found no effect for females or for the unified Type D personality itself (i.e., SI and NA scores in combination). However, a socially salient laboratory stressor was used and this may explain the observed tendency for high SI participants to show increased CVR; it may be the case that the pattern of responses exhibited by Type D individuals differs depending on the social context of the task and it would be interesting to know whether Type D individuals demonstrate altered physiological response profiles to an *asocial* laboratory stressor.

In a subsequent study, Williams et al. (2009) exposed 90 college students to a cognitive stressor in the laboratory (again, with a social dimension; participants returned solutions verbally to the experimenter) and found that Type D personality was associated with exaggerated cardiac output (CO) reactivity. Like Habra et al. (2003), however, effects were confined to male participants, with no associations between Type D and systolic blood pressure (SBP), diastolic blood pressure (DBP), or heart rate (HR) reactivity in either male or female participants.

A noteworthy aspect of the previously published findings is that Type D effects have been observed only in relation to particular underlying hemodynamic determinants of blood pressure. It is known that changes in blood pressure reflect underlying dynamics including changes in CO, total peripheral resistance (TPR), or both (Turner, 1994). There is a reciprocal relationship between CO and TPR such that an increase in one parameter tends to be accompanied by a proportional decrease in the other (e.g., Guyton, 1987). As such, little or no change in blood pressure level can sometimes disguise more vigorous changes in underlying physiological determinants. The dynamic relationship between CO and TPR, or hemodynamic profile, may be further characterized as myocardial (changes in CO exceed proportional changes in TPR) or vascular (changes in TPR exceed proportional changes in CO). There is evidence that certain characteristics of hemodynamic profile indicate potentially harmful disruption of the inherent homeostasis between CO and TPR (Obrist, 1981; Eliot et al., 1982; Kasprovicz et al., 1990). Thus, examination of the physiological determinants of blood pressure, and in particular, hemodynamic profile (i.e., relative change in CO and TPR), may help to clarify whether Type D personality influences physiological reactivity to stress, which in turn could have long-term consequences for physical health.

Examination of hemodynamic profile can be quantified using trigonometric rotation, as proposed by Gregg et al. (2002). Composite scores are computed, allowing representation of hemodynamic profile (HP) and compensation deficit (CD) as continuous variables. This offers possible improvements on earlier methods for characterizing hemodynamic profile, which relied on categorization into CO-dominant, TPR-dominant, and mixed-response groups (e.g., Eliot et al., 1982; Girdler et al., 1990; Sherwood et al., 1990). Such categorization not only involves the use of arbitrary criteria for determining group membership, but also involves loss of information due to the reduction of continuous variables to a few categories. By computing both HP and CD, the individual can be described in terms of their response profile (HP) and the extent of reactivity (CD).

The present study sought to examine the association between Type D personality and laboratory measures of CVR, focusing on blood pressure, HR, and hemodynamic profile. In a sample of female college students, a standardized *asocial* laboratory stressor was employed to assess CVR. Although women tend to demonstrate lower resting blood pressure and higher SBP response to stress than men (Turner, 1994), males were not recruited for this study mainly due to the highly imbalanced gender distribution within the sampling population (undergraduate psychology students), which impeded our ability to

include sufficient numbers of biometrically comparable males. However, as previous findings examining Type D personality and CVR to laboratory in stress in healthy individuals reported effects confined to males, the inclusion of a female-only sample allowed investigation of the association between Type D personality and CVR in females. An *asocial* cognitive task was chosen in order to examine if Type D personality was associated with an altered cardiovascular response profile when there was no social dimension to the laboratory task. It was predicted that Type D personality would be associated with a maladaptive cardiovascular response, in particular, influencing hemodynamic profile in response to the mental arithmetic stressor.

2. Materials and methods

2.1. Participants

Participants were 89 female college students (age 18 to 29 years; $M = 19.70$, $SD = 1.87$ years) with normal body mass index ($M = 22.67$, $SD = 3.33$). All participants were normotensive (resting blood pressure $< 140/90$ mmHg), physically healthy, and reported no history of heart disease. Students were recruited through class announcements and received course credit for participation. Participation was voluntary and participants were free to withdraw at any time. All participants signed a consent form prior to participation.

2.2. Materials and apparatus

Participants first underwent psychometric testing to establish Type D status using the 16-item Type D scale (DS16; Denollet, 1998) immediately prior to the laboratory session. The DS16 consists of two 8-item scales measuring NA and SI, each producing subscores ranging from 0 to 32. Conventionally, a median split on both scales is used to identify Type D (e.g., Denollet, 1998; Denollet et al., 2000; Pedersen and Middel, 2001), and good internal reliability has been reported (Denollet, 1998). In the present sample, Cronbach's α for the NA and SI scales was 0.87 and 0.75, respectively, indicating acceptable internal consistency. Participants scoring above the median on both subscales (i.e., ≥ 10 on the NA scale and ≥ 12 on the SI scale) were identified as Type D. This resulted in 33 individuals identified as Type D and 56 as non-Type D. As the convention of classifying Type D by cross-tabulated double-dichotomies of subscores is reliant on median splits, there is a particular risk of misclassification error with regard to borderline cases (Veiel, 1988). Although the use of median splits to create dichotomies in psychometrics is generally advised against (Veiel, 1988), the use of a cross-tabulated double-dichotomy to create quadrants remains common in personality and social psychology research (cf. Berry, 1970; Karasek, 1979; Dworkin, 1990; Jamner et al., 1991; Ries and Miller, 1992; Everson et al., 1997; Derakshan et al., 2007). Given the possibility that Type D may represent a continuum rather than a taxon (Ferguson et al., 2009), it is important that researchers consider how they might compute continuous Type D variables (such as might be achieved by combining NA and SI scores arithmetically) in order to assess whether such measures offer statistically stronger tests of Type D-related hypotheses. As such, a continuous score representing Type D personality tendencies was computed as the product of raw NA and SI subscores (i.e., $NA \times SI$; cf. Whitehead et al., 2007), and all analyses reported below were duplicated using this score as a continuous independent variable in place of categorical Type D classifications.

Participants also completed the state form of the state-trait anxiety inventory (STAI; Spielberger et al., 1983) immediately after the laboratory stressor. The STAI has been used extensively in research and clinical practice. The state anxiety scale consists of 20 questions which evaluate how the person feels *right now*. Responses range on a four-point Likert scale from *not at all* to *very much so*. Alpha coefficients of over 0.90 have been reported for the state anxiety

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