



The joint influence of emotional reactivity and social interaction quality on cardiovascular responses to daily social interactions in working adults

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ABSTRACT

Objective: Social interaction quality is related to cardiovascular functioning. Trait emotional reactivity may amplify cardiovascular responses to social interactions, but is often examined as a tendency to react to negative events. We took a broader approach by examining the joint effects of positive and negative emotional reactivity and social interaction quality on ambulatory blood pressure (ABP) and heart rate (HR) responses to daily social interactions.

Methods: Participants were part of a larger study on BP and cardiovascular health ($N = 805$; $M_{Age} = 45.3$; 40.1% male). Participants completed a measure of emotional reactivity (BIS/BAS) and 24-hour ABP monitoring accompanied by ecological momentary assessments (EMA) about just-experienced social interactions and their pleasantness. Multilevel models tested the associations of emotional reactivity, average pleasantness, and momentary pleasantness with BP and HR.

Results: Participants who reported more pleasant interactions on average had lower BP (systolic BP: $B = -0.51$ mmHg; diastolic BP: $B = -0.46$ mmHg). These effects did not depend on emotional reactivity. The effect of momentary pleasantness depended on BIS/BAS; in less reactive participants, greater pleasantness was associated with lower HR, $B = -0.13$ bpm; in more reactive participants, greater pleasantness was associated with increased HR, $B = 0.16$).

Conclusions: Participants who had more pleasant social interactions throughout the day had lower mean ABP. The acute effect of a given social interaction on HR depended on emotional reactivity: HR increased for participants high in emotional reactivity during pleasant interactions. Thus, emotional reactivity may influence cardiovascular responses to social stimuli.

1. Introduction

Social interactions have a significant impact on cardiovascular health. Negative social interactions such as argumentative exchanges predict increased risk for cardiovascular disease and incident coronary events [12,22]. Conversely, positive aspects of relationships such as social support and affiliation predict a lower incidence of coronary heart disease [23,27] and lower mortality among congestive heart failure patients [10].

The effects of social interactions on cardiovascular outcomes may emerge as cumulative consequences of repeated interactions over days, weeks, and months. These physiological mechanisms can be observed most precisely at the level of a given interaction. The emotional quality of an interaction, for example, reliably alters blood pressure. Interactions with a romantic partner or close other are associated with

lower ambulatory blood pressure [14,16], whereas interactions with a partner toward which one has ambivalent feelings are associated with higher blood pressure throughout the day [16]. More broadly, social interactions that are seen as unpleasant predict greater increases in blood pressure [2]. This pattern suggests that unpleasant, uncomfortable, or stressful interactions can be detrimental for heart health, whereas pleasant or comfortable interactions can be beneficial [32].

Yet the cardiovascular effects of social interactions are not the same for everyone. Rather, people with different dispositions react to social stimuli in different ways, and the way in which someone tends to react emotionally may shape acute physiological responses to social situations. This possibility is highlighted by research showing that individual differences in emotional responding, such as the tendency to react with hostility, affects blood pressure during social interactions [28,31]. For

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instance, interactions perceived as intimate may lead to lower blood pressure, but only for individuals low in hostility [31]. Threatening situations may increase blood pressure in particular for high-hostility individuals [28], and social interactions that are high in instrumental support may increase blood pressure for high-hostility people [31], ostensibly because they do not want “help.” Hostility may also exacerbate increases in blood pressure during emotionally intense encounters [2].

A person's emotional reactivity to pleasant and unpleasant stimuli and situations may be especially important in social contexts. Highly reactive people may over-respond to social pleasantness or unpleasantness cues, which may increase stress on the cardiovascular system through heightened blood pressure variability [21,29,30]. Indeed, individuals who are more variable in negative emotion throughout the day also experience higher blood pressure in response to negative emotions [5]. Emotional reactivity may be an especially potent moderator when considering how blood pressure is affected by acute changes in relative pleasantness (versus differences in average level of pleasantness). Reactivity entails reacting to a situation at hand, and therefore it should ostensibly be more relevant for shaping cardiovascular responses to momentary fluctuations in pleasantness than for influencing a person's average blood pressure/heart rate during a generally pleasant or unpleasant day.

Emotional reactivity is a broadly defined concept pertaining to typical responses to emotion-eliciting stimuli and situations. A majority of research on this construct has focused on negative affect (e.g., “upset,” “agitated,” “anxious”) in response to unpleasant events, and this is reflected in many of the psychometric assessments designed to quantify emotional reactivity (e.g., [20]). Yet positive affect in response to pleasant events is also an important dimension of emotional reactivity.

Because measures to assess emotional reactivity generally focus solely on reactivity to negative events, alternative approaches are warranted. Although the BIS/BAS questionnaire was originally developed to measure two aspects of personality pertaining to avoidance and approach dimensions of motivation [6], and is therefore usually treated as separate subscales, it is possible to conceptualize this scale as a single total score measuring individual differences in emotional reactivity across positive and negative domains (see also [8,9]). The BIS/BAS encompasses two dimensions: behavioral inhibition sensitivity (BIS) (e.g., “Criticism or scolding hurts me quite a bit”), and behavioral activation sensitivity (BAS) (e.g., “When I get something I want, I feel excited and energized”). Items on the BIS/BAS have been shown to be related to both negative and positive affect [15]. BIS is measured by a single subscale, and is associated with greater self-reported unpleasant emotion and a higher tendency to engage in rumination [33], whereas BAS consists of three subscales related to pleasant emotion(s) and appetitive motivation: reward responsiveness, fun-seeking, and drive. BAS has been associated with some adaptive outcomes such as lower depressive symptoms [34], but has also been associated with adverse emotional, behavioral, and health outcomes. For example, higher reward responsiveness is associated with impulsive buying [8], and fun-seeking is associated with greater alcohol use and symptoms of mania among college students [35,19]. Furthermore, although there is strong evidence that negative affect is reliably associated with BIS [15], BAS has sometimes also been associated with negative affect (e.g., reward responsiveness is associated with heightened frustration; [7]).

This study explored the intersection of social context (both pleasantness of social interactions on average and fluctuations in pleasantness within the day) and individual differences in emotional reactivity as they relate to ambulatory blood pressure and heart rate in real time and in individuals' naturalistic context. Given previous research showing exaggerated responses to unpleasant emotional or social stimuli amongst individuals who are higher in hostility or negative emotions (e.g., [5,28,31]), we hypothesized that more emotionally reactive people would experience greater changes in blood pressure and heart rate in response to the pleasantness (or unpleasantness) of

interactions.

We had two hypotheses. First, greater pleasantness in social interactions—both on average and relative to average (i.e., more or less pleasant than usual)—is associated with lower blood pressure and heart rate. Second, participants who are high in emotional reactivity will exhibit exaggerated changes in blood pressure and heart rate across the range of pleasantness in social interactions relative to participants low in emotional reactivity. Although we were primarily interested in emotional reactivity towards both negative and positive stimuli, it is possible that these associations may differ for participants who are reactive to unpleasant situations (i.e., high versus low BIS) and participants who are reactive to pleasant situations (i.e., high versus low on BAS subscales). As such, in addition to testing the moderating effects of the total BIS/BAS score, we explored potential moderating effects of each of the four subscales. Although we initially hypothesized that blood pressure and heart rate responses to social interactions would be similar, we were sensitive to the possibility that this might not be true. For example, Brosschot et al. [3] found that induction of negative emotion influenced blood pressure recovery, but not heart rate recovery, after a stressor.

2. Method

2.1. Participants

Participants ($N = 805$) were part of a larger study on the correlates of and cardiovascular sequelae of masked hypertension (Masked Hypertension Study; see [24] for further details and CONSORT information). Initial inclusion criteria included: 1) 21 years of age or older, 2) working at least 17.5 hours per week, 3) able to speak and read English, 4) pre-enrollment screening blood pressure of less than 160/105 mmHg, and 5) not taking blood pressure-lowering medication. Participants were excluded if they reported a history of cardiovascular disease (e.g., myocardial infarction), or chronic renal, liver, thyroid, or adrenal disease, cancer that was not in remission for at least six months, and active substance abuse or a serious mental health illness. Participants were also excluded if they had evidence of secondary hypertension. Finally, those taking any cardiovascular medication other than a statin and pregnant women were excluded. This study was approved by the Columbia University Medical Center and Stony Brook University Institutional Review Boards.

To be included in the analyses reported here, participants needed to have reported having had at least one social interaction “just prior” to a blood pressure reading; this question was asked first, and, if the participant indicated no interaction, it was followed by a question asking about “any” interaction since the last reading. We included only interactions “just prior” to the ABP reading, given that “any” interaction might have occurred up to 28–30 min prior, and therefore results would not reflect the acute/momentary effect of social interactions on ABP and HR. We acknowledge that we could examine the possibility of protracted and/or delayed effects of social interactions on BP and HR, but that would be secondary to our primary focus. Because the presence/absence of social interactions was only assessed for awake readings, all sleep readings were excluded from the analysis.

2.2. Procedure

Participants were recruited from workplace blood pressure screenings between 2005–2011. After determining eligibility, participants completed informed consent. Participation consisted of five visits to our clinic setting. Relevant to this study, at the first visit, participants received a psychosocial questionnaire including the assessment of emotional reactivity. This was returned prior to the third visit, at which participants were fitted with an ambulatory blood pressure monitor and trained in the use of an electronic diary to complete ecological momentary assessments (EMAs). Blood pressure readings were taken every

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