



Heart rate response is longer after negative emotions than after positive emotions

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Abstract

Summary. Recent ambulatory findings showing comparable cardiovascular effects of positive and negative emotions are not consistent with the assumed etiological role of negative affect in stress-related diseases. We tested the hypothesis that regardless of initial reactivity, responses associated with negative emotions would be prolonged compared to responses associated with positive emotions. During 8 h, 33 healthy subjects from a general population reported their emotional arousal, emotional valence and physical activity and recorded their heart rates (HR) after a beep at each 60th min ('initial HR'; T_0), followed by two 'prolonged activation' recordings, respectively 5 min later (T_1) and 10 min later (T_2). While emotional arousal and activity predicted initial HR, prolonged activation at T_1 was solely predicted by emotional valence (negative affect) at T_0 , independent of emotional recovery. The results lend support to the hypothesis that cardiovascular activation after negative emotions last longer than after positive emotions. This finding is consistent with the view that prolonged activation, and not so much reactivity, might be a mechanism underlying the etiological role of negative emotions ('stress') in somatic disease. Perseverative cognition (worry, rumination) might be responsible for this prolonged activation.

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1. Introduction

The effects of stressors on the onset and course of cardiovascular and other diseases are often suggested to be mediated by negative affect (e.g. Gallo and Matthews, 1999; Kiecolt-Glaser et al., 2002; Smyth et al., 1998; van Eck et al., 1996). The often implicit rationale is that stressors cause

negative affect, which in turn is accompanied by high physiological arousal. According to the widely accepted reactivity hypothesis (e.g. Gerin et al., 2000), frequent high physiological responding, for example, high cardiovascular or endocrine responses, may lead to tissue damage and dysregulation and finally to disease. According to this view, negative and positive emotions should have the highest physiological consequences. However, the picture emerging from the literature is not consistent with this hypothesis. Often only the negative affect has cardiovascular effects (e.g.

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Shapiro et al., 2001), but sometimes the positive affect also has substantial physiological effects (e.g. James et al., 1986), or effects equal to those of negative emotions (e.g. Futterman et al., 1994; Jacob et al., 1999). Jacob et al. (1999), for example, showed in a recent ambulatory study that positive and negative emotions were associated with comparable levels of heart rate (HR) and blood pressure reactivity (Jacob et al., 1999). Controlling for a wide range of possible factors that could influence these cardiovascular parameters, such as movement, posture, activity, diurnal rhythm, they found mood-related increases of 6/3.7 mmHg for systolic/diastolic blood pressure and 2.5 bpm for HR. The difference between the effects of negative and positive mood on systolic blood pressure and HR was not significant. Clearly, comparable or only marginally different cardiovascular effects of positive and negative emotions are inconsistent with the widely accepted view that negative emotions would mediate the effects of stressors on health.

One reason for this inconsistency may be that the reactivity hypothesis is incorrect or at least incomplete. Recently, this hypothesis has been challenged on both empirical and theoretical grounds (Brosschot and Thayer, 1998; Linden et al., 1997; Schwartz et al., 2003). A major gap in the reactivity hypothesis seems to be that it does not account for the duration of physiological responses, which would be important in causing the intermediate chronic pathogenic state that is necessary to arrive at a disease endpoint (Brosschot and Thayer, 1998). One important cause for a long duration of activity is a slow recovery or prolonged activation after stress (Linden et al., 1997; Ursin and Murison, 1983). This point of view yields a clue about how negative and positive emotions might differ in their health-related physiological effects. It is possible that while the magnitudes of the initial physiological responses to negative and positive stimuli may not be substantially different, duration of the responses after a negative stimulus may be more prolonged than those after a positive stimulus. A reason for this might be that negative affect implies the continuation of unresolved problems or an uncontrollable

threatening situation, leading to prolonged rumination (Brosschot and Thayer, in press).

In the present study, we set out to test the hypothesis that cardiovascular activation associated with negative states lasts longer than activation associated with positive states, independent of the initial activation ('reactivity'). During 1 day, 33 subjects from a general population indicated on an hourly basis their affective state, posture, activity and HR in clusters of three measurements separated by 5 min. We expected that, independent of the initial HR during positive and negative episodes, HR after negative affective episodes would be sustained longer than after the positive affective episodes. We also expected that the sustained activation after negative episodes would not be due to heightened physical activity, and we explored whether it was mediated by prolonged negative emotion.

2. Materials and methods

2.1. Subjects

Thirty-three subjects, 12 men and 21 women, were recruited from the social networks (family and friends) of seven undergraduate psychology students who assisted in this study. The ages of the subjects ranged from 16 years to 58 years with a mean of 29.18 years. The subjects were kept blind as to the purpose of the study. They filled in a small booklet containing hourly diary records, and carried a fitness meter and a stopwatch (see below). For their participation they received a small gift or the equivalent of \$15 (US).

2.2. Instruments

The booklet contained 8-hourly records, each of which consisted of three identical clusters of questions about their momentary emotion and activity. The stopwatch beeped every hour (T_0) and 5 min (T_1) and 10 min later (T_2). Of the total of 264 records that were gathered (33 subjects \times 8-hourly measurements) 236 were valid. The remaining 28 records were considered missing because of various technical problems or because they lacked scores on one of the critical variables (affective

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