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The interaction between stress and positive affect in predicting mortality

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ABSTRACT

Objective: Positive affect is associated with longevity; according to the stress-buffering hypothesis, this is because positive affect reduces the health harming effects of psychological stress. If this mechanism plays a role, then the association between positive affect and mortality risk should be most apparent among individuals who report higher stress. Here, we test this hypothesis.

Methods: The sample consisted of 8542 participants aged 32–86 from the National Health and Nutrition Examination Survey (NHANES I) Epidemiological Follow-up Study (NHEFS). We used Cox's proportional hazards regression to test for the main effects of and the interaction between positive affect and perceived stress in predicting mortality risk over a 10 year follow up period.

Results: Greater positive affect was associated with lower mortality risk. We found a significant interaction between positive affect and perceived stress such that the association between positive affect and mortality risk was stronger in people reporting higher stress. In the fully adjusted model, a standard deviation increase in positive affect was associated with a 16% (HR = 0.84; 95% CI = 0.75, 0.95) reduction in mortality risk among participants who reported high levels of stress. The association between positive affect and mortality risk was weaker and not significant among participants who reported low levels of stress (HR = 0.98; 95% CI = 0.89, 1.08).

Conclusion: Our results support the stress-buffering model and illustrate that the association between positive affect and reduced risk may be strongest under challenging circumstances.

1. Introduction

Positive affect is a component of psychological wellbeing and can be defined as the experience of positive emotion such as happiness, joy, excitement, or contentment [1]. People who experience frequent positive affect tend to live longer, healthier lives [2–4]. The discovery that this association is not fully explained by differences in demographic factors or depressive symptoms has led authors to suggest that positive affect is causally related to physical health [2–4]. However, the mechanisms by which positive affect impacts health outcomes is not fully understood. Pressman and Cohen [1] proposed two potentially compatible models that could explain this association. According to the direct effects model, the experience of positive affect impacts directly on physiological processes and health behaviours associated with healthy functioning. The stress-buffering model, on the other hand, proposes that positive affect is associated with good health because it protects against the pathogenic consequences of psychological stress [1]. If the positive association between positive affect and better health is caused by this stress buffering mechanism, then the protective effect of positive emotion should be stronger for people who experience more stress. In other words, psychological stress should moderate the association between positive affect and health. To date, researchers interested in the link between higher positive affect and lower mortality risk have focused on the direct effects model; consequently, it is unclear whether perceived stress moderates this risk association.

Positive affect can be measured at the trait or state level; trait measures assess how an individual 'typically' feels and state measures assess how an individual feels at a particular point in time. Both trait and state measures of positive affect have been linked to longevity [4] and biomarkers of neuroendocrine, inflammatory and cardiovascular functioning [1,5,6]. There is evidence that positive and negative affect represent independent constructs rather than opposite points on a continuum and that these construct are independently associated with mortality risk [2,7,8].

The idea that positive affect serves an adaptive function during periods of stress was prompted by the observation that stress and

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positive affect can co-occur [9]. For example, in a longitudinal study of 253 male caregivers, participants reported experiencing positive affect as frequently as they did negative affect [10]. Accounts of positive affect during periods of severe stress can also be found in studies into the process of bereavement [11,12], and the onset of disability [12].

Pressman and Cohen [1], hypothesize that the experience of positive affect during periods of stress could reduce behavioural and physiological stress responses. Health harming responses to stress include overactivation of allostatic systems, such as the hypothalamic–pituitary–adrenal (HPA) axis or the autonomic nervous system (ANS) [13], and an increase in unhealthy behaviours such as smoking, alcohol consumption, or substance abuse [14]. The stress buffering model identifies physiological and psychosocial factors associated with positive affect that may interact with these stress responses [1]. Firstly, at a physiological level, the release of endogenous opioids (a correlate of high positive affect) could dampen HPA and ANS responses to stress [15,16]. At a cognitive level, positive affect may facilitate creative problem solving or the appraisal of a stressful situation as an opportunity or challenge [17,18]. These responses may reduce exposure to stressors, and, consequently, both HPA and ANS activity, as well as health harming behaviours. Finally, Pressman and Cohen [1] suggest that individuals who experience more positive affect are more likely to have social and physical resources that facilitate adaptive coping—both at a behavioural and physiological level. Similar mechanisms are proposed in Fredrickson's Broaden-and-Build theory [19,20], which posits that the experience of positive affect can help individuals build the psychosocial resources needed to cope with stress and adversity. Fredrickson [19] also proposes that the experience of positive emotions following a stressful experience can help undo the physiological responses (specifically cardiovascular reactivity) and cognitive responses (narrowing of the thought-action repertoire) to stress [19].

Studies of positive affect and stress responses provide evidence for the mechanisms identified in the stress-buffering model and the Broaden-and-Build theory [19]. Several studies have tested whether positive affect dampens physiological responses to laboratory stress tasks. Fredrickson, Mancuso, Branigan, and Tugade [20] measured cardiovascular recovery following a stress induction task in 170 students. Participants who viewed films that elicited amusement or contentment following the stress task were characterized by quicker cardiovascular recovery than participants who viewed neutral films or films that elicited sadness. Similarly, in 170 participants, Kraft and Pressman [21] found that maintaining a positive (versus neutral) facial expression during a stress task was associated with lower heart rate during the stress recovery period. Finally, in 72 healthy men, frequency of self-reported positive affect was associated with lower systolic blood pressure during a stress task and quicker diastolic pressure recovery following the task [5]. Although less is known regarding associations between stress, positive affect, and health behaviours, there is evidence that greater wellbeing is associated with positive behaviour change following stressful events, such as diagnosis of chronic disease [22–24]. In addition, in a longitudinal study of 83 college students, positive affect was associated with better sleep efficiency (hours of sleep/time in bed) on days of higher stress but not on days of lower stress [25].

Fewer studies have tested the key prediction from these theories, that is, there should be an interaction between positive affect and perceived stress in predicting health outcomes. In a cross-sectional study of 382 participants, the association between higher stress and lower self-rated health was significantly moderated by positive affect such that the association was strongest at low levels of positive affect [26]. Blevins, Sagui, and Bennett [27] tested whether self-reported stress moderated the association between higher positive affect and lower levels of systemic inflammation. Using cross-sectional data from the National Longitudinal Study of Adolescent to Adult Health (n = 3093), they found that higher positive affect was associated with lower levels of inflammation only among participants who reported higher levels of stress. Finally, in an experimental study (n = 60), Robles, Brooks, and Pressman [28] compared the strength of the association between positive affect and skin barrier recovery (following a 'tape stripping' procedure) between participants assigned to a stress condition and participants assigned to a control condition. Higher positive affect was associated with faster recovery in the stress condition but not in the control condition.

In a recent meta-analysis on positive affect as a predictor of longevity, Zhang and Han [4] identified one study that tested for an interaction between perceived stress and positive affect. This study used data from the National Health and Nutrition Examination Study I (NHANES I) Epidemiologic Follow-Up Study (NHEFS) [29]. The authors found evidence of a stress-buffering effect only in a subsample of participants who had no chronic conditions and were over the age of 65. In this subsample, the association between higher positive affect and lower mortality risk was strongest among participants that reported higher stress. However, as the primary aim of Moskowitz and colleagues' [29] study was to compare participants with and without diabetes, the sample was restricted to participants diagnosed with diabetes (n = 715) and participants without any chronic conditions (n = 2673).

In summary, previous studies report that positive affect protects against some health harming responses to stress and that positive associations between positive affect and better health are stronger under conditions of high stress. However, it is unclear whether this moderating effect applies to the association between higher positive affect and lower mortality risk. In the current study, we tested whether perceived stress moderated the positive association between positive affect and longevity in a large, nationally representative sample.

2. Methods

2.1. Participants

We used data from the NHEFS [30]. The NHANES I (1971–1975) data were taken from a nationwide probability sample of 32,000 Americans aged 1 to 74. The NHEFS began in 1982 and included 12,220 participants aged 25–74 who had completed the medical examination in NHANES I. Subsequent waves of NHEFS data collection were conducted in 1986, 1987, and 1992. Of the 12,220 participants in the NHEFS sample, we excluded 1697 participants due to missing vital status data and an additional 1,981 participants due to missing covariate data. This left us with an analytic sample of 8542 participants. The excluded participants differed from the analytic sample on several variables (see Supplementary Table 1 for a summary of these differences).

2.2. Measures

Positive affect, stress, and covariate measures, apart from wealth and height, were taken from the NHEFS wave 1 (1982) interview. Wealth and height were taken from the NHANES I (1971–1975) interview.

2.2.1. Positive affect

As has been done previously [31,32], positive affect was measured using the positive affect subscale of the General Wellbeing Questionnaire (GWQ) [33]. The positive affect subscale consists of three questions: "How have you been feeling in general in the past month?" (anchors were "in excellent spirits" and "in very low spirits"), "How happy, satisfied, or pleased have you been with your personal life, during the past month?", and "How much energy, pep, vitality have you felt, during the past month?". This subscale's scores range from 0 to 20 with higher scores indicating higher positive affect. Cronbach's alpha for this scale in our sample was 0.60.

2.2.2. Stress

Following Moskowitz et al. [29], we used three items from the GWQ