

Positive affect and biological function in everyday life

Andrew Steptoe^{a,*}, Jane Wardle^b

^a *Psychobiology Group, Department of Epidemiology and Public Health, University College London, 1-19 Torrington Place, London WC1E 6BT, UK*

^b *Health Behaviour Unit, Department of Epidemiology and Public Health, University College London, 2-16 Torrington Place, London WC1E 6BT, UK*

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Abstract

There is accumulating evidence that positive affect may protect against ill-health and risk of disease. Here, we summarize results from our research program into the biological correlates of positive affect. Data have been collected from middle-aged men and women, with positive affect assessed through repeated ratings of happiness over a working day. The results indicate that greater happiness is associated with lower salivary cortisol both on working and nonworking days, reduced fibrinogen stress responses, and lower ambulatory heart rate in men. These effects are independent of age, socioeconomic status, smoking, body mass and psychological distress. A 3 year follow-up has confirmed these biological associations with happiness. In addition, we found that happiness was inversely related to ambulatory systolic blood pressure on follow-up, again independently of potential confounders including negative affect. These results suggest that positive affective states are linked to favorable health outcomes through their influence on health-related biology, and may be particularly relevant in old age, when the accumulation of risk factors leads to increased risk of chronic disease.

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1. Introduction

There is compelling evidence that negative affective traits, such as depression and anxiety are associated with adverse health outcomes. Longitudinal observational studies have established relationships with cardiovascular disease risk, diabetes, progression of disability, and premature mortality [9,15]. A notion that is being increasingly studied is the converse possibility that positive well-being and affect have favorable effects, reducing the rate of premature mortality and the development of various physical illnesses [2,7]. Such effects may be particularly relevant to older sectors of the population, among whom aging processes and the accumulation of risk factors lead to a high incidence of chronic disease. The maintenance of positive well-being with advancing years may help protect against in age-related morbidity.

If positive affect is associated with good health, the question arises as to which pathways underlie this relation-

ship. This question has led to research into the biological correlates of positive affect. Some studies have indicated that positive affect is associated with characteristic patterns of electrocortical activation [16], although findings are not entirely consistent [17]. Positive mood in everyday life also appears to be associated with high levels of central serotonergic function [1], a potentially important relationship in view of the links between deficient serotonergic function and higher body mass index (BMI), insulin resistance and blood pressure [5]. Neuroendocrine and immune responses have also been examined as possible mediators of the health effects of positive affect with some positive results [7].

Since positive and negative affect are inversely correlated, the demonstration that positive states are associated with reduced biological responses may be trivial, merely reflecting the absence of negative affect [7]. The conclusions that can be drawn from studies that have measured the biological correlates of positive affect without controlling for negative states are therefore ambiguous. We recently reported an investigation of late middle-aged men and women in which positive affect was associated with lower cortisol, lower heart rate,

* Corresponding author. Tel.: +44 207 679 1804; fax: +44 207 916 8542.
E-mail address: a.steptoe@ucl.ac.uk (A. Steptoe).

and reduced fibrinogen stress responsivity [13]. These effects were independent of known confounders, such as age and socioeconomic position, and also of negative mood states as indexed by the General Health Questionnaire (GHQ). In this article, we provide a summary of these findings, then present new data demonstrating the stability of the biological correlates of positive affect over a 3 year period.

2. Biological function in everyday life

Several methods are used to study biological factors in relation to psychological variables, such as positive affect, including laboratory experiments and epidemiological surveys. A particularly attractive strategy is measurement of biological function under naturalistic conditions, since it overcomes some of the limitations of other methods. The criticism is often made of laboratory studies that the situation is unrepresentative of real life, and that the acute responses observed experimentally are not relevant to chronic biological dysfunctions. Epidemiological approaches seldom involve measurement of biological activity on more than a single occasion, and this may be unsatisfactory for indicators that fluctuate over time. The measurement of biological function in everyday life using ambulatory, noninvasive methods allows the relationship between natural variations in physiological activity and psychological state to be assessed.

The biological variables that have been studied most intensively are ambulatory blood pressure and heart rate and salivary cortisol concentration. Repeated measures in everyday life are especially appropriate for these biological indicators, since all show marked variation over the day. They are also highly relevant to long-term health risk. Dysregulation of cortisol is implicated in a range of disorders, including depression, abdominal adiposity, type 2 diabetes, hypertension and inflammatory conditions, while raised blood pressure and heart rate are risk factors for coronary heart disease.

There are two different methods of analyzing the relationship between psychological factors and biological function everyday life. The first is the within-subject method, in which covariation between psychological states and biological variations are assessed. Such methods have generated some evidence that cortisol levels are lower when people are in more positive mood states [11], but have also shown that blood pressure is often higher in positive than neutral mood states [10]. The second method involves between-subject analysis, comparing individuals who differ in the psychological factor under investigation. This method has been used less frequently for studying positive affect, and previous findings have been inconsistent. Polk et al. [6] studied 334 men and women with cortisol sampled several times over the day and evening. Positive affect was derived from ratings obtained daily for 14 days. Higher levels of positive affect were associated with lower cortisol levels, with effects being larger in women than men. Volunteers took part in this study immediately before an investigation involving experimental infection

with the common cold, and were quarantined in a hotel over the measurement period, so the conditions of assessment were atypical. In contrast, no relationship was observed between positive affect and cortisol sampled from saliva in another study of women aged 61 and older [8].

3. Whitehall psychobiology study

The analyses that we have carried out were part of the Whitehall psychobiology study, an investigation of the biological processes associated with psychosocial risk factors for coronary heart disease [12]. This study involved monitoring of biological function in everyday life and measurement of responses to mental stress testing in the laboratory in a subgroup of the larger Whitehall II epidemiological cohort. A major focus was on socioeconomic disparities in health, and the greater cardiovascular disease risk in lower socioeconomic status (SES) individuals. Because of this, we recruited participants systematically across grades of employment, to allow us to compare higher, intermediate and lower SES groups. Ambulatory monitoring of blood pressure and heart rate using a Spacelabs 90217 device was carried out by 227 men and women over a working day and evening. The monitor was programmed to take a reading every 20 min from morning until bed-time. Additionally, eight saliva samples were taken at 2 h intervals over the same day, starting at 8.00–8.30, and finishing at 22.00–22.30. Saliva samples were also obtained over a weekend leisure day using this schedule, and data were analyzed by immunoassay at the University of Düsseldorf.

We hypothesized that positive affect would be associated with lower cortisol levels over the working and leisure day, and with lower ambulatory blood pressure and heart rate. We also reasoned that if the association between positive affect and biology was independent of negative affect, then it would persist after controlling statistically for psychological distress, as indexed by the GHQ.

3.1. Measurement of positive affect

Most work on affective states relies on global estimates of positive and negative affect, taken with ratings or questionnaires on a single occasion. Such methods have been criticized on the grounds that single measures are strongly affected by current state, memory distortion and recall bias [14]. Even though the respondent may be asked about mood over the past week or month, he or she is likely to be strongly influenced by mood over the past few minutes. It has been argued that a more reliable method is to assess momentary experience repeatedly on several occasions. This technique takes account of fluctuations in mood, and aggregates of momentary measures may provide robust estimates of typical levels of positive affect. In our study, participants gave ratings of happiness on a five-point scale (from 1 = *low* to 5 = *high*) after every blood pressure reading. We obtained an

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