



## Respiratory responses during affective picture viewing

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Received 7 June 2002; accepted 8 March 2004

Available online 19 May 2004

### Abstract

Previous research has demonstrated covariation of physiological responding with judgments of valence and arousal. However, until now links between these affective dimensions and respiratory measures have not been extensively investigated. In this study, eight picture series of different affective valence and arousal level were shown to 30 subjects, while respiration, skin conductance level (SCL), heart rate (HR) and affective judgments were measured. With increasing pleasantness, inspiratory time lengthened, mean inspiratory flow decreased and thoracic breathing increased. With increasing arousal, inspiratory time and total breath duration shortened and mean inspiratory flow, minute ventilation, thoracic breathing and electrodermal activity increased. These findings confirm the importance of arousal in respiratory responding, but also indicate a modulatory role of affective valence. We propose that the arousal effects reflect energy mobilization in preparation to act, and that the valence effects might be a manifestation of an attention bias toward negative stimuli.

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*Keywords:* Arousal; Emotion; Heart rate; Pictures; Respiration; Skin conductance; Valence

### 1. Introduction

Empirical work (Lang et al., 1990; Mehrabian, 1970; Osgood et al., 1957; Russell, 1980) has repeatedly confirmed that differences in affective meaning among stimuli—words,

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objects, events—can succinctly be described by three basic emotional dimensions, that is a dimension of affective valence, also called pleasure or pleasantness, ranging from positive (pleasant) to negative (unpleasant), one of arousal, ranging from calm (low-arousal) to excited (high-arousal), and one called dominance or control, ranging from controlled to in control. The valence and arousal dimensions are primary, and they typically account for most of the variance in emotional judgments (Bradley and Lang, 1994; Hamm and Vaitl, 1993). Recent work has provided evidence for a correspondance between physiological variables and the emotional dimensions of valence and arousal (e.g., Greenwald et al., 1989; Lang et al., 1993; Simons et al., 1999). However, very few studies have investigated the relation between respiratory measures and these emotional dimensions (Nyklíček et al., 1997; Van Diest et al., 2001), although most available data suggest that respiration patterns may reflect general dimensions of emotional response (for review, see Boiten et al., 1994).

As to the relation between respiration and the dimensions of valence and arousal, a number of studies suggest a central role of arousal. An increase in subjective arousal appears to be accompanied by breathing acceleration and an increase in mean inspiratory flow and minute ventilation (e.g., Boiten, 1998; Boiten et al., 1994; Nakamura, 1984; Nyklíček et al., 1997; Van Diest et al., 2001). On the contrary, no study has yet provided clear evidence for a relationship between inspiratory volume and valence and arousal (Boiten, 1998; Boiten et al., 1994; Van Diest et al., 2001). Pleasantness has been suggested to influence the relative contribution of the rib cage and the abdomen to inspiratory volume (Boiten et al., 1994). Yet, Boiten (1998) failed to confirm a covariation between pleasantness and thoracic-abdominal balance.

This study pursued two goals. One goal was to assess physiological reactions as they vary when looking at pictures, as defined by a priori groupings on the valence and arousal dimensions. A second goal was to assess the covariation between individual subjects' reports of valence and arousal and their physiological responses. A similar two-step analysis has been recently used by Bradley and Lang (2000).

Based on the above-mentioned evidence, we predicted respiratory variables to be mainly modulated along the arousal dimension. With increasing arousal, time parameters (inspiratory and expiratory time, total breath duration) were expected to decrease and flow parameters (mean inspiratory flow, minute ventilation) to increase. For inspiratory volume and the thoracic-abdominal ratio, no specific predictions were advanced.

Besides respiration, two other measures known to show covariation with valence and arousal were measured; skin conductance level (SCL) that we expected to increase with arousal (Greenwald et al., 1989; Lang et al., 1993) and mean heart rate (HR) that we predicted to be lower for unpleasant pictures compared to pleasant pictures (Greenwald et al., 1989; Lang et al., 1993; Palomba et al., 1997).

## 2. Methods

### 2.1. Subjects

Participants in this study were 16 men and 14 women, aged 20–28 years (mean age 23.4 years). Most participants were undergraduate students. Entry criteria for the study included good general health and no consumption of drugs that may influence the emotional

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