

## A Study on the Emotional Processing of Visual Stimuli through Event-Related Potentials

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The effect of emotional charge of visual stimuli on cerebral activity was investigated through ERPs. This emotional charge is explained through two dimensions: arousal (relaxing-activating) and valence (attractive-repulsive). Stimuli were 12 paintings selected through questionnaires: three activating-attractive pictures (A+ group), three activating-repulsive (A-), three relaxing (R), and three neutral (N). The ERPs were recorded from the 31 subjects at F3, Fz, F4, C3, Cz, C4, P3, Pz and P4. N200 and P300 did not show significant reactions to the emotional charge of the stimuli. N300 showed greater amplitudes in response to activating stimuli: at frontal sites for A+ and at parietal sites for A-. © 1997 Academic Press

### INTRODUCTION

Cerebral activity associated with affective processing of stimuli has scarcely been studied via event-related potentials (ERPs). First studies by Johnston and co-workers established that some late components of ERPs could reflect the emotional processing of different visual stimuli (Johnston, Burleson, & Miller, 1987; Johnston, Miller, & Burleson, 1986). Specifically, they found that emotionally positive and negative stimuli evoked greater P300 amplitudes than neutral ones. Similar results have been found in subsequent experiments (Palomba, Angrilli, & Bravi, 1993).

A common characteristic present in most of the studies exploring emotional reactions is that their objectives are explicit in the stimuli themselves. Thus, the presentation of so diverse stimuli as, for example, nudes and dermatological diseases, as in the studies by Johnston and co-workers, allows subjects to easily deduce that the experiment deals with emotional reactions. If it is always important to control the extent to which subjects know the

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objectives of an investigation, this control becomes essential when studying late components of ERPs. In fact, P300 amplitude increases in response to stimuli considered relevant for the task by subjects (see, e.g., reviews by Bashore & van der Molen, 1991; Johnson, 1988; Picton & Hillyard, 1988). Therefore, P300 amplitude could have been greater in response to the emotional stimuli than to the neutral ones (as Johnston and co-workers found) because subjects considered them more relevant for an experiment on emotional reactions, but not (or not only) because of their affective implications.

An additional comment is that the stimuli presented in previous studies explored only one affective dimension: the *valence* (whose extremes are positive-negative or attractive-repulsive: Johnston et al., 1986, 1987; Yee & Miller, 1987). The *arousal* (its extremes being relaxing-activating) was out of them. Both dimensions explain the principal variance in emotional meaning (Lang, Greenwald, Bradley, & Ham, 1993; Osgood, Suci, & Tannenbaum, 1957; Russell, 1979; Smith & Ellsworth, 1985). The interaction of both dimensions is not balanced. Thus, their "interaction area" forms a sort of triangle: valence dimension reaches its maximum size in the activating extreme of the arousal dimension and diminish as it approaches to the relaxing extreme. In other words, a clearly attractive or repulsive stimulus cannot be relaxing.

The scope of the present experiment was, first, to obtain additional data on the actual characteristics of late component amplitudes in response to visual emotional stimulation. To achieve this, "nonexplicit" or "nonevident" stimuli will be used, so that the subjects consider them all with the same level of relevance for the study. Since this "relevance-for-task effect" we are referring to will be avoided, we could determine whether later components are actually capable of reflecting the affective processing of visual stimuli. Second, the sensitivity of late components to both affective dimensions (valence and arousal) introduced above will be explored in order to determine the global effect of emotional stimuli on ERPs. The main hypotheses we would like to contrast through the present experiment could be specified at this point. First, P300 is expected not to show significant differences in response to the diverse valence and arousal charge of the visual stimuli presented to the subjects, since the relevance-for-task-effect is controlled (that is, it is made homogeneous for all conditions). Second, due to the implication of limbic system structures in the generation of endogenous components (see, e.g., Ganglberger, Groll-Knapp, Haider, Schmid, & Trimmel, 1986), the sensitivity of any of the remaining components of the late ERP region to the emotional charge of the stimuli should not be discarded.

## METHOD

### *Subjects*

Thirty-seven right-handed students at the Universidad Autónoma de Madrid took part in this experiment. The data of only 31 were eventually analyzed, as explained in the section

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