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Dissociating love-related attention from task-related attention: An event-related potential oddball study

Sandra J.E. Langeslag *, Ingmar H.A. Franken, Jan W. Van Strien

Erasmus Affective Neuroscience Lab, Institute of Psychology, Erasmus University Rotterdam, The Netherlands

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Abstract

The present event-related potential (ERP) study was conducted to investigate the P3 component in response to love-related stimuli while controlling for task-related factors, and to dissociate the influences of both love-related and task-related attention on the P3 amplitude. In an oddball paradigm, photographs of beloved and friends served as target and distractor stimuli. Love-related and task-related attention were separated by varying the target and distractor status of the beloved and friends full factorially. As expected, the P3 amplitude was larger for beloved compared to friends and for targets compared to distractors. Moreover, task-related and love-related attention were unconfounded. These results are in line with findings that the P3 is modulated by both emotion- and task-related factors, supporting the view that the P3 amplitude reflects attention. Furthermore, this study validates the notion that romantic love is accompanied by increased attention for stimuli associated with the beloved, and also shows that this form of attention is different from task-related attention.

Keywords: Love; Attention; Oddball; Event-related potential (ERP); P3; Late positive potential (LPP)

It does not take too much effort to locate your beloved among a large group of unfamiliar people because his or her face stands out due to its emotional significance. In addition, people are able of locating a person with brown hair and green eyes among a group of people with many different hair and eye colors. Not because the combination of brown hair and green eyes has an emotional meaning, but because people are able to actively direct attention to particular features as well. The first form of attention can be called emotion-related attention or, in this specific case, love-related attention. It is reflexive in the sense that the attention allocation occurs effortless. It has also been called motivated attention, because it is allocated to stimuli that activate motivation systems such as approach or avoidance [18]. The second form of attention can be called task-related attention and is a more voluntary form of attention because it is directed to certain stimuli actively.

In the current study, these two forms of attention, love-related and task-related, will be examined using event-related potentials (ERPs). Of interest is the late positive potential that emerges around 300 ms after stimulus onset and is maximal over the parietal scalp, because both the emotional nature of stimuli as well as task instructions have been found to modulate this potential [16,19]. In research concerning emotions, this potential has often been called the late positive potential (LPP), whereas it has usually been called the P3 in research regarding task-related attention. Here the term P3 will be used (see also ref. [20]).

In ERP studies using emotional stimuli, the P3 is typically larger for emotional than for neutral stimuli. This increased P3 has been interpreted as reflecting motivated attention, which is allocated more to emotional than to neutral stimuli [19]. In a previous study, infatuated people viewed photographs of their beloved, of a close friend and of an unknown person. As expected, the comparison of the accompanying ERPs yielded a larger P3 in response to the beloved than to the friend and unknown person [11]. These results implied that romantic love is associated with increased attention, as had been suggested earlier [6].

Task-related attention has typically been studied in various oddball paradigms. In a three-stimulus oddball task, a train of frequent standard stimuli is occasionally interrupted by

* Corresponding author at: Institute of Psychology, T12-45, P.O. Box 1738, NL-3000 DR Rotterdam, The Netherlands. Tel.: +31 10 408 2663; fax: +31 10 408 9009.
E-mail address: langeslag@fsw.eur.nl (S.J.E. Langeslag).
URL: http://www.psyweb.nl/homepage/sandra_langeslag.htm (S.J.E. Langeslag).

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infrequent target and distractor stimuli. Participants are instructed to respond to the target stimuli only, for example, by silently counting the number of target presentations. Both target and distractor stimuli are associated with a P3 (e.g. ref. [4]) because they elicit passive attention due to their infrequent occurrence [19]. Nevertheless, the target stimuli are usually associated with a larger P3 than the distractor stimuli because additional attention is allocated to them actively [17].

Studies employing an oddball task with emotional stimuli have shown that the P3 can be modulated by both emotional factors and task instructions in the same paradigm. Delplanque et al. [3], for example, presented emotional and neutral target stimuli (IAPS pictures) among geometric shapes that served as standard stimuli. The P3 appeared larger for target compared to standard stimuli, as well as for emotional compared to neutral targets. Similarly, in another study, they varied the emotionality of distractor stimuli (IAPS pictures) that were presented against a background of geometric shapes serving as target and standard stimuli. Again, the P3 was larger for targets and distractors than for standards, as well as for emotional compared to neutral distractors [4]. Unfortunately, however, the effects of task and emotion on the P3 amplitude could not be dissociated because the valence of the stimuli was varied within one task category only (i.e. targets or distractors). In contrast, in a study by Schupp et al. [20], unpleasant, pleasant and neutral IAPS pictures alternately served as targets and non-targets (technically speaking, these non-targets cannot be considered standard stimuli because the pictures of the three valence categories were presented with equal probability). As expected, the P3 was larger for target compared to non-target stimuli and for emotional compared to neutral stimuli. Moreover, the difference between targets and non-targets was larger when the stimuli were of emotional nature.

The sensitivity of the P3 to emotion- and task-related factors implies that previous findings of an increased P3 for the beloved [11], though in line with other emotion studies, may have been confounded by task-related factors. For example, the participants knew they were taking part in a study concerning romantic love and may therefore have experienced the face of their beloved as a target stimulus. As a result, the increased P3 in response to the beloved might have been the result of task-related instead of love-related attention.

The present study was conducted to investigate love-related attention, as indexed by the P3, in response to the beloved while controlling for task-related attention. Love-related attention was dissociated from task-related attention by counterbalancing the target and distractor status of the photographs of the beloved and a close friend in a full factorial design. The friend was included because both the beloved and the friend are associated with positive feelings and familiarity, whereas the beloved alone is associated with romantic love. It was expected that the P3 would be increased for target compared to distractor stimuli, as well as for the beloved compared to the friend. This pattern of results would support the previous interpretation that love-related factors increased the P3 amplitude. Moreover, such a pattern of results would also sustain the interpretation that the increased P3 for the beloved reflects increased attention. Lastly, the full factorial design will allow for a dissociation of the contributions of love-related and task-related attention on the P3 amplitude.

Twenty undergraduate psychology students (9 men, 11 women; mean age 19.3, range 18–23 years) volunteered to participate in return for course credit. Only participants who had been in love for a relatively short period of time (less than 7 months) and were in love with someone of the opposite sex were included. Other inclusion criteria were normal or corrected-to-normal vision, no medical diagnosis and no use of medication known to affect the central nervous system. All participants were right-handed as determined by a hand preference questionnaire [21]. The study was approved by the local Ethical Committee for psychological research and the participants provided written informed consent prior to testing.

The stimuli were photographs of the faces of the participants' beloved and friends, and of a person that was unknown to them. The photographs of the beloved and friend were supplied by the participants and were digitally adjusted to meet the requirements of the experiment (grey-scale, neutral background, showing face only). The male participants viewed only female faces, whereas the female participants viewed male faces (i.e. the beloved and friend were of the opposite sex, the male participants viewed an unknown female and the female participants viewed an unknown male). Each of the stimuli subtended a visual angle of approximately 3° horizontally and 4° vertically. The face of the unknown person always served as the standard stimulus, occurring in 80% of the trials. The faces of the beloved and friends each appeared pseudo randomly in 10% of the trials and served as target and distractor stimuli in rotation. A trial consisted of the presentation of a fixation cross with random duration between 800 and 1000 ms, followed by the presentation of a face for 250 ms, with no inter-trial interval. A total of 1200 experimental trials were presented in four blocks. In two of the blocks, the beloved was the target stimulus and the friend was the distractor. In the other two blocks, the friend was the target and the beloved was the distractor. These block types alternated each other and block order was counterbalanced across participants.

At the testing session, the participants were asked for how many months they had been in love (love duration), as well as for how many months they had been involved in a romantic relationship with their beloved (relationship duration). Furthermore, they rated the extent to which they experienced romantic love with the beloved on a nine-point Likert scale (self-reported love; 1, not in love at all; 9, very much in love). The participants also completed the Dutch versions of the passionate love scale (PLS) [8], which assesses the extent to which someone experiences passionate or romantic love (minimum mean score, 1; maximum, 9) and the affect intensity measure (AIM) [12], which determines the general tendency to experience emotions intensely (minimum mean score, 1; maximum, 6). In a previous study [11], Cronbach's alpha was 0.76 for the PLS and 0.88 for the AIM (unpublished data). Next, the electrodes were placed and the participants were seated in a comfortable chair in a soundproof, dimly lit room. The participants were instructed to limit movements and eye blinks during testing. After ten practice trials, the participants completed the four experimental blocks, each of which was preceded by the instruction to silently count one