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The influence of encoding intention on electrophysiological indices of recognition memory

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Abstract

The main aim of this study was to further specify the encoding and retrieval conditions that determine the success of an ERP-based memory assessment procedure, originally derived from lie detection studies. We examined whether event-related brain potentials (ERPs) recorded during successful and unsuccessful retrieval would vary according to intentional (study) and incidental (repetition) encoding conditions. Participants (N=20) were asked to indicate recognition of previously studied words (learned targets, p=0.2) and words that were used as distractors in a preceding recognition task (repeated targets, p=0.2). Words that were recognised elicited a P3 component, which was largely absent for new words and words that failed to be recognised. Encoding intention was found to increase the P3 amplitude slightly but had no influence on P3 scalp distribution, suggesting that the differently encoded targets were similarly processed during retrieval but to a different extent. The amplitude difference was explained in terms of variance in memory trace strength and decision confidence. With respect to negative findings for repeated items in our earlier study (Van Hooff, J.C., Golden, S. 2002. Validation of an event-related potential memory assessment procedure: Intentional learning as opposed to simple repetition. J. Psychophysiol., 16, 12–22.), it was suggested that the instruction to actively retrieve the repeated words was essential for obtaining reliable indications of the presence or absence of weak memory traces.

Keywords: P3; Recognition memory; Encoding intention; Memory trace strength; Retrieval instruction

1. Introduction

This experiment is part of a series of studies examining the sensitivity of a memory assessment procedure, which, in addition to recognition judgements, involves the recording of event-related brain potentials (ERPs). The rationale of this procedure is derived from lie detection studies (e.g., Allen et al., 1992; Farwell and Donchin, 1991) and is based on the assumption that a P3 ERP component can be reliably elicited by items that are infrequently presented and that possess special significance for the participants. In previous studies, we have demonstrated that, in

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absence of a behavioural indication of recognition, items could gain special significance, and hence the ability to elicit a P3, by virtue of previous learning (van Hooff et al., 1996a) but not by virtue of mere repetition (van Hooff and Golden, 2002). These results have implications for the applicability of the ERP-based memory assessment procedure since they suggest that it may not be sensitive enough to detect possible weak memory traces, for example, as a result of suboptimal encoding conditions (e.g., during sleep or anaesthesia, or in dual-task situations) or in patients with amnesic syndrome (cf., Allen, 2002). The main aim of this study was to further specify the encoding and retrieval conditions that determine the success of the ERP-based memory assessment procedure. More specifically, it focused on effects of intentional vs. unintentional encoding and successful and unsuccessful retrieval.

The P3 component is identified as a positive deflection in the ERP waveform, reaching a maximum over the central–parietal areas in a 250–800 ms poststimulus time window. The P3 is typically elicited during an oddball paradigm and is believed to reflect processes that are essential for event categorisation. According to Kok (1997), these processes are controlled by working memory and attention, which refers to both automatic capturing of attention and active focussing of attention. To this extent, researchers sometimes distinguish different P3 subcomponents where the 'novelty P3' mainly reflects involuntary attention shifts to changes in the environment (Spencer et al., 1999) while the centro-parietal 'P3b' (or 'classical P3') mainly reflects processes associated with the evaluation of task relevant stimuli (Kok, 2001). Furthermore, the novelty P3 has a more fronto-central distribution than P3b and is believed to be functionally related to the P3a subcomponent, which indexes the automatic detection of deviant stimuli that are not task relevant (Squires et al., 1975). In the rest of this report, the P3 is referred to as the total collection of these subcomponents, which frequently overlap in time and which are not always easily distinguishable.

Targets or task relevant items are subject of focused attention and can thus be expected to elicit large P3s when correctly classified as targets. In contrast, non-targets or task irrelevant items *may* capture the participant's attention and, consequently, *may* elicit a P3, depending on the items' specific attributes and their relationship to the participant. The P3-evoking ability of personally relevant items is believed to be an automatic and involuntary process (Kok, 2001) and has been used in the past to detect guilty knowledge (Farwell and Donchin, 1991), deception (Rosenfeld et al., 1991), concealed learning (Allen et al., 1992), and feigned amnesia (Rosenfeld et al., 1995). In a typical experiment of this kind, participants are first confronted with a small set of items (i.e., the critical items), which subsequently are embedded as *nontargets* in a two-choice recognition task. The main finding in these studies was that despite their nontarget status, the critical items elicited a P3 component, presumably due to automatic attention processes.

The above studies have in common that the critical items were infrequently presented (cf., oddball paradigm) and were made extra important by means of a deceive or conceal instruction. Furthermore, the items were typically well encoded through enactment (Farwell and Donchin, 1991) or elaborate study (Allen et al., 1992), or alternatively, were of an autobiographical nature (Rosenfeld et al., 1995). Following on from these studies, we demonstrated that neither a deceive instruction nor an association with a crime-related or autobiographical event was needed to obtain comparable results (van Hooff et al., 1996a). Aurally presented, neutral words from one semantic category that was previously studied were found to elicit a reliable P3 component, even when these words did not require a behavioural recognition response (*studied nontargets*). This was replicated in a subsequent study for visually presented words that were not semantically related, but a similar effect could not be observed for items that were repeated from an earlier phase of the experiment (*repeated nontargets*; van Hooff and Golden, 2002). This seemed to imply that the type or depth of encoding crucially affected the items' ability to elicit a P3. It was therefore concluded that the ERP-based memory assessment procedure might be less suited to demonstrate the presence of weak memory traces (here modelled by repetition) in the absence of overt behavioural recognition responses. Accordingly, this would then also provide an explanation as to why we did not find ERP evidence for memories for intraoperatively presented words, using a highly similar memory assessment procedure (van Hooff et al., 1996b). There is at least one reason to doubt this conclusion, however, because participants were not asked to