Editorial

Brain-Electrical Correlates of Negative Priming

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Over the past three decades research using event-related brain potentials (ERPs) has lead to important advances in the study of human attention (for a review, see Luck, Woodman, & Vogel, 2000). The list of well-known examples includes, among many other things, the operating of attention at early stages of selection (Hillyard, Hink, Schwent, & Picton, 1973), the factors eliciting early selective attention (Luck & Hillyard, 1999), the functional analysis of attentional networks (Posner & Petersen, 1990), and the controlled and automatic aspects of auditory match and mismatch (Näätänen, 1992). This special issue follows the tradition of using ERPs as a means to develop further the insight into attentional mechanisms.

If one object is selectively attended, distracting objects must be ignored. It has been known for quite some time that ignoring a distracting object leaves processing traces that can be measured in participants' behavior at some point later in time. Specifically, reactions to recently ignored objects are slower and typically also more error-prone than reactions to novel objects (Dalrymple-Alford & Budayr, 1966), which is why "negative priming" has evolved as the term representing the behavioral consequences of ignoring.

These behavioral consequences of ignoring are extremely robust. They can be observed with stimuli as diverse as simple geometric shapes (Yee, 1991), line drawings of objects (Tipper, 1985), photographs of faces (Buchner, Steffens, & Berry, 2000), written letters (Neumann & DeSchepper, 1991), written words (Rothermund, Wentura, & De Houwer, 2005), spoken words (Banks, Roberts, & Ciranni, 1995), animal sounds (Mayr & Buchner, in press), instrument sounds (Buchner & Mayr, 2004) and even across the visual and auditory modalities (Buchner, Zabal, & Mayr, 2003; Driver & Baylis, 1993). In fact, research on the behavioral consequences of ignoring an object has become so numerous and so diverse that the customarily cited reviews (most often Fox, 1995; May, Kane, & Hasher, 1995; Neill, Valdes, & Terry, 1995; Tipper, 2001) have ceased being adequate for characterizing the field.

Despite the abundance of experimental evidence pertaining to the behavioral consequences of ignoring, hardly anything seems to have been published about the concurrent brain-electrical correlates of ignoring. In fact, this empirical gap in our understanding of the negative priming phenomenon began to be closed only recently (Kathmann, Bogdahn, & Endrass, 2006; Mayr, Niedeggen, Buchner, & Pietrowsky, 2003). The apparent gap has also stimulated the current special issue on brain-electrical correlates of negative priming, the more so as one may hope that this research may help deciding which theory best explains the negative priming phenomenon by enabling us to look beyond mere reaction times and error rates using a high temporal resolution research tool.

Needless to say, the experimental work collected here is just about as diverse as the rest of the negative priming literature. The contribution by *Ruge and Naumann* is based on a spatial negative priming task. In this task, participants report the location of a target object while ignoring a distractor object. The typical slowdown in reactions and increase in error rates are observed when the target object appears at the location at which a distractor was presented on the preceding trial, that is, when the previous distractor location (the *prime* distractor location) becomes the subsequent target location (the *probe* distractor location). When compared to a control condition with no overlap of prime and probe locations, this condition was characterized by a lower-amplitude N1 and an enhanced-amplitude N2pc, both contralateral to the visual half-field of the target location, and a posteriorly distributed enhanced-amplitude N2 without lateralization. Ruge and Naumann interpret their findings as evidence in favor of a variant of a *distractor inhibition account* of negative priming.

According to the distractor inhibition account (Houghton & Tipper, 1994; Neill, 1977; Tipper, 1985), negative priming reflects the operation of an attentional selection mechanism that prevents access of ignored objects to overt responses by suppressing competing distractor input. This mechanism enables more efficient responding to the current target, but causes a delay in responding when the previously ignored (and, hence, inhibited) distractor becomes the new target. Neill and colleagues (Neill & Valdes, 1992; Neill, Valdes, Terry, & Gorfein, 1992) later argued that a

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probe target that is identical to the prime distractor (which is the case on ignored repetition but not on control trials) may serve as a retrieval cue to the prime episode. Part of the retrieved prime episode may be some sort of "do-not-respond" information associated with the prime distractor. This nonresponse information may lead to time-consuming conflicts with the required probe-target response, which would also explain the performance decreases in the ignored repetition relative to the control condition. Note that distractor inhibition and episodic retrieval theories are not mutually exclusive. Both inhibitory and retrieval processes could be involved in the emergence of negative priming (Chao & Yeh, 2004; Kane, May, Hasher, & Rahhal, 1997; Tipper, 2001).

The data presented by *Gibbons* seem to support such a combined "inhibition-plus-episodic-retrieval" account. In a spatial negative priming task similar to that used by Ruge and Naumann, an enhanced posterior N2 component was observed, replicating this aspect of the results of Ruge and Naumann. Gibbons agrees with Ruge and Naumann that this finding supports the distractor inhibition account of negative priming. However, Gibbons also investigated an identity negative priming condition, that is, a condition in which participants had to report, using a key press, the identity of a digit presented in a particular target color while ignoring a distractor digit. Analyses of LRPs provided evidence consistent with an episodic retrieval account, in that the similarity between prime and probe stimuli in negative priming trials provoked retrieving the prime response, which would create a conflict with the required probe response.

This interpretation is consistent with that preferred by *Mayr, Niedeggen, Buchner, and Orgs* for results that were also obtained in an identity negative priming task, but one with auditory stimuli. Specifically, their analyses revealed a parietally located negativity of the negative priming condition compared to the control conditions between 550–730 ms poststimulus, replicating earlier findings (Mayr et al., 2003). Because corresponding ERP components were found to be sensitive to stimulus recognition and familiarity, the results may be interpreted to support an episodic retrieval account of negative priming. However, Mayr et al. found that this effect was stronger for slow than for fast reactions, suggesting that instructions focusing on response speed may reduce, or even eliminate, the chances of obtaining ERP correlates just like the behavioral consequences of ignoring (Neill & Westberry, 1987).

Finally, *Wagner, Baving, Berg, Cohen, and Rockstroh* compared a group of medicated schizophrenic patients and a group of matched controls using visually presented words as stimuli. In terms of reaction times, patients showed stronger positive priming than controls, but the groups did not differ in terms of negative priming, a result that is parallel to recently reported data that were obtained using auditory stimuli (Zabal & Buchner, 2006). In terms of ERPs, negative priming affected the N400, but only in controls and not in schizophrenic patients. Negative repetition priming, but not negative semantic priming, increased the late positive complex (500–700 ms) in both groups, consistent with findings recently reported by Kathmann et al. (2006), and in line with a prime-response retrieval account of negative priming (Mayr & Buchner, in press; Rothermund et al., 2005).

This overview is obviously biased in that it points out the consistencies across findings. It should not be overlooked that the results reported in this special issue also differ in certain respects. To some degree this is probably due to differences in the tasks that were used, but a certain degree of inconsistency is inevitably due to chance. It is currently not possible to tell which of these differences are substantial and which are not, but this may change soon as more ERP researchers decide no longer to ignore the negative priming phenomenon.

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