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INTERNATIONAL  
JOURNAL OF  
PSYCHOPHYSIOLOGY

International Journal of Psychophysiology 49 (2003) 75–87

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## The effects of aging on selective attention to touch: a reduced inhibitory control in elderly subjects?

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Received 17 September 2002; received in revised form 26 March 2003; accepted 1 April 2003

### Abstract

This article aimed at disclosing differences in the brain mechanisms underlying selective attention between elderly and young subjects. We studied two populations of subjects, 17 elderly (mean age: 71.7) and 12 young (mean age: 26.9). Somatosensory evoked potentials (SEPs) to median nerve stimulation were recorded from 19 scalp electrodes in a neutral condition (NC), in which subjects were asked to disregard the electrical stimulation and in a selective attention condition (SAC), in which the subjects had to count tactile stimuli delivered on the same hand of the stimulated median nerve. In a further 3 old and in 3 young subjects, SEPs were recorded also in a distraction condition (DC), in which the subjects had to perform a mathematical task. The SEP amplitude increase during SAC was lower in old than in young subjects. Moreover, while in young subjects the N140 potential was identifiable only in SAC, in the elderly population it was already evoked during both NC and DC. Elderly subjects are probably unable to divert their attention from the median nerve electric stimuli during NC and DC and, therefore, have lower attention resources to invest during SAC. This may explain the recording of the attention-related N140 potential even in NC and DC and the lower SEP amplitude increase in SAC, observed in elderly subjects. These findings agree with recent hypotheses that suggest a decrease of the inhibitory control of the attention mechanisms during aging.

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**Keywords:** Aging; Inhibition; Somatosensory evoked potential; Attention; Human brain

### 1. Introduction

Many neuropsychological and psychophysiological studies were dedicated to the investigation of the effects of aging on the cognitive functions and to clarify the mechanisms that underlie the worsening, shown by elderly subjects in their cognitive performances (Rubert et al., 1996; Kok, 2000).

However, whether the difference in cognitive processing between young and elderly subjects is only quantitative, yet it represents a debated problem. In other words, we may wonder whether only a functional worsening of the same cognitive processes that work well in the youth takes place in elderly subjects or, instead, cognitive strategies change during aging. There are several neuropsychological observations suggesting that decreased inhibitory modulation of cognitive and perceptual

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processes is central to the psychology of normal human aging (Hasher and Zacks, 1988). In particular, the model proposed by Zacks and Hasher (1997) emphasizes a reduction of the inhibitory control of attentional and behavioural systems during normal aging. Evoked potentials are very suitable to investigate this issue, since they can reveal the activation of different cerebral areas, and functional modification of neuronal circuits. Indeed, event-related potentials evoked by different modalities have been compared between young and elderly subjects (Kok, 2000). It has been shown that a global slowing of all cognitive operations, irrespective of the specific nature of the task, occurs in the old age. Therefore, according to these studies, young and old subjects do not substantially differ in the quality of cognitive functions. Most efforts were devoted to the study of the P300 potential (Ford et al., 1979; Pfefferbaum et al., 1980; Picton et al., 1984; Polich et al., 1985; Yamaguchi and Knight, 1991; Vesco et al., 1993; Anderer et al., 1998), while the middle-latency EP components have never been investigated. However, it has been demonstrated that selective attention influences the topography and the amplitude of the somatosensory evoked potentials (SEPs) as early as 40 ms after the stimulus (Desmedt et al., 1983; Desmedt and Tomberg, 1989; Garcia-Larrea et al., 1991). This finding means that the attentional mechanisms start being effective simultaneously with or immediately after the perception of the stimulus.

Our study aimed at investigating the effect of selective attention toward somatosensory stimuli on scalp SEPs in a latency range from 40 to 200 ms. We compared the SEP modifications induced by attention between young and old subjects. If the same SEP amplitude and latency modifications were observed during the attention task in young and elderly subjects and only the amount of such variations were different, there would be evidence that the same cognitive strategies work independently from the subject's age. Instead, if changes in SEP topography due to attention mechanisms were demonstrated, and they were different in elderly and young subjects, a qualitative age-related difference in cognitive operations would be suggested.

## 2. Materials and methods

### 2.1. Subjects

Our study was performed on a group of 29 right-handed subjects, divided into two different groups: 17 healthy elderly subjects (5 men, 12 women; mean age 71.7, range 58–90), and 12 healthy young subjects (7 men, 5 women; mean age 26.9, range 17–35). All participants were free from neurological symptoms or signs, and unaware of the experimental procedure. All of them gave an informed consent.

### 2.2. Experimental procedure

SEPs were recorded after electrical stimulation of both the right and the left median nerves. Brain activity was analysed under two different experimental conditions in each subject. During the neutral condition (NC), the subjects were asked to stay relaxed, and to disregard the electrical stimulation. In the selective attention condition (SAC) subjects had to count silently brief mechanical targets, made manually by a gauze ball on the tip of the first and the second finger of the hand ipsilateral to median nerve stimulation. Around 100 targets were presented for each hand with an interstimulus interval variable between 3 and 7 s. The 'gauze ball test' was performed by the same examiner (F.R.) in all subjects, thus ensuring us that no important difference in target presentation could occur between subjects. The order of the stimulated median nerves (right or left) and of the conditions (NC and SAC) was randomly chosen and counterbalanced across subjects.

### 2.3. Additional experiment

In further 3 old subjects (3 men; mean age 65.3, range 58–72) and in further 3 young subjects (1 man, 2 women; mean age 26.3, range 24–28) SEPs were recorded in NC, in SAC and also in a distraction condition (DC), where the subjects were asked to count back from 1000 by steps of 7, after both right and left median nerve stimulation. This additional experiment was performed to evaluate the capability of subjects to ignore the

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