

Acute effects of caffeine on selective attention and visual search processes

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Abstract

The influence of a single dose of caffeine was evaluated in focused and divided attention conditions of a visual selective search task in which subjects had to perform controlled search processes to locate a target item. Search processes were manipulated by varying display load. A dose of 3 mg/kg body weight caffeine or lactose, dissolved in a cup of decaffeinated coffee, was administered double blindly and deceptively to overnight abstinent coffee drinkers. Behavioral measures were supplemented by event-related potentials (ERPs). Subjects reacted faster in the caffeine condition. The P3b peak latency decreased after caffeine in the low display load condition and in the focused attention condition, indicating that the effects of caffeine are dependent on the number of relevant display items, not on the total number of display items presented. Search processes, as reflected in a negative ERP deflection, were not affected by caffeine.

Descriptors: Caffeine, Focused attention, Divided attention, Display load, Visual event-related potentials

In situations such as driving a car, there are many sources of information in the environment that have to be attended to to drive safely. In the optimal situation, subjects are able to pay attention to all information at the same time. However, the human information processing system is limited in its processing capacity and can only process a restricted amount of information at the same time. Therefore, one has to select relevant cues in the environment to attend to at appropriate times to perform optimally. Performance failures can be made easily if attention is distracted by irrelevant information.

Two types of selective attention can be discerned. In a *focused attention* condition, subjects have to concentrate on one source of information; for example, a conversation in which one is involved. The *divided attention* condition is defined as a situation in which attention has to be divided over a number of stimuli. An example of the latter situation is the automobile driver who has to attend to the road signs while maintaining control of the car.

Experimental evidence indicates that increases in arousal tend to restrict the focus of attention (Humphreys & Revelle, 1984; Posner & Raichle, 1994) and thus might prevent people from being distracted by irrelevant information. In accordance with this, Lorist and colleagues (Lorist, Snel, Kok, & Mulder, 1994; Lorist, Snel, Mulder, & Kok, 1995) found that subjects seemed

to be less distracted by irrelevant information after they used caffeine, which is regarded as a stimulant. They used a focused attention version of a selective search task (Okita, Wijers, Mulder, & Mulder, 1985; Shiffrin & Schneider, 1977; Schneider & Shiffrin, 1977; Wijers et al., 1987) in which subjects had to detect the possible occurrence of a memory set item presented on relevant diagonal positions of the display and to ignore stimuli appearing at the irrelevant diagonal. Different computational processes are involved in the task. First, subjects have to discriminate between relevant and irrelevant information, followed by a comparison of the selected information to internal representations. Thereafter, a response decision should be made, and, subsequently, this response has to be selected, programmed, and executed (see also Mulder, Wijers, Lange, Smid, & Gunter, 1993). Information transformations related to the encoding of incoming information, that is, to the identification of incoming information, are supposed to be input-related processes. Memory search and response decision are regarded as central processes involved in the further processing of information. The preparation, activation, and execution of responses are assumed to represent output mechanisms associated with the organization of motor-related activities.

These different mental operations are assumed to be reflected in various components of the event-related brain potential (ERP). The selection between relevant and irrelevant information can be observed by superimposing the ERPs elicited by attended and unattended stimuli. Previous studies have indicated that these two waveforms start to diverge at 260 ms, with a maximum at frontocentral scalp positions, independent of whether subjects had caffeine or placebo. However, the amplitude of this

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Effects Of Caffeine On Visual Attention

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