



# Controlled processes account for age-related decrease in episodic memory

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## Abstract

A decrease in controlled processes has been proposed to be responsible for age-related episodic memory decline. We used the Process Dissociation Procedure, a method that attempts to estimate the contribution of controlled and automatic processes to cognitive performance, and entered both estimates in regression analyses. Results indicate that only controlled processes explained a great part of the age-related variance in a word recall task, especially when little environmental support was offered. © 2006 Elsevier B.V. All rights reserved.

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## 1. Introduction

Automatic memory processes, also called “ecphoric” processes, allow the activation of a memory trace from a cue without intention or conscious effort, at least if there is overlap between this cue and the memory trace. On the contrary, controlled processes are not supported by environmental support and do not depend on habits (Bialystok, Craik, Klein, & Viswanathan, 2004). They are involved in the rejection of irrelevant stimuli, the orienting of attention to the relevant ones, the conscious mental manipulation of information, etc. They also allow intentional and active memory search of a past event; in the memory context, they are called “recollection” and are assumed to be independent of the automatic use of memory (Jacoby, Bishara, Hessels, & Toth, 2005).

It is now well known that elderly adults, compared with younger adults, are typically disadvantaged in their performance on direct or explicit tests of memory (such as free recall, recognition, and cued recall), in which participants are asked to recollect a previous study episode (for reviews, see Craik, Anderson, Kerr, & Li, 1995; Craik & Jennings, 1992). For the last 15 years, much work has focused on the possible causes of such a decline. One interesting hypothesis stems from the convergence of two sets of data. Studies on brain-damaged patients and studies using brain imaging, have shown that the frontal lobes play an important role in memory tasks requiring controlled processes such as initiation, planning, reorganisation, spatial and temporal contextual details retrieval or in dual task memory situations (Craik & Grady, 2002; Moscovitch, 1994a; Norman & Schacter, 1996; Shimamura, Janowsky, & Squire, 1990). Moreover, age-related physiological brain changes are particularly visible in those cerebral structures (Grady & Haxby, 1995; Martin, 1998; Prull, Gabrieli, & Bunge, 2000) and could therefore disrupt controlled processes in aging people (Buckner & Koutstaal, 1998).

Age effects on tasks implying control and effortful strategies have indeed been frequently described. Craik (1986, 2002) noted that aging persons obtained lower memory performances than young adults, especially when strategic demands were high, and that giving the participants environmental support reduced these age-related differences. For instance, telling people in advance the best way to encode the to-be-presented words reduced differences in memory performance between young and elderly adults (Bäckman & Karlsson, 1986; Bäckman & Larsson, 1992). In the same way, giving them semantic cues at retrieval reduced the gap between elderly and young people (Bäckman & Karlsson, 1986; Bäckman & Larsson, 1992; Craik, Byrd, & Swanson, 1987) because retrieval cues allowed them to recover information from memory even if specification of some retrieval cues (attributed to controlled processes) was deficient (Burgess & Shallice, 1996). As also noted by Moscovitch (1992), free recall implies strategic processes to retrieve information (since no cues are given) while cued recall can be based on more automatic processes. However, strategic processes can also be implied in cued recall tasks in order to consciously retrieve encoded information (free and cued recall tasks being explicit tasks). It is therefore difficult, with these manipulations (e.g. giving cues), to distinguish the contribution of automatic and controlled processes to memory performance.

In contrast to the age-related decline in tasks of direct or explicit memory, some studies have proposed that performance of older and younger adults do not differ on indirect or implicit memory tests (e.g. Ergis, Van der Linden, & Deweer, 1995; Light, La Voie, & Kennison, 1995; Winocur, Moscovitch, & Stuss, 1996). Implicit tasks, such as word

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