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Age effects on response monitoring in a mental-rotation task

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Abstract

A mental-rotation task was presented to young (18–28 years) and old (60–76 years) adults to simultaneously assess age-related changes in performance, response monitoring and adaptive behavior. Relative to young participants, older adults were less inclined to adjust their speed at the expense of accuracy. They displayed a larger number of slow errors, smaller error potentials (Ne and Pe), more immediate corrections of errors when detected, and a larger speed reduction on trials following an error. The data suggest that for older adults an increase of task complexity sometimes caused a radical failure in determining the correct response, rather than a gradual reduction of efficiency. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

1.1. Age effects on speed

Traditionally, speed has been the most important measure for the assessment of cognitive aging, while measures such as accuracy have been largely ignored. Older adults are known to respond slower than young adults on basically all speeded tasks, and an important goal of aging research has always been to translate this slowing to changes in component mental processes or even neural processes. This approach has resulted in two opposing interpretations of slowing. On the one hand,

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the large similarity across tasks in age-related slowing has been reason for some researchers to propose a generalized effect of age onto all processes (e.g. Cerella, 1990; Myerson et al., 1990; Kail and Salthouse, 1994). Proponents of generalized-slowing theories argue that task requirements do not modulate the amount of age-related slowing.

On the other hand, there are researchers who emphasize the specific effects that age seems to have on a restricted number of mental processes. According to these researchers, it is essential to know the task content before performance of older adults can be predicted. For example, Fisk and Rogers (1991) have shown that older adults are more delayed than young adults by an increase in memory load, whereas an increase in display load had similar effects for both age groups. Dissociations such as these suggest that the generalized effect does not exhaustively describe mental changes with age, and that age affects some processes or task domains more seriously than others.

1.2. Qualitative differences with age

Generalized-slowing and process-specific slowing theories are based exclusively on speed. There are, however, some scarce attempts to complement quantitative (speed) analysis with an assessment of qualitative differences (accuracy). These extended analyses yield a more accurate account of age-related changes to information processing, because speed and accuracy are mutually dependent. Whenever speed is compared between young and old¹, the source of reaction time (RT) in both groups is assumed to be equivalent (correspondence axioma or the age-invariance assumption: Cerella, 1990; Myerson and Hale, 1993; see Ridderinkhof et al., 1999 for a discussion). If, however, young and old differ in processing architecture or in the accuracy level that they arrive at, RTs do not reflect the same constructs (cf. Eckensberger, 1973). It is therefore dangerous to infer age-related processing differences from speed alone.

At least two important additional performance factors should be explored to justify a comparison of speed. Speed–accuracy relations can reveal the efficiency at the production level, while response monitoring represents adaptive processes at a hierarchically superior level, which is not involved in the response production itself. We assume that age-related differences in efficiency at the production level occurs as a result of reduced processing capacity. As the task demands become higher, the most efficient strategies for information processing may no longer be applicable. A slower strategy or the acceptance of occasional failures of a faster strategy may be required. Accuracy depends increasingly on efficient monitoring of the selection and execution of responses as orchestrating these strategies becomes more difficult. Once processing capacity is exceeded, response monitoring may also fail and errors may go unnoticed.

¹ We will use the terms young and old as shorthand for the population of healthy young adults (18–30 years old) and healthy people over 60 years old. Note that age continues to affect processing speed after 60 years, and that the present data can not be generalized to ages 75 years and older.

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