

Metamemory monitoring in mild cognitive impairment: Evidence of a less accurate episodic feeling-of-knowing

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Abstract

This study aimed at exploring metamemory and specifically the accuracy of memory monitoring in mild cognitive impairment (MCI) using an episodic memory feeling-of-knowing (FOK) procedure. To this end, 20 people with MCI and 20 matched control participants were compared on the episodic FOK task. Results showed that the MCI group made less accurate FOK predictions than the control group by overestimating their memory performance on a recognition task. The MCI overestimation behavior was found to be critically related to the severity of their cognitive decline. In the light of recent neuroanatomical models showing the involvement of a temporal-frontal network underlying accurate FOK predictions, the role of memory and executive processes was evaluated. Thus, participants were also administered memory and executive neuropsychological tests. Correlation analysis revealed a between-group differential pattern indicating that FOK accuracy was primarily related to memory abilities in people with MCI, whereas it was specifically related to executive functioning in control participants. The lesser ability of people with MCI to assess their memory status accurately on an episodic FOK task is discussed in relation to both their subjective memory complaints and to their actual memory deficits which might be mediated by the brain vulnerability of their hippocampus and medial temporal system. It is suggested that their memory weakness may lead people with MCI to use other less reliable forms of memory monitoring.

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1. Introduction

Mild cognitive impairment (MCI; Flicker, Ferris, & Reisberg, 1991) is the term used to define a transitional zone between normal aging and dementia. This intermediate stage of cognition has been characterized in many ways, but the most frequently endorsed criteria are those described by Petersen et al. (1999), involving a subjective as well as objective memory impairment, against a background of preserved general cognitive and functional abilities. The cognitive deficit must not be severe enough to meet dementia criteria. MCI is of considerable clinical relevance and is becoming a central focus of research as it helps identify people at high risk of developing dementia. Alzheimer's Disease (AD) appears to be the most common cause of this mild

cognitive decline, particularly in the amnesic subtype of MCI, but MCI may also be prodromal in other dementia disorders (Petersen et al., 2001). In some cases, the cognitive impairment may either improve or remain stable over time (Palmer, Wang, Backman, Winblad, & Fratiglioni, 2002; Ritchie, Artero, & Touchon, 2001). This inherent etiological heterogeneity and blurred boundaries of MCI as currently conceptualized has been widely criticized in the literature. To optimize its clinical significance, the validity of diagnosis criteria needs to be verified and the cognitive deficits better defined, notably with regard to the memory dysfunction profile. The aspect which undoubtedly raises the most controversy is the relevance of subjective memory complaints (SMC) in diagnosing MCI, and there has been a long-running debate about the predictive validity of memory complaints for memory impairment and dementia. Numerous cross-sectional studies relating SMC to memory performance have resulted in inconsistent outcomes, some authors finding an association (Bassett & Folstein, 1993; Jonker, Launer, Hooijer, & Lindeboom, 1996), others finding none (O'Connor,

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Pollitt, Roth, Brook, & Reiss, 1990; Schmidt, Berg, & Deelman, 2001; Sunderland, Watts, Baddeley, & Harris, 1986). Subjective complaints may be more closely associated with depression and anxiety disorders than actual memory impairment (Bolla, Lindgren, Bonaccorsy, & Bleecker, 1991; Hänninen et al., 1994; Zimprich, Martin, & Kliegel, 2003). On the other hand, the majority of data from community-based longitudinal studies have shown that subjective complaints of cognitive loss are predictive of future cognitive impairment and dementia in elderly people with mild cognitive decline (see for a review Jonker, Geerlings, & Schmand, 2000; for contradictory results, Jorm et al., 1997), and even in older people with normal baseline cognitive functions (Reisberg et al., 2005). These findings provide powerful legitimacy to the notion of SMC as part of the MCI concept. However, while SMC as a criterion for MCI are the focus of much attention, the mechanisms by which such memory complaints are made have been under- or mis-exploited.

SMC are the product of a memory monitoring process which is a metamemory component consisting of the individual's subjective assessment of his or her own memory ability (Nelson & Narens, 1990). The central role of this metamemory process is based on the idea that accurate monitoring allows optimal self-regulation of memory behavior (Koriat, 2000; Nelson & Narens, 1990, 1994) and should therefore lead to higher levels of memory performance (Metcalf, 1993). Thus, the study of metamemory provides qualitative clues about the mechanisms of the human memory system and how it changes. Examining metamemory in people with MCI is of both clinical and theoretical interest, helping to characterize their cognitive deficits, while providing powerful knowledge about episodic memory functioning, which is particularly vulnerable in these people. Furthermore, insight into the possible impairment of metamemory processes could help draw up targeted rehabilitation programs. The few currently available data likely to provide information on the memory monitoring capacities of people with MCI come from studies on the accuracy of the link between SMC and actual memory impairment in MCI based on methodological approaches commonly used to assess deficits in cognitive awareness (Clare, 2004; Clare, Marková, Verhey, & Kenny, 2005). These methods consist of comparing the perceived difficulties reported by the subject with either those reported by an informant on parallel measures or the subject's performance on objective memory tests. In general, it seems that people with MCI lack precision in their own reports of cognitive impairment. These misjudgments mainly involve an underestimation of dysfunction (Albert et al., 1999; Collie, Maruff, & Currie, 2002; Vogel et al., 2004), but as well in the sense of an overestimation (Kalbe et al., 2005). These cross-sectional studies have produced divergent results and are far from being in agreement about the idea of diminished self-awareness of cognitive impairment in MCI. An important factor that may account for variance in the results concerns differences in patient sampling, particularly in terms of severity of overall cognitive impairment. Many studies have documented significant relationships between impaired awareness and severity of cognitive decline in AD (Harwood, Sultzer, & Wheatley, 2000; McDaniel, Edland, Heyman, & the CERAD clinical investigators, 1995; Migliorelli et al., 1995; Ott

et al., 1996; Sevush, 1999; Wagner, Spangenberg, Bachman, & O'Connell, 1997). A similar association has also been reported in MCI, suggesting that people with MCI may have a critical view of their performance in the earliest phase of impairment and then show a decrease of this insight with the progression of the disease (Kalbe et al., 2005). Results of longitudinal studies suggest that lack of insight into their deficits in the cognitive area of memory (Tierney, Szalai, Snow, & Fisher, 1996) and functional abilities (Tabert et al., 2002) can be predictive of dementia in people with MCI. However, both these studies use questionnaires or self-report measures for operationalization of memory self-awareness or metamemory and contain a large number of methodological limitations (for more details see Hertzog, Hultsch, & Dixon, 1989; Hertzog, Park, Morrell, & Martin, 2000; Trosset & Kaszniak, 1996). Despite their limitations, these earlier studies indicate that when people with MCI have to make global judgments of memory, they experience certain difficulties in monitoring their memory functioning accurately. Moreover, they highlight the importance of looking at the severity of cognitive impairment when investigating awareness-related processes.

A more reliable way of examining memory monitoring processes is to use specific experimental metamemory paradigms. In the experimental literature on memory monitoring, a great deal of attention has been paid to 'metamemory judgments', which consist of evaluating the current state of one's memory during an ongoing memory task. This online monitoring of memory is typically assessed by having people to predict item-by-item how well they will remember items during an upcoming memory test (i.e., prospective monitoring judgments). In particular, the feeling-of-knowing (FOK) judgments consist in asking subjects to estimate the likelihood that they will later recognize a piece of information they had just failed to recall with a cue. These predictions concern either semantic memory (Hart, 1965) or recently learned episodic memory information (Schacter, 1983). The feeling-of-knowing experience commonly occurs when one fails to retrieve specific information, and this feeling indicates the extent to which the information seems available in memory for future retrieval. In situations such as recall failure, the monitoring function is therefore implemented to assess and infer from a variety of clues (data or processes) the likelihood that the solicited information is retained in memory (Koriat, 1993; Nelson & Narens, 1990). Accuracy of monitoring is thus deduced from the degree to which a person's judgment predicts memory performance. At the present time and to our knowledge, the metamemory of people with MCI has never been investigated experimentally with these empirical monitoring measures. The aim of this paper is to undertake this type of investigation using an episodic FOK procedure.

There is now a broad base of empirical observations using different versions of the FOK procedure confirming the accuracy of judgments which reliably predict performance (Gruneberg & Monks, 1974; see Metcalfe & Shimamura, 1994; Nelson, Gerler, & Narens, 1984). Two theoretical views have been proposed to explain how FOK judgments are made to predict future memory performance. One concerns the cue-familiarity account (Metcalf, Schwartz, & Joaquim, 1993; Reder, 1987) suggesting

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