Prospective and Retrospective Memory Complaints in Mild Cognitive Impairment and Mild Alzheimer's Disease

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Current management attempts for Alzheimer's disease (AD) focus on the identification of individuals in the preclinical stage. This has led to the development of the diagnostic concept of Mild Cognitive Impairment (MCI), which applies to individuals with declining cognitive abilities but largely preserved everyday functioning. Previous findings indicate that prospective memory deficits are a sensitive marker of preclinical AD and that awareness of prospective memory failures is particularly high, based on its dependence on executive functions. Thus, the goal of this study was to evaluate the usefulness of subjective prospective versus retrospective memory complaints for an initial screening for MCI and their respective associations with executive functions. 71 healthy older adults, 27 MCI patients, and 9 patients with mild AD completed the Prospective and Retrospective Memory Questionnaire (PRMQ) and three executive functions tests. The healthy and the MCI group could not be distinguished by their level of subjective prospective or retrospective memory complaints, but the mild AD patients differed from the other groups by complaining more about retrospective than prospective memory failures. For the healthy older adults, the prospective memory complaints were correlated to an inhibition test, whereas they did not correlate with any of the executive function tests in the MCI patients. In contrast, in both groups the retrospective memory complaints were related to a task switching test. The findings are discussed with respect to differences between the three groups in cognitive abilities, attention to failures of, use of mnemonic aids for, and everyday demands of prospective and retrospective memory.

Keywords: subjective cognitive complaints, prospective memory, mild cognitive impairment, Alzheimer's disease

With growing life expectancy, Alzheimer's disease (AD) has become a major health challenge for industrialised countries (Sloane, Zimmerman, Suchindran, Reed, Wang et al., 2002). Clinical diagnosis of AD requires the presence of multiple cognitive deficits and impairment of everyday functioning (see 4th edition of the *Diagnostic and Statistical Manual for Mental Disorders, DSM-IV*; American Psychiatric Association, 1994). This has been considered as a very late stage for possible therapeutic intervention in the neuropathological process (Reisberg & Gauthier, 2008) and, therefore, current management attempts focus on the identification of individuals in the transitional state between normal ageing and AD characterised by first cognitive impairments, but still

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largely preserved functional abilities (Caselli, Beach, Yaari, & Reiman, 2006; Leifer, 2003).

Among diagnostic concepts developed for this purpose (see Reisberg, Ferris, Kluger, Franssen, Wegiel et al., 2008 for an overview), *Mild Cognitive Impairment* (MCI) as proposed by the International Working Group on Mild Cognitive Impairment (Winblad et al., 2004) has lately achieved the most general acceptance. However, it has been criticised for its heterogeneity (Rockwood, Chertkow, & Feldman, 2007): although there is a markedly higher incidence of AD in individuals with MCI as compared to the general population (Petersen & Negash, 2008), a rather high percentage develops other dementias, remains stable, or even reverts to a cognitively intact status (Ganguli, 2006). Furthermore, prevalence of MCI and conversion rates to AD vary between different studies, caused by differences in populations being studied (clinic attenders or normal population) and in specific operationalisation of MCI criteria (Bruscoli & Lovestone, 2004; Panza, D'Introno, Colacicco, Capurso, Del Parigi et al., 2005).

Diagnostic criteria for MCI are (a) the person is neither normal nor demented, (b) there is evidence of cognitive deterioration shown by either decline in neuropsychological test performance over time and/or subjective report of decline by self and/or informant in conjunction with objective cognitive deficits as defined by neuropsychological test performance below age-adjusted norms, and (c) activities of daily living are preserved and complex instrumental functions are either intact or minimally impaired. As for AD diagnosis, other causes for cognitive dysfunction have to be excluded. For first diagnostic assessment of MCI a stepwise procedure is recommended: first the examination of cognitive complaints by the person assessed or a close acquaintance of this person, then the assessment of the person's cognitive and functional abilities. Since information from an acquaintance takes time and might be difficult to acquire, the question arises whether self-reported cognitive deficits constitute a useful initial screening for MCI.

Such a screening should distinguish MCI patients from healthy older adults as well as from mild AD patients. Studies with elderly population-based samples (Fisk, Merry, & Rockwood, 2003; Fisk & Rockwood, 2005; Jungwirth, Fischer, Weissgram, Kirchmeyr, Bauer et al., 2004; Luck, Busse, Hensel, Angermeyer, & Riedel-Heller, 2008; Purser, Fillenbaum, & Wallace, 2006) question the ability of self-reported cognitive impairments to discriminate MCI patients from healthy older adults. They demonstrated that about as many people with cognitive impairments and largely preserved everyday functioning complained about cognitive impairments as not. Furthermore, many people with normal cognitive and functional abilities also complained about cognitive deficits.

However, in these studies subjective cognitive complaints were assessed with a single question regarding memory impairment that seems to be inappropriate with regard to its specificity and sensitivity for MCI. Cognitive impairment indicative for MCI is defined by neuropsychological test performance below age-adjusted norms. However, normal ageing is associated with mild cognitive decline and thus many older adults will judge their memory as impaired. On the other hand, since MCI patients may experience deficits in other cognitive domains than memory and do not show impairments in most aspects of everyday functioning, many of them will judge their memory as intact. Therefore, a screening instrument for subjective cognitive complaints suggestive for MCI should rather include several questions regarding different aspects of cognitive functioning and differences between MCI patients and healthy older adults should arise in their level of positive answers or ratings. The same holds true for the differentiation between MCI and mild AD patients, because they also only differ in their level of cognitive and functional impairment.

Indeed, several studies using questionnaires or interviews about everyday impairments in memory (Clément, Belleville, & Gauthier, 2008; De Jager & Budge, 2005; Perrotin, Belleville, & Isingrini, 2007) or in several cognitive domains (Kliegel, Zimprich, & Eschen, 2005; Rabin et al., 2006) have demonstrated that MCI patients report a higher level of subjective cognitive complaints than healthy older adults, but a similar level of subjective memory (Clément et al., 2008) or general cognitive complaints (Kalbe et al., 2005) as mild AD patients.

The latter findings have been explained with the diminished insight of the mild AD patients in their cognitive deficits. On cognitive questionnaires, they evaluate their cognitive abilities as more positive than their carers (e.g.,, Cahn-Weiner, Ready, & Malloy, 2003; Derousné et al., 1999). However, findings by Vogel, Hasselbach, Gade, Ziebell, and Waldemar (2005) also question insight of MCI patients: in comparison with their carers, MCI patients underreported their cognitive deficits to a similar degree as mild AD patients. In contrast, Kalbe and colleagues (2005) found MCI patients to over- and mild AD patients to underreport their cognitive impairments.

These differential findings might be caused by differences in the instruments used. Kalbe and colleagues questioned their participants on various

cognitive abilities, while Vogel and colleagues used a memory questionnaire only, suggesting that MCI patients have a diminished insight for this cognitive ability specifically. This is surprising, since episodic memory impairment is one of the earliest and best cognitive predictors of AD (Almkvist, 1996; Bäckman, Jones, Berger, Laukka, & Small, 2005; Rubin et al., 1998) and the MCI patients in Vogel and colleagues' study had a severe impairment in this cognitive domain only. Kalbe and colleagues, however, did not find significant differences between the MCI and AD patients' and their caregivers' ratings for their memory question. Clément and colleagues (2008) reported that although their MCI and mild AD patients had similar sum scores on a memory questionnaire, the AD patients had significantly higher scores than their healthy older sample on 3 of 10 questionnaire subsections referring to different memory types, whereas the MCI patients had significantly higher scores than the healthy older adults on these and three additional subsections. This suggests that only questionnaires on certain types of memory impairments might be useful to discriminate between healthy older adults, MCI patients, and mild AD patients.

Research on episodic memory impairment in AD has so far mainly concentrated on one of its domains, that is, *retrospective memory,* whereas prospective memory has largely been neglected. While retrospective memory relates to remembering past events, *prospective memory* refers to remembering to carry out planned actions at prespecified times in the future (McDaniel & Einstein, 2007). Prospective memory has a *retrospective component* (remembering which actions were intended for what times), but involves distinct processes (termed *prospective component*) that enable self-initiated punctual action execution (for verification of discriminant validity of prospective versus retrospective memory see Salthouse, Berish, & Siedlecki, 2004 and Zeintl, Kliegel, & Hofer, 2007). Among these distinct processes, executive functions, such as monitoring for execution times while performing other activities, inhibition of ongoing activities, and initiation of the planned actions at the critical times, seem to play a leading role (for detailed task analyses see Burgess & Shallice, 1997; Ellis, 1996; Knight, 1998; for evidence on greater involvement of executive functions versus retrospective memory see Kopp & Thöne-Otto, 2003; McDaniel, Glisky, Rubin, Guynn, & Routhieaux, 1999).

To date, only a few studies have compared the sensitivity of prospective and retrospective memory as an early indicator of AD. Maylor, Smith, Della Sala, and Logie (2002) found that individuals with mild to moderate AD performed worse than healthy controls on prospective memory tasks, but were even more impaired on retrospective memory tasks. Surprisingly, the retrospective component of the prospective memory task was intact in all their AD patients. Duchek, Balota, and Cortese (2006) also demonstrated a clear prospective memory deficit relative to healthy controls in older adults with very mild AD. The authors did not directly compare prospective and retrospective memory performance of their participants, but demonstrated that the prospective memory performance helped to discriminate between the very mild AD patients and healthy adults above and beyond retrospective memory performance. Moreover, within their prospective memory task, the AD patients' impairment was greater for the prospective than for the retrospective component. Finally, in a large longitudinal population-based study, Jones, Livner, and Bäckman (2006) found that compared to participants who remained healthy, participants who three years later received an AD diagnosis showed similar deficits in prospective and retrospective memory. Additionally, their impairments in the retrospective and the prospective component of the prospective memory task were of equal size. In summary, these findings indicate that prospective memory is a similarly sensitive marker of preclinical or early AD as retrospective memory.

With regard to subjective memory complaints, prospective memory complaints may have a higher discriminative power than retrospective memory complaints for MCI. Mäntylä (2003) suggested that people are more aware of their prospective than their retrospective memory failures because prospective memory tasks involve more executive and thus conscious, self-initiated behaviour and are, therefore, more often subject to conscious perception and evaluation processes. Furthermore, people may monitor their prospective memory performance more closely than their retrospective memory performance since prospective memory failures seem to cause a greater impairment in everyday functioning (Kliegel & Martin, 2003) and have more negative social consequences — they are attributed to a person's lack of reliability, whereas retrospective memory failures are ascribed to a weakness of a person's memory (Winograd, 1988).

With the Prospective and Retrospective Memory Questionnaire (PRMQ; Smith, Della Sala, Logie, & Maylor, 2000), a questionnaire specifically developed for capturing differences between subjective prospective and retrospective

memory complaints, a greater awareness for prospective than for retrospective memory failures has been consistently found in the normal population (Crawford, Smith, Maylor, Della Sala, & Logie, 2003; Kliegel & Jäger; 2006; Mäntylä, 2003; Rönnlund, Mäntylä, & Nilsson, 2008; Singer, Falchi, MacGregor, Clerkas, & Spector, 2006; Smith et al., 2000). Furthermore, Singer and colleagues (2006) could demonstrate a specific association of subjective prospective memory complaints with executive functions: in a large sample of healthy twins the PRMQ Prospective Scale was not correlated to classical retrospective memory tasks, but to a working memory task only. However, Smith and colleagues (2000) found the PRMQ Prospective and Retrospective Scales to discriminate AD patients from healthy older adults equally well. Nevertheless, Smith and colleagues had asked the carers of their AD patients to complete the PRMQ on the patients' behalf and the objectivity of the carers' judgement was questioned by the finding that the carers evaluated their own everyday prospective and retrospective memory better than age-matched healthy control participants.

Therefore, the first aim of this study was to evaluate the usefulness of self-reported prospective versus retrospective memory complaints as an initial screening for MCI by comparing the ratings of a group of healthy older adults, a group of MCI patients, and a group of mild AD patients on the Prospective and the Retrospective Scale of the PRMQ. It was anticipated that all participant groups complain more about prospective than retrospective memory failures. MCI patients were expected to report more prospective and retrospective memory failures than the healthy older adults, while the AD patients were expected to report more prospective memory failures than the MCI patients, but a similar amount of retrospective memory failures.

The second aim of this study was to evaluate Mäntylä's claim that greater awareness of everyday prospective than retrospective memory competence is based on its greater dependence on executive functioning and whether this applies to healthy older adults as well as to MCI patients for whom insight in their memory competence has been questioned. This was done by calculating correlations between the scores of the healthy older adults or MCI patients, respectively, on the PRMQ Prospective and Retrospective Scales and on three executive function tests. It was expected that for both healthy older adults and MCI patients, at least one of the executive function tests would be correlated to the Prospective Scale, but none to the Retrospective Scale.

Method

Participants

In total, 107 participants were included in the analyses: 27 MCI patients, 9 patients with mild AD, and 71 healthy older controls.

MCI and AD Patients

The MCI and AD patients were recruited out of 311 in- and outpatients of the Gerontopsychiatric Centre of the Psychiatric University Hospital Zurich who underwent a neuropsychological examination as part of an extensive diagnostic assessment for self- or informant-reported cognitive decline between July 2003 and June 2005 for the first time. At the end of the neuropsychological examination, patients who were not handicapped by too severe perception, language, or comprehension impairments were asked to complete the PRMQ. In total, 101 patients were able to and agreed to fill out the questionnaire.

The neuropsychological test battery (see below) contained a depression screening questionnaire and tests for the cognitive domains memory, language, praxia, perception, executive functions, attention, speed, and crystallised intelligence. Cognitive impairment was operationalised by test performance of at least one standard deviation below age-adjusted norms, since MCI diagnosis based on this cut-off score has been found to have the highest predictive power for later development of dementia (Busse, Hensel, Gühne, Angermeyer, & Riedel-Heller, 2006). In addition to the neuropsychological examination, a clinical interview with the patient and a person who knew the patient well was conducted to determine the patient's level of functional ability, to evaluate the presence of psychiatric disorders including substance abuse, and to obtain a medical history. The medical history was corroborated by and complemented with relevant previous medical reports about the patient. Furthermore, a neurological, a neuroradiological (either computer tomography or magnetic resonance imaging), and a laboratory examination were conducted to screen for neurological and systemic diseases known to cause cerebral dysfunction. Based on the assessment results, patients were diagnostically classified by a consensus conference of the multidisciplinary clinic staff.

Out of the 101 patients who completed the PRMQ, 9 received the diagnosis of a probable AD according to the *DSM-IV* (American Psychiatric Association, 1994) and the NINCDS-ADRA criteria (McKhann et al., 1984), and 27 received the diagnosis of MCI according to the

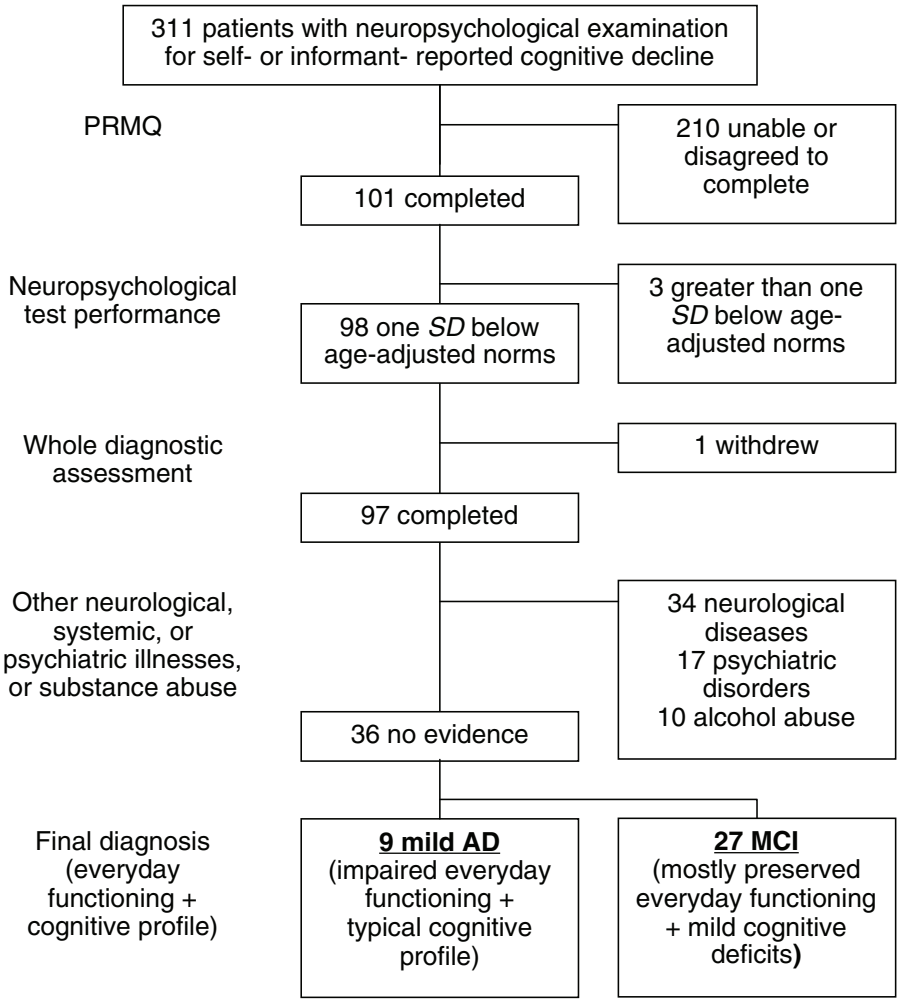

FIGURE 1
Selection procedure for the MCI and the mild AD patients.

general MCI criteria as proposed by the International Working Group on Mild Cognitive Impairment (Winblad et al., 2004). All AD patients were in the mild stage of the disease as indicated by MMSE scores greater than 17 and by their individual neuropsychological profiles, that is their cognitive impairments were restricted to memory, naming, executive functions, and constructional praxia deficits (Ballard et al., 1999; Storey, Slavin, & Kinsella, 2002). Like AD, MCI was only diagnosed when there was no evidence for neurological and systemic diseases, psychiatric disorders, or substance abuse that could account for the cognitive deficits. The remaining 65 patients who completed the PRMQ were excluded from the analyses for the following reasons: 1 did not complete the whole assessment procedure, 3 showed normal test performance, 1 had a schizoaffective disorder, 16 for indication of a depressive episode (either by clinical diagnosis or by the scores on the depression screening questionnaire), 10 for alcohol abuse, 3 for epilepsy, 1 for a traumatic brain injury, 1 for a subdural hematoma, 12 for strokes or cerebrovascular haemorrhages, 2 suffered from a subcortical vascular dementia, 11 from a mixed dementia, and 4 from Parkinson's disease. Figure

1 shows a schematic overview of the diagnostic procedure for the MCI and the mild AD patients.

Healthy Older Controls

Altogether 80 community-dwelling older adults aged between 54 and 91 years (in order to match for the typical patient age range of the Gerontopsychiatric Centre) were recruited as controls. They were screened with the help of a specifically designed health questionnaire and a depression screening questionnaire (see below) for the same exclusion criteria that were applied for the diagnosis of the MCI and AD patients: regular use of neurotoxic substances or neurological, psychiatric, and systemic diseases known to cause cognitive dysfunction. With this procedure, nine participants were excluded: five for indication of alcohol abuse and four for indication of a depressive episode (either by relevant information from the health questionnaire or by the scores on the depression screening questionnaire).

Materials

Depression Screening Questionnaires

For the patients the short form of the Geriatric Depression Scale (GDS; Sheikh & Yesavage, 1986) was used to screen for the presence of a depressive episode, whereas for the healthy elderly volunteers the depression subscale of the Hospital Anxiety and Depression Scale (HADS; Zigmond & Snaith, 1983) was applied. Both questionnaires focus on emotional and motivational depressive symptoms, thus avoiding overlap with somatic symptoms common in ageing. The GDS was chosen for the mostly cognitively impaired patients because of its easy response format (yes/no-format). For the healthy older adults, the HADS depression subscale was chosen because it has a greater score range and allows for graded responses to single items and therefore was expected to lead to a more accurate identification of depressive cases.

Short form of the Geriatric Depression Scale (GDS). It includes 15 questions that can be agreed or disagreed to. Answers indicative of a depressive episode are summed up. Possible minimum and maximum scores are 0 and 15. Sum scores greater than 5 are considered to be suggestive, scores greater than 10 to be indicative of the presence of a depressive episode. GDS scores greater than 5 lead to exclusion from this study. All patients completed the GDS in the presence of their neuropsychologist and were thus able to ask comprehension questions.

The depression subscale of the Hospital Anxiety and Depression Scale (HADS). It contains seven items (e.g., 'I have lost interest in my appearance'). Participants have to indicate on a 4-point rating scale (*nearly all of the time, very often, sometimes, not at all*) how often these symptoms occurred in the last week. These ratings are assigned numerical values of 3 (*nearly all of the time*) to 0 (*not at all*) and summed up. Consequently, possible scores range from 0 to 21. Scores between 8 and 10 are regarded as suggestive, scores of 11 and higher as indicative of the presence of a depressive episode. In this study, scores greater than 7 lead to exclusion. All healthy volunteers completed the HADS depression subscale in the presence of the experimenter and were thus able to ask comprehension questions.

Neuropsychological Tests

MCI and AD patients. The neuropsychological examination for the MCI and AD patients included the German version of the Consortium to Establish a Registry for Alzheimer's disease Neuropsychological Assessment Battery (CERAD-NAB) that was scaled on a large Swiss German sample of healthy adults aged between 53 and 92 years to provide age-, gender-, and education-specific norms (Berres, Monsch, Bernasconi, Thalmann, & Stähelin, 2000). It has been proven to discriminate between healthy older adults, patients with a major depression, with MCI, with mild, and with moderate AD, respectively (Barth, Schönknecht, Pantel, & Schröder, 2005) as well as between patients with mild AD, mild frontotemporal dementia, and mild semantic dementia (Diehl et al., 2005). The CERAD-NAB contains seven subtests: the Mini-Mental State Examination (MMSE; Folstein, Folstein, & McHugh, 1975), a semantic fluency test, a 15-item form of the Boston Naming Test, a constructional praxia test, a visual delayed free recall test, a word list learning test, a delayed free recall, and a delayed recognition test for this word list.

All participants. The following tests were completed by all participant groups. They were selected from the neuropsychological test battery for the MCI and AD patients, to allow for a short measurement of crystallised intelligence and executive functioning (i.e., working memory, task switching, and inhibition) in the healthy older adults.

- *Crystallised intelligence* was evaluated with the Mehrfachwahlwortschatztest B (MWT-

B; Lehrl, 1977), a multiple-choice vocabulary test. Raw scores can be converted to IQ scores. Since crystallised intelligence is thought to be a product of both formal and informal educational efforts throughout life (see Cattell, 1987), this test was used as a second measure for educational attainment next to years of schooling which reflect by definition only formal educational efforts in the youth.

- *Working memory* was tested with the Digit Span backward subtest of the German version of the Wechsler Memory Scale-Revised (WMS-R; Härting et al., 2000). Possible minimum and maximum scores are 0 and 12.
- *Task switching* was measured with the Trail Making Test (TMT; Reitan, 1955; version and norms according to the new extended German CERAD-NAB online version 'CERAD-Plus online', Memory Clinic Basel). In Part A of the TMT (TMT-A), the time (in s) was measured that the participants needed to connect randomly distributed digits (1–25) in ascending order. This is regarded as a measure for motor speed. In Part B of the TMT (TMT-B) the time (in s) was measured that the participants needed to alternately connect randomly distributed digits (1–13) and letters (A–L) in ascending or alphabetical order, respectively. In the 'CERAD-Plus online' — TMT version the quotient of time for Part B and time for Part A (TMT B/A) is used as a measure for task switching, thus controlling for motor speed.
- *Inhibition* was measured with the third plate of the Stroop-Victoria Test (Regard, 1981). The third plate depicts the words 'yellow', 'red', 'blue', and 'green' (altogether 20) in the yellow, red, blue, and green with the colour of the words not corresponding to their meaning. The time (in s) was measured that the participants need to correctly state the colour of all words.

Prospective and Retrospective Memory Complaints

For the assessment of the amount of prospective and retrospective memory complaints, all participants completed the German version of the PRMQ (Kaschel, 2002; original version by Smith et al., 2000). The PRMQ contains 16 items. Eight of these items refer to everyday prospective memory failures (e.g., 'Do you fail to mention or give something to a visitor that you were asked to pass on?') and form the Prospective Scale. The 8 other items refer to everyday retrospective memory failures (e.g., 'Do you fail to recognise a place you have visited before?') and form the Retrospective Scale. The questions on both scales are matched for two other dimensions of episodic memory (i.e., self- versus environmentally-cued retrieval and length of retention interval). On each item, one can indicate on a 5-point Likert-type rating scale (*very often*, *quite often*, *sometimes*, *rarely*, and *never*) how often one has recently experienced this particular memory failure. These ratings are assigned numerical values of 5 (*very often*) to 1 (*never*) and are summed up. Consequently, possible minimum and maximum scores on the Prospective and Retrospective Scales are 8 and 40.

Confirmatory factor analyses on the PRMQ items in a large British (Crawford et al., 2003) and in a large Swedish (Rönnlund et al., 2008) population-based sample have indeed proven a three-factor structure of the PRMQ, with the Prospective and Retrospective Scales as orthogonal factors and episodic memory as a common factor. These studies also confirmed a high reliability of both scales (Crawford et al.: Cronbach's alphas were 0.84 and 0.80; Rönnlund et al.: Cronbach's alphas were 0.86. and 0.78 for the Prospective and Retrospective Scales, respectively). Additionally, concurrent validity of the Prospective Scale has been demonstrated: in healthy middle-aged (Mäntylä, 2003) and older adults (Kliegel & Jäger, 2006; Zeintl, Kliegel, Rast, & Zimprich, 2006), performance on laboratory prospective memory tasks was correlated to the PRMQ Prospective Scale. Moreover, Mäntylä (2003) could provide evidence that the Prospective Scale is indeed related to everyday prospective memory performance. He demonstrated that middle-aged women who specifically regarded their prospective memory as poor had higher scores than middle-aged women who considered their memory generally as intact only on the Prospective Scale. Additionally, the complaining women performed equally well as the non-complaining women on classical retrospective memory tasks, but were slightly impaired on laboratory and severely impaired on naturalistic prospective memory tasks.

All MCI and AD patients completed the PRMQ in the presence of their neuropsychologist; all healthy older adults in the presence of the experimenter. All participants were thus able to ask comprehension questions.

Results

Excluded Participants

Excluded Patients

There were no differences between excluded patients ($n = 65$) and the included MCI and mild AD patients ($n = 36$) in age, $t(99) = –0.34$, $p < .80$; years of schooling, $U(65) = 412.5$, $p < .20$; crystallised intelligence, $U(84) = 814.0$, $p < .80$; MMSE scores, $U(100) = 981.5$, $p < .30$; PRMQ Prospective, $t(98) = 1.30$, $p < .30$; and Retrospective Scale scores, $t(96) = 0.20$, $p < .90$. There was a significantly lower proportion of women, 53.8% vs. 75.0%, $\chi^2(1, N = 101) = 4.37$, $p = .036$, and a trend towards a lower proportion of outpatients, 69.2% vs. 86.1%, $\chi^2(1, N = 101) = 3.54$, $p = .060$) in the excluded patient group. They had significantly higher Geriatric Depression Scale scores than the included patients ($Mdn = 6.0$, range = 15 vs. $Mdn = 2.0$, range = 5), $U(99) = 373.0$, $p < .001$.

Excluded Healthy Controls

There were no differences between excluded ($n = 9$) and included healthy control participants ($n = 71$) in age, $t(78) = –0.79$, $p < .50$; gender, $\chi^2(1, N = 80) = 2.16$, $p = .141$; crystallised intelligence $t(78) = –0.58$, $p < .60$; PRMQ Prospective, $t(78) = –0.90$, $p < .40$; and Retrospective Scale scores, $t(77) = –0.74$, $p < .50$. The excluded healthy participants had more years of schooling ($M = 15.00$, $SD = 2.50$ vs. $M = 13.30$, $SD = 2.86$) and higher HADS depression subscale scores than the included healthy controls ($M = 5.22$, $SD = 3.11$ vs. $M = 3.08$, $SD = 1.75$), but these differences just failed to reach significance level, $t(8.65) = 2.02$, $p = .075$; or $t(78) = 1.71$, $p = .091$, respectively.

Participant Groups Characteristics

Table 1 provides demographic data (age, gender, years of schooling, crystallised intelligence) about the three participant groups. For the MCI patients and the mild AD patients additionally GDS scores, proportion of outpatients, MMSE scores, and CERAD-NAB memory subtest scores are presented.

Demographic Variables

The three participant groups did not differ in age, $F(2, 104) = 0.36$, $p < .80$, or gender, $\chi^2(2, N = 107) = 3.63$, $p < .20$. There was a group difference with respect to formal education, $F(1,104) = 3.28$, $p = .042$, with post-hoc comparisons (Tukey *a*) indicating a trend to fewer years of schooling in the AD patients as compared to the healthy older adults, HSD = –2.18, $p = .087$. A Kruskal-Wallis test with participant group as between-subject variable was used to evaluate group differences in crystallised intelligence because variance homogeneity between groups was not given. According to this analysis, $\chi^2(2, N = 105) = 28.98$, $p < .001$, the groups differed in their crystallised intelligence level. Post-hoc comparisons (independent *t* tests) indicated that the healthy older adults had a higher crystallised intelligence level than the MCI, $t(94) = 4.95$, $p < .001$, and the AD patients,

TABLE 1
Participant Groups Characteristics

	Control ($n = 71$) M (*SD*)	MCI ($n = 27$) M (*SD*)	AD ($n = 9$) M (*SD*)
Age (years)	73.20 (7.34)	73.44 (6.84)	75.33 (6.56)
Proportion of women	59.2 %	70.4 %	88.9 %
Years of schooling	13.30 (2.86)	12.15 (3.27)	11.11 (1.54)
Intelligence (IQ)[a]	124.0 (52)	107.0 (50)[b]	104.0 (15)
GDS scores		2.02 (1.54)	2.22 (1.39)
Proportion of outpatients		88.9 %	77.8 %
MMSE		27.44 (2.08)	25.78 (3.53)
Word list learning[c]		–1.34 (1.69)	-2.48 (0.86)
Word list delayed free recall[c]		–1.08 (1.48)	-2.76 (0.60)
Word list delayed recognition[c]		–1.26 (2.60)	-3.84 (2.76)
Visual delayed free recall[c]		–0.79 (1.50)	-1.87 (0.86)

Note: [a]Medians and ranges are reported because group variances were inhomogeneous.
[b]$n = 25$. [c]CERAD-NAB subtests. In age-, gender-, and education-adjusted *z* scores.

$t(32.85) = 8.74$, $p < .001$. The median crystallised intelligence level of the healthy older adults was above average and that of the MCI and the AD patients approximately average, with all participants individually having at least an average IQ (minimum IQ of the whole sample was 86). This is in line with findings of higher incidence rates for MCI (Kumar et al., 2006; Panza et al., 2005; Tervo et al., 2004) and AD (see Caamaño-Isorna, Corral, Montes-Martínez, & Takkouche, 2006 for a meta-analysis) in older adults with lower educational attainment.

Depressivity

Due to the strict selection procedure (exclusion of healthy older adults with scores greater than 7 on the HADS depression subscale and of patients with scores greater than 5 on the GDS), the reported level of depressivity in all participant groups was very low (for patient groups see Table 1; healthy participants: mean HADS depression subscale score = 3.08, $SD = 1.75$). The MCI and AD patients did not differ in GDS scores, $t(34) = -.35$, $p < .80$.

Patient Status of MCI and AD Patients

The two patient groups did not differ in the relative proportion of in- and outpatients, $\chi^2(1, N = 36) = 0.68$, $p < .50$. The large majority of the patients were outpatients, indicating that most patients' functional status was relatively mildly impaired.

General Cognitive Status of MCI and AD Patients

The MMSE scores of both patient groups were in the range regarded as typical for MCI and mild AD patients, that is for the MCI group between 24 and 30 and for the mild AD group between 18 and 30. The mean MMSE scores of the two patient groups indicate a very mildly impaired general cognitive status of the MCI patients and a mildly impaired general cognitive status of the AD patients. There was a trend towards higher MMSE scores in the MCI patients, $t(34) = 1.73$, $p = .092$.

Retrospective Episodic Memory of MCI and AD Patients

Table 1 displays the CERAD-NAB memory subtest scores as age-, gender-, and education-adjusted z scores according to the norms provided by a large healthy elderly Swiss German sample, thus allowing for comparison between the test performances of the two patient groups and the test performances of demographically-matched healthy older adults. Compared to the healthy normative sample, as a group, the MCI patients showed only mild verbal retrospective memory impairments (mean CERAD-NAB word list subtests z scores between one and two standard deviations and mean CERAD-NAB visual free delayed recall subtest z score within one standard deviation below demographic-adjusted norms). In contrast, the mild AD patients showed severe verbal retrospective memory impairments (mean CERAD-NAB word list subtests z scores below at least two standard deviations below demographic-adjusted norms) and additionally a mild visual retrospective memory deficit (mean CERAD-NAB visual free delayed recall subtest z score between one and two standard deviations below demographic-adjusted norms). The MCI patients performed significantly better than the mild AD patients on all CERAD-NAB memory subtests; word list learning: $t(27.77) = 2.65$, $p = .013$; word list delayed free recall: $t(32.41) = 4.83$, $p < .001$; word list delayed recognition: $t(34) = 2.54$, $p = .016$; visual delayed recall: $t(24.80) = 2.62$, $p = .015$.

Group Differences in Prospective and Retrospective Memory Complaints

In Table 2, the mean PRMQ Prospective and the mean Retrospective Scale scores for each of the

TABLE 2

Comparison of the Participants Groups for the PRMQ Prospective (PS) and Retrospective Scale (RS) Scores

Group	*n*	PS *M (SD)*	RS *M (SD)*	Average between PS and RS *M (SD)*
Control	70	19.06 (4.38)	18.87 (4.24)	18.96 (4.41)
MCI	27	18.85 (5.82)	18.56 (4.82)	18.70 (4.41)
AD	9	17.22 (6.08)	20.56 (5.90)	18.89 (4.41)
Whole sample	106	18.93 (4.52)	18.85 (4.91)	18.85 (6.10)

three participant groups and the whole sample are presented. Additionally, in the last column of Table 2 the means for the average between the Prospective and Retrospective Scale scores for each participant group and the whole sample are provided.

A 3 × 2-mixed ANOVA with participant group as between-subject factor and type of memory complaint (i.e., Prospective versus Retrospective Scale of the PRMQ) as within-subjects factor was conducted to assess whether the participant groups differed in the amount of prospective versus retrospective memory complaints. The main effect of group was not significant, $F(2, 103) = 0.03$, $p < .97$, partial $\eta^2 = 0.001$, indicating that the groups did not differ in the amount of reported memory failures (regardless of which type). As can be seen in the last column of Table 2, the means for of the average between the Prospective and Retrospective Scale scores were very similar for all groups. There was a main effect of type of memory complain, $F(1, 103) = 4.16$, $p = .044$, partial $\eta^2 = 0.039$. As can be seen in the last row of Table 2, the mean Prospective Scale scores of the whole sample were lower than the mean Retrospective Scale scores of the whole sample. This indicates that in the whole sample more retrospective than prospective memory failures were reported. Furthermore, there was an interaction between participant group and type of memory complaint, $F(2, 103) = 4.33$, $p = .016$, partial $\eta^2 = 0.077$. As can be deducted from Table 2, the Prospective and Retrospective Scale scores of the healthy older adults and the MCI patients were very similar, whereas the Retrospective Scale scores of the AD patients were greater than their Prospective Scale scores. Post-hoc paired t tests confirmed that there was no difference between the Prospective and Retrospective Scale scores of the healthy older adults, $t(69) = -.55$, $p < .60$, $d = 0.04$, and of the MCI patients, $t(26) = -.35$, $p < .80$, $d = 0.05$), whereas this difference was marginally significant for the AD patients, $t(8) = 2.22$, $p = .057$, $d = -0.56$. Therefore, the main effect of greater Retrospective than Prospective Scale scores was probably mainly caused by the greater Retrospective than Prospective Scale scores of the AD patients. In conclusion, these analyses indicate that the participant groups did not differ in their mean level of prospective and retrospective memory complaints. However, the AD patients reported more retrospective than prospective memory complaints, whereas the healthy older participants and the MCI patients complained as much about prospective as about retrospective memory failures.

Relation of Prospective and Retrospective Memory Complaints to Executive Functioning in Healthy Older Adults and MCI Patients

To assess whether prospective memory complaints were differentially associated with executive functioning for both healthy older adults and MCI patients, Pearson product–moment correlations between the PRMQ Prospective and Retrospective Scale scores and the three applied executive functions tests scores (i.e., Digit Span backward scores as working memory measure, TMT-B/A scores as task switching measure, and third plate Victoria-Stroop Test scores as inhibition measure) were calculated separately for the healthy older adults and the MCI patients. The results of these analyses are displayed in Table 3.

Healthy Older Adults

The PRMQ Prospective Scale scores correlated significantly only with the Victoria-Stroop Test scores. Additionally, there was a marginally significant correlation between the PRMQ Retrospective Scale scores and the TMT-B/A scores. Both correlations were positive and of moderate size. This indicates (a) that healthy older adults who rated their prospective memory

TABLE 3

Correlations Between the PRMQ Prospective (PS) and Retrospective Scale Scores (RS) and Executive Functions Tests for Healthy Older Adults and MCI Patients

	Controls		MCI	
	PS	RS	PS	RS
Digit Span backward	−.03 (70)	−.15 (69)	−.03 (25)	−.18 (25)
TMT-B/A	.16 (71)	.23 (70)†	.18 (20)	.60 (20)**
3rd plate Stroop	.24 (70)*	.15 (69)	.26 (25)	.10 (25)

Note: Pearson product-moment correlations are presented with n in brackets.
†$p = .058$. *$p < .05$. **$p < .01$.

competence as poor tended to have a poor inhibition performance and (b) that healthy older adults who rated their retrospective memory competence as poor tended to have a poor task switching performance.

MCI Patients

The PRMQ Prospective Scale scores did not significantly correlate with any of the included executive functions tests. In contrast, the PRMQ Retrospective Scale scores correlated significantly with the TMT B/A scores. This correlation was positive and of moderate size, indicating that MCI patients who rated their retrospective memory competence as poor tended to have a poor task switching performance.

Discussion

The aims of this study were to evaluate (a) the usefulness of subjective prospective in comparison to subjective retrospective memory complaints for an initial screening for MCI and (b) the appropriateness of the proposal that awareness of everyday prospective, but not retrospective memory failures, is related to executive functioning in healthy older adults and patients with MCI. For this purpose, 71 healthy older adults, 27 individuals with a clinical diagnosis of MCI, and 9 individuals with a clinical diagnosis of mild AD were asked to complete the PRMQ. Their scores on the Prospective Scale of the PRMQ were used as a measure for subjective prospective memory complaints and their scores on the Retrospective Scale of the PRMQ as a measure of subjective retrospective memory complaints. In addition, the participants completed three executive functions tests.

Since previous findings indicate that on the one hand prospective memory is an equally sensitive marker as retrospective memory for preclinical and mild AD, and on the other hand awareness of everyday prospective memory deficits is greater than awareness of everyday retrospective memory deficits, it was anticipated that all participant groups would complain more about prospective than retrospective memory failures. Additionally, it was expected that the MCI patients would report more prospective and retrospective memory failures than the healthy older adults. The AD patients were expected to report more prospective memory failures than the MCI patients. However, due to their well-known diminished insight in this cognitive ability, we predicted that the AD patients would report a similar amount of retrospective memory failures as the MCI patients. Interestingly, contrary to these predictions, we found that both the healthy older adults and the MCI patients complained as much about prospective as about retrospective memory deficits, while the mild AD patients even complained more about retrospective than prospective memory problems. Additionally, neither the amount of subjective prospective nor retrospective memory complaints could discriminate the MCI patients from the healthy older adults or the AD patients. However, the difference between subjective prospective and retrospective memory complaints distinguished the patients with mild AD from the other two participant groups, thus suggesting the usefulness of assessing both subjective prospective and retrospective memory complaints for a screening for mild AD.

To evaluate whether awareness of everyday prospective memory failures is specifically related to executive functioning in healthy older adults as well as in MCI patients, correlations between their scores on the Prospective and Retrospective Scale of the PRMQ and on the three executive functions tests were calculated separately for the two participant groups. It was expected that for both healthy older adults and MCI patients, their scores on the Prospective Scale, but not on the Retrospective Scale of the PRMQ, were related to their scores on at least one of the executive functions tests. Although the scores of our healthy older adults on the Prospective Scale were correlated with their scores on one of the three executive functions tests, in contrast to the predictions the scores of the MCI patients on the Prospective Scale were not correlated to any of the included executive functions tests. Furthermore, for both the healthy older adults and the MCI patients, the Retrospective Scale scores were correlated with one of the executive functions tests. Nevertheless, a differential pattern of associations emerged: the Prospective Scale scores of the healthy older adults were correlated to their scores on the inhibition test, while the Retrospective Scale scores of both the healthy older adults and the MCI patients were correlated to their scores on the task switching test.

With regard to previous empirical evidence, our finding of a similar amount of subjective prospective and retrospective memory complaints in a group of healthy older adults is surprising. To recap, all previous studies using the PRMQ (Crawford et al., 2003; Kliegel & Jäger; 2006; Mäntylä, 2003; Rönnlund et al., 2008; Singer et al., 2006; Smith et al., 2000) reported a higher amount of subjective prospective than retrospective memory complaints in healthy samples. A

comparison of our data with that of Kliegel and Jäger (2006) who applied the same PRMQ version in another Swiss healthy sample indicates a particularly high amount of subjective retrospective memory complaints in our sample (PRMQ Retrospective Scale: M = 18.87, SD = 4.98 vs. Kliegel et al.: M = 16.48, SD = 3.84), whereas the amount of subjective prospective complaints was very similar in both samples (PRMQ Prospective Scale: M = 19.06, SD = 4.38 vs. Kliegel et al.: M = 18.16, SD = 4.20). With respect to possible variables moderating this effect, one factor may be age. Our sample of healthy adults was older (M = 73.20, SD = 7.34, 54–91 years) than Kliegel and Jäger's sample (M = 44.11, SD = 18.94) and the samples of the other previous studies on the PRMQ (Crawford et al., 2003: M = 63.62, SD = 15.59, 17–94 years ; Mäntylä, 2003: age range 35–55 years; Rönnlund et al., 2008: M = 60.58, SD = 16.42, 35–90 years; Singer et al., 2006: M = 51, 19–85 years; Smith et al., 2000: M = 58.47, 17–93 years[1]). Thus, our finding of a similar amount of subjective prospective and retrospective memory complaints in the healthy older adults might be caused by a specific increase of subjective retrospective memory complaints beginning in old age, while the amount of subjective prospective memory complaints may stay rather stable across the lifespan.

In line with this proposal, we found a significant positive correlation between PRMQ Retrospective Scale scores and age (r = .26, p = .030) for the healthy older adults, whereas the PRMQ Prospective Scale scores and age were not significantly correlated to each other. In contrast, in previous studies on the PRMQ with altogether younger samples consistently no significant correlations between PRMQ Retrospective Scale scores and age were found, whereas the findings regarding the correlation between PRMQ Prospective Scale scores and age were very diverse: ranging from a weak negative correlation (r = -.21; Rönnlund et al., 2008) to no correlation (Crawford et al., 2003) to a weak positive correlation (r = .13; Singer et al., 2006).

The specific increase of subjective retrospective memory complaints in old age might be related to the onset of retrospective memory decline around the age of 60 years (e.g., Rönnlund, Nyberg, Bäckman, & Nilsson, 2005; Schaie, 2005) or to a greater direction of attention to retrospective memory failures from this age on due to the generally expected onset of retrospective memory decline at this age in Western cultures (Heckhausen, Dixon, & Baltes, 1989). On development of prospective memory over the lifespan no longitudinal data is yet available. Cross-sectional studies comparing two extreme age groups (adults aged between 18–30 years and adults aged above 60 years) generally found performance decrements for older adults in laboratory prospective memory tasks, whereas they typically outperformed younger adults in naturalistic prospective memory tasks (for meta-analyses see Henry, MacLeod, Philipps, & Crawford, 2004; Uttl, 2008). Since the latter tasks are more similar to everyday prospective memory tasks targeted by PRMQ items, it seems reasonable to assume that subjective prospective memory complaints do not increase in old age. Furthermore, the more negative functional and social consequences of prospective as compared to retrospective memory failures may lead to a close monitoring of prospective memory performance from early adulthood on and to an early development and long practise of strategies in order to keep it on a similar level over the lifespan. Accordingly, the reliance on external aids, such as calendars, notebooks, reminder notes, or to-do-lists, for managing everyday prospective memory tasks is a common practice in the normal population from early adulthood on (Long, Cameron, Harju, Lutz, & Means, 1999), whereas such external aids seem to be rarely employed for everyday retrospective memory tasks such as remembering names, object locations, or conversations.

One possible reason why both subjective prospective and retrospective memory complaints did not discriminate the MCI patients from the healthy older adults in our study may be that they were relatively mildly impaired in retrospective memory compared to the MCI patient groups in previous studies (Clément et al., 2008; De Jager & Budge, 2005; Perrotin et al., 2007) demonstrating that MCI patients report a higher level of subjective memory complaints than healthy older adults. In these studies, test performance of at least 1.5 standard deviations below age-adjusted norms was used to define memory impairment, whereas we used a cut-off score of one standard deviation only and the mean scores of our MCI patients in the CERAD-NAB retrospective memory subtests were all above 1.5 standard deviations below age-adjusted norms. It might be possible that because of their mild impairment and an appropriate use of external aids, our MCI patients were still able to manage everyday retrospective and prospective memory tasks as well as healthy older adults. Moreover, the MCI patients may not have complained more about prospective than retrospective memory deficits because they still put more effort into managing prospective memory tasks and

were, due to their greater practise in using external aids for this type of everyday memory task, more successful in accomplishing them. Findings by Marsh, Hicks, and Landau (1998) indicate that mild retrospective memory deficits can be in fact compensated by the use of daily planners. They reported that young healthy adults who habitually used daily planners for managing their everyday prospective memory tasks had worse retrospective memory abilities than young healthy adults who did not use daily planners, but were able to complete a similar amount of prospective memory tasks during one week. Furthermore, recently improvements in the functional ability of MCI patients after a short training in the use of an electronic calendar system have been demonstrated (Greenaway, Hanna, Lepore, & Smith, 2008), showing that MCI patients, despite their mild cognitive impairments, are able to successfully apply external memory aids.

In contrast to the MCI patients, the mild AD patients in this study were severely impaired in retrospective memory tasks and had also other cognitive deficits. This may have hindered them in the appropriate use of external memory aids. Therefore, the finding that they reported a similar level of prospective and retrospective memory failures as the healthy older adults and the MCI patients seems to be most likely caused by a diminished insight in the severity of their prospective and retrospective memory impairment. However, since they reported more retrospective than prospective memory impairments, their insight in their retrospective memory competence seems to be more preserved than their insight in their prospective memory impairments. On the other hand, Smith et al. (2000) reported that carers of AD patients are more frustrated about the patients' prospective than retrospective memory failures. Therefore, they may relieve the AD patients from many everyday prospective memory tasks. Consequently, the AD patients may indeed experience fewer everyday prospective than retrospective memory failures. Alternatively, it might be easier for the AD patients and their carers to identify and accept retrospective memory failures since their physicians presented them as the core symptom of the disease, whereas they did not mention prospective memory failures because of their little familiarity with this type of episodic memory.

In our study, we could not confirm Mäntylä's (2003) proposal of a differential relation of subjective prospective memory complaints to executive functioning, since only for the healthy older adults were the PRMQ Prospective Scale scores correlated with an executive functions test, while the PRMQ Retrospective Scale scores were correlated to an executive functions test for both the healthy older adults and the MCI patients. This might be caused by the fact that the Retrospective Scale included a similar amount of questions relating to tasks demanding self-initiated retrieval as the Prospective Scale. In line with this suggestion, Dubreuil, Adam, Bier, and Gagnon (2007) could not find a significant correlation between subjective mainly retrospective memory complaints with a classical retrospective memory task. However, when they separated controlled and automatic memory processes in this task with the Process Dissociation Procedure, they could demonstrate a significant correlation between the subjective memory complaints and the controlled processes. Subjective prospective memory complaints may rather be related to planning instead of working memory, inhibition, or task switching that were measured with the executive functions tests included in this study. In everyday life, people may indeed try to schedule their intended activities so that interruptions of or switches between activities are avoided and, therefore, their timely execution does not depend critically on inhibition or task switching abilities.

A clear limitation of this study is the small sample size of the mild AD patients, thus diminishing the power of the statistical analyses, and particularly challenging nonsignificant findings. However, for the main effect of group on subjective prospective and retrospective memory complaints, as well as for the difference between these two types of memory complaints in the healthy older adults and in the MCI patients, the observed effect sizes were very small, whereas a medium effect size was found for the difference in the mild AD patients, indicating a replication of our findings with larger samples would be worthwhile. Another limitation of this study is the use of convenience samples. The MCI and mild AD patients were recruited from a gerontopsychiatric hospital and thus may have been more aware of their memory problems than similarly affected individuals who do not seek medical advice. The healthy older adults were community-dwelling volunteers. They may have a better memory and thus may complain less about memory failures than the general older population. Consequently, the distribution of the PRMQ to a population-based sample of older adults would be desirable in the future. Furthermore, individuals with MCI constitute a heterogeneous group with regard to cognitive profile and conversion to AD. At the present, a lot of research is dedicated to determining the predictive

power for AD of different cognitive subtypes of MCI (Petersen & Negash, 2008). In future research, it would be useful to include a cognitively more homogeneous sample of patients with a subtype of MCI that has high predictive power for AD. Moreover, we have explained our findings with differences between healthy younger and older adults, MCI patients, and AD patients in prospective and retrospective memory ability, awareness for failures of, the use of external aids for, or everyday demands on prospective and retrospective memory, but did not record most of these variables, or if so, not in all groups. To test the validity of our explanations, in a follow-up study the inclusion of an additional sample of healthy young or middle-aged adults and the measurement of the aforementioned variables in all included groups would be desirable. Furthermore, it would be interesting to directly target insight in prospective and retrospective memory in MCI patients and mild AD patients by comparing their own ratings on the PRMQ with that of their caregivers. For this purpose, the proxy-rating version of the PRMQ (Crawford, Henry, Ward, & Blake, 2006) could be applied.

In conclusion, our results indicate that the assessment of subjective prospective and retrospective memory complaints with the Prospective and Retrospective Scales of the PRMQ is particularly useful for the discrimination of mild AD patients from healthy older adults and MCI patients. However, the mild AD patients could not be distinguished from the other groups by a greater amount of prospective or retrospective memory complaints, but by a greater amount of retrospective relative to prospective memory complaints. Furthermore, our data point to a change of the relation between subjective prospective and retrospective memory complaints in healthy old age with a relative increase in retrospective memory complaints. However, for a deeper understanding of self-reports on prospective and retrospective memory competence in normal adults, MCI patients, and AD patients more research on variables influencing them is needed.

Endnote

1 All available data reported.

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