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Subjective memory beliefs and cognitive performance in normal and mildly impaired older adults

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Abstract

Previous research suggests that subjective perceptions of memory may be related to objective memory performance. In the present study, healthy community-dwelling elders ($N = 73$, mean age = 75.25 years, education = 16.2 years) completed a neuropsychological assessment, including two questionnaires of subjective memory beliefs. Each participant was identified, via consensus conference, as belonging to either an amnesic mild cognitive impairment (MCI, $n = 16$) or no mild cognitive impairment (noMCI, $n = 57$) group. Results indicated that subjective memory capacity beliefs were significantly related to verbal memory performance in the MCI group, but not in the noMCI group. This differential relationship persisted even after controlling for depressive symptoms, and was not reflective of unequal variances in the two groups. Thus, results indicate that subjective memory beliefs may be better indicators of performance in those with possible incipient cognitive impairment than normal older adults, perhaps because persons with MCI have heightened insight into their memory functioning, and that this relationship is not due to group differences in depressive symptoms.

Introduction

Subjective reports of beliefs about one's memory are commonly measured, but there are little data regarding the accuracy of beliefs under conditions of cognitive impairment. Thus, a question yet to be answered is whether cognitive impairment (with its a presumed accumulation of behavioral episodes of memory failure, possibly resulting in increasing memory worry and complaint) transforms the accuracy of such subjective beliefs. In the metacognition and aging literature, mild cognitive impairment (MCI; Petersen et al., 1999, 2001) has not received much attention. Mild cognitive impairment is interesting and potentially clinically important because individuals with MCI are thought to be at an increased risk for the development of Alzheimer's disease (AD); 10–15% of those identified as having MCI progress to AD each year compared to 1–2% of the general same-aged population (Petersen et al., 1999, 2001).

Original criteria for MCI emphasized primarily focal memory deficits (e.g., Petersen et al., 1999). Recent conceptualizations of MCI have broadened to include not only individuals with a mild memory impairment (amnesic MCI or AMCI), but also to include subtypes characterized by a single impairment in a non-memory domain (e.g., working memory or language abilities) or a mild impairment in multiple domains (Petersen et al., 2004). According to Petersen's criteria (Petersen et al., 1999, 2001), individuals with AMCI have a mild memory problem that exceeds what is expected for their age (perform >1.5 SD below age and education corrected norms) while other cognitive domains (e.g., working memory or language abilities)

are generally preserved. The criteria also require: a subjective memory complaint, intact activities of daily living (ADLs), and not meeting the criteria for dementia. The present study focused solely on AMCI. The rationale for this focus was both to constrain the complexity of the population under study and also due to the domain-specificity of study hypotheses. Specifically, we were interested in whether memory self-evaluations were related to memory performance, and to compare this relationship in persons with and without a focal memory deficit.

There has been a growing literature involving a lack of insight (e.g., the lack of the ability to elaborate on the experience of a disease, label the symptoms of the disease as pathological, or have knowledge of the deeper effects that the symptoms or disease will have on one's environment; Marková & Berrios, 2000) in patients with neurodegenerative diseases of aging (Freidenberg, Huber, & Dreskin, 1990; Kalbe et al., 2005; Koltai, Welsh-Bohmer, & Schmechel, 2001). The term anosognosia has been used to describe such lack of insight. In terms of memory, Roberts (1984) claimed that a failure to acknowledge memory difficulty is more indicative of AD, whereas spontaneous memory complaints are more indicative of depression or MCI. Thus, the implied trajectory is one of increasing insight during the early/mild stages of memory impairment, followed by diminishing insight as the disease progresses (Freidenberg et al., 1990; Kalbe et al., 2005). Other investigators have also reported that patients with MCI may have considerable insight into their memory problems (Kalbe et al., 2005).

Age-related self-reported memory problems are one of the most widely studied self-perception constructs in old age, possibly due to the fact that subjective memory problems are present in up to 35–40% of community-dwelling, non-demented elders (Grut et al., 1993). This perception of cognitive decline from earlier levels of ability concerns older adults, perhaps in part due to the surge of public information on AD and other progressive dementias in popular media. Some (Camp & Pignatiello, 1988) believe that adults of all ages have pessimistic stereotypes and beliefs about how aging effects memory. Studies have looked at memory ratings of typical persons at different age points and found that people perceive memory as declining with age (Heckhausen, Dixon, & Baltes, 1989; Ryan, 1992; Ryan & Kwong See, 1993). At least two mechanisms may be responsible for self-reported decline in cognition in old age: (1) a stereotype-based perception that age-associated reduction in performance is normal in old age, which should be generally found in most older adults, and/or, (2) a specific, episodically-based perception of impairment in performance, which should vary between individuals based on their personal experiences of daily memory failures, and perceived changes from previous levels of performance.

Two types of memory self-evaluations have been studied. The clinical aging literature, including Petersen's conceptualization of MCI (Petersen et al., 1999, 2001), has mainly been concerned with subjective memory complaints, which are brief and unstructured responses to questions from healthcare providers about the state of one's memory ability and how memory changes might be adversely affecting one's daily function. In contrast to memory complaints, in the experimental aging literature, there has been extensive research on subjective memory beliefs. These beliefs represent a set of more general cognitions one holds about one's memory as one ages. Hertzog, Lineweaver and McQuire (1999) argue that such beliefs develop less from recalled episodes of forgetting, and more from an individual's general philosophy about one's memory. Beliefs have tended to be assessed by reliable multi-item questionnaires. Many approaches to measuring memory beliefs have been developed because of the widespread notion that beliefs about one's ability may influence actual performance (Cavanaugh & Green, 1990), however researchers have generally found that the relationship between self-assessment of knowledge of a skill and objective performance of the skill is typically low (Dunning, Heath, & Suls, 2004).

There has been inconsistent empirical evidence to date about the link between subjective memory beliefs and actual memory performance. Some previous literature suggests that memory beliefs are related to performance on memory tasks, tasks of attention, and overall cognitive functioning, with significant relationship magnitudes ranging from 0.20–0.40 (e.g., Johansson, Allen-Burge, & Zarit, 1997; Jonker, Launer, Hooijer, & Lindeboom, 1996; Zelinski, Gilewski, & Anthony-Bergstone, 1990). However, there are also findings not supporting such a relationship. For example, Schmidt, Berg and Deelman (2001) found that the correlations between subjective memory beliefs and objective memory performance were not statistically significant once age was controlled for. Thus, the evidence on the relationship between subjective memory beliefs and objective measures of cognitive performance is inconsistent over studies, which could be due to the heterogeneity in subjective belief and objective cognitive measurement across studies.

Approaches to the measurement of subjective memory beliefs in research have mainly relied on self-report questionnaires. Evidence has shown (Blair & Burton, 1987) that people use schematized general estimations about themselves in self-reporting how often they engage in certain behaviors, rather than thinking back to specific episodic representations about their memory functioning. Using such general estimations rather than episodic recall has implications for the veridicality of self-reported behaviors. Accuracy of self-reports based on self-schemas may be further biased by factors like depression (Gilewski & Zelinski, 1986; Schwarz, 1999).

Depression as a self-reporting bias is noteworthy in late life, in part because of the increase in depressive symptoms in later life (Borson et al., 1986). Depressive symptoms can affect cognitive performance; for example, Lockwood and Colleagues (2002) have noted that depressed elders display executive cognitive dysfunction (e.g., impaired initiation, inhibition, task switching, processing speed, and mental manipulations) when compared to non-depressed elders. Moreover, the direction of relationship could also be reversed: the etiology of a mood disturbance could result from self-awareness of one's cognitive decline. Depression can also influence self-perception of memory; some studies have shown that depressed patients are more likely to complain about their memory (Grut et al., 1993). Because of these complex relationships between memory, memory self-perception and depression, it is important to rule out the possibility that depression mediates or moderates the relationship between memory self-report and cognition.

The current study investigated the relationship between subjective memory beliefs and cognitive performance in older adults with and without cognitive impairment. The current MCI literature has focused on spontaneous memory complaints (i.e., single, open-ended items elicited in a clinical interview) in its diagnosis. The psychometric characteristics (reliability and validity) of such spontaneous complaints are not known. Thus, this study chose to examine participant memory beliefs, which are typically assessed through reliable multi-item questionnaires. Some research has suggested that subjective beliefs are better predictors of memory performance (Zelinski et al., 1990) than subjective complaints, possibly due to the greater range and variability that psychometrically validated memory belief scales possess. The specific aims of this study were to examine: (1) if the relationship between subjective memory beliefs and objective measures of memory varies by level of cognitive functioning, and (2) how depressive symptomatology might influence the relationship between memory performance and beliefs, including possible mediation or moderation of the relationship.

Method

Participants

Seventy-three community-dwelling volunteers age 65 years and older participated in this study, with 57 subsequently classified as normal controls (noMCI) and 16 classified as having amnesic mild cognitive impairment (hereafter called MCI). (Details of the consensus procedure by which these groupings were achieved are provided below.) Table I shows the demographic information for each group. The two groups demographically differed only in the sex distribution ($p = 0.02$), with a higher proportion of males in the MCI group. Participants were recruited in multiple ways, including articles in a local senior newspaper, advertisements, and from the participant pools of other local aging investigators. While not related to the goals of the present investigation, all participants for this study were recruited to, and initially agreed to take part in, a 30-day program of in-home daily cognitive assessments; all data in this present study come from an initial screening neuropsychological assessment for this larger study. The exclusion criteria for participation included: (1) history of neurological disease (i.e., Parkinson's disease, Alzheimer's disease, or epilepsy); (2) history of drug or alcohol abuse; (3) history of psychiatric hospitalization; (4) current cancer treatment; or (5) stroke or heart attack within the last year. It is important to note that none of the participants endorsed depressive symptoms indicative of clinical depression. The Institutional Review Board of the University of Florida approved the study and informed consent was obtained prior to participation.

Measures

Cognitive measures—All participant measures and scores used in the analyses are listed in Table II. Detailed assessment of memory, including both verbal and visual memory, was necessary in order to determine if participants met the impaired memory criteria for AMCI (operationalized as at least 1.5 standard deviations below published normative means, adjusted for age and education; Petersen et al., 2001). The domains of attention, working memory, speed of processing, and language, were also assessed in order to exclude persons with other or multiple impaired domains.

Subjective memory belief measures—The first measure of subjective memory beliefs administered was the Memory Functioning Questionnaire (MFQ; Gilewski, Zelinski, & Schaie, 1990). The measure has been shown to be internally consistent (Cronbach's alpha range 0.83–0.94 for each scale) and invariant with age and longitudinal analysis (Gilewski et al., 1990). The MFQ contains four factor-derived scales: Frequency of Forgetting, Seriousness of Forgetting, Retrospective Functioning, and Mnemonics Usage. The second memory beliefs questionnaire was the Metamemory in Adulthood Questionnaire (MIA; Dixon et al., 1988). The MIA contains seven factor-derived scales: Strategy, Capacity, Change (stability), Anxiety, Task Knowledge, Achievement, and Locus of Control. This scale differs from the MFQ in the type of response required, contains a broader range of beliefs, and has been unexplored in older adults with MCI to our knowledge. This questionnaire has been shown to be internally consistent (Cronbach's alpha range 0.71–0.93), valid with diverse samples and with other scales measuring the same concept (Dixon et al., 1988). The MFQ and MIA scales have shown convergent validity and subscale correlations ranging from 0.0–0.72 in previous studies (see Hertzog, Hulstsch, & Dixon, 1989), and such correlations are similar to those found in the present study (see Results).

Data reduction—Cognitive and subjective belief composites were estimated via confirmatory factor analysis, using the LISREL 8.3 program, and maximum likelihood estimation and were evaluated on the basis of overall fit indices: root mean square error of approximation (RMSEA, Steiger & Lind, 1980), normed fit index (NFI), non-normative fit

index (NNFI), and comparative fit index (CFI; Bentler, 1989; Bentler & Bonnett, 1980; Marsh, Balla, & McDonald, 1988), as well as the incremental fit index (IFI; Bollen, 1990) and examination of individual parameter estimates provided by the program. Similar to the work of Akaike (1987) and Carmines and McIver (1981), the ratio of the model's chi-square (χ^2) to its degrees of freedom was also examined; chi-square values less than twice the degrees of freedom were also considered suggestive of acceptable fit. Initial factor solutions had been identified via exploratory factor analysis on a subsample of the current study in Cook (2004). For the current study, we examined whether our initial solutions could be replicated for our full sample. With a sample size of less than 75 persons, the obtained confirmatory results could only be suggestive of the underlying dimensionality of the data, and would need to be replicated in a larger independent sample. The obtained solutions, however, produced idealized simple structures (i.e., each measure loaded on only a single factor), and factor scores were subsequently created using unit-weighted composites of the measures loading on each factor. Two separate confirmatory analyses were conducted. The first, on the cognitive data, examined whether five factors could describe the data: were Visual Memory (Brief Visual Memory Test [Benedict, 1997]; see Table II for information on variables used from each test), Verbal Memory (Hopkins Verbal Learning Test [Brandt & Benedict, 2001] and Rivermead Behavioural Memory Test [Wilson et al., 1985]), Trails (Trailmaking Test [Reitan, 1992]), Language (North American Adult Reading Test [Blair & Spreen, 1989]; Boston Naming Test [Kaplan et al., 2001]; letter fluency [Benton & Hamsher, 1989]; and category fluency [Benton & Hamsher, 1989]), and Overall Cognition (Mini-Mental Status Examination [Folstein et al., 1975] and Everyday Problem Test [Willis & Marsiske, 1993]). This cognitive solution fit acceptably: $\chi^2(93, n = 66) = 146.11, p < 0.001$; RMSEA = 0.09, $p = 0.05$, NFI = 0.89, NNFI = 0.94, CFI = 0.96, IFI = 0.96, and since the goal of this study was not principally factor analytic, we did not pursue further model modifications or variable transformations to improve fit in this or the subsequent model. Standardized factor loadings ranged from 0.59–0.96, and the absolute value of factor correlations ranged from 0.37–0.71.

A second factor analysis was conducted on the subjective rating data, and tested whether three factors described the data well. These factors were: Perceived Capacity (reflecting individuals' overall judgment of how well they are doing, how much their memory has changed, and how worried they are about their memory and forgetting), External strategy use (reflecting the frequency and extent to which individuals endorse using mnemonic strategies), and Internal Management and Motivation (reflecting scales measuring individuals' achievement motivation, locus of control, and perceived knowledge about how to achieve a good memory). The fit of this factor solution was as follows: $\chi^2(413, n = 66) = 85.84, p < 0.001$; RMSEA = 0.10, $p = 0.04$, NFI = 0.82, NNFI = 0.86, CFI = 0.89, IFI = 0.90. Standardized factor loadings ranged from 0.53–0.96, and the absolute value of factor correlations ranged from 0.07–0.46. The fit indices suggest that the solution could likely be further optimized. Unit-weighted composites (summations of standardized variables thought to load on each factor) were used in subsequent analyses, so that sample-specific factor weightings obtained from the solution were not used. The factors obtained conformed well to existing theory and previous analyses of these domains.

Daily functioning measure—The Clinical Dementia Rating Scale (CDR; Morris, 1993), a measure of overall cognitive impairment severity, was used to measure the daily functioning of the participants, including activities of daily living. This scale is a semi-structured interview of an informant who knows the participant well. The participant also answers questions of orientation and judgment. The CDR contains six scales (Memory, Orientation, Judgment/ Problem Solving, Home/Hobbies, Community Affairs, and Personal Care), which are each rated by the interviewer on a scale from 0 (No Dementia) to 3 (Severe Dementia), with a score of 0.5 indicative of MCI or very mild dementia. An algorithm is then used to produce an overall score from 0 to 3. Validation studies (e.g., Morris, McKeel, Fulling, Torack, & Berg, 1988)

determined that clinical research criteria of AD, including CDR score, was indicative of AD pathology at autopsy. In this study, participants had a CDR of 0 ($n = 46$) or 0.5 ($n = 21$; six participants were missing this data). Further analysis revealed that 44 participants with CDR = 0 were classified as noMCI while 13 participants with CDR = 0.5 were classified as AMCI. Only two participants subsequently classified as AMCI had a CDR = 0 and two participants classified as noMCI had a CDR = 0.5. Thus, there was substantial dependency between CDR status and MCI status ($\chi^2 = 27.49, p < 0.01$).

Depression measures—Two measures were used to make a composite variable of depressive symptoms to rule out depressive symptoms as a mediator of any relationship between subjective beliefs and cognition because of the established relationship that subjective memory beliefs are associated with depressive symptoms (Blazer, Hays, Fillenbaum, & Gold, 1997; Kahn, Zarit, Hilbert, & Niederehe, 1975; Minett, Dean, Firbank, English, & O'Brien, 2005). The first measure was the Geriatric Depression Scale (GDS; Yesavage, 1983). The GDS is a 30-item self-report scale of yes/no questions about symptoms of depression (e.g., Do you feel that your life is empty?). This measure has been shown to be a reliable and valid measure of depressive mood in older adults. The second measure was the Center for Epidemiological Studies-Depression Scale (CES-D; Radloff, 1977), a 20-item instrument developed to detect clinical depression in adults. It asks about how often you felt certain ways within the past week, rated on a four-point scale. It contains four factors: depressive affect, somatic symptoms, positive affect, and interpersonal relations.

Procedures

All participants completed a consent procedure and telephone screening to exclude participants who did not meet the inclusion criteria. Participants who were eligible and interested in participating were then scheduled for an in-person visit where a two to three hour neuropsychological assessment with the aforementioned measures was completed. The questionnaire measures of subjective memory were administered to participants after the neuropsychological assessment, and were often sent home with the participant in order to decrease the likelihood of fatigue from testing. Prior research (Lane & Zelinski, 2003) indicated that MFQ scoring patterns did not differ when administered either prior to or after completing memory tasks. Because the MFQ and MIA have shown adequate correlations and are thought to measure the same construct (Hertzog et al., 1989), it was inferred that the MIA would also not differ as a function of when it was administered.

Participants were classified as noMCI or AMCI by a consensus conference consisting of five individuals (one neuropsychology PhD, one developmental/gerontology PhD, and three neuropsychology graduate students). Each case was presented to the consensus members with information about demographics (identity masked) and all available neuropsychological assessment data (see Table II for measures). Special attention was paid to participants scoring more than 1.5 standard deviations below age-corrected normative means on at least one verbal or visual memory variable (see Table II for variables considered). The number of impaired variables per MCI participant ranged from 1–5, with 37.5% of the MCI having only one score impaired, 31.3% had two scores impaired, 12.5% had three, 12.5% had four, and 6.3% had five out of the possible seven variables in the impaired range. Mild impairments based on normative standards in other cognitive domains (e.g., executive tasks, language) were noted, since a goal was to exclude persons with impairments in domains other than memory. Two persons were excluded from this study for having such multiple impairments. In addition, the Clinical Dementia Rating Scale (CDR; with attention paid to those scoring a 0.5) and a composite score representing subjective complaints from the MFQ (with attention paid to participants rating themselves at least one standard deviation below the sample mean) were also considered in the judgment. All of these variables were chosen to reflect the spirit of the

Petersen criteria for MCI (Petersen et al., 2001). No exact algorithm was used in classifying participants to allow for rater judgment, which was then validated and replicated through consensus. If all members of the consensus panel agreed on group placement, that placement prevailed. If at least one member disagreed, a discussion would take place about how the participant fit the criteria, and then a revote took place. At this point, the majority vote stood.

Statistical analyses

Characteristics of all unit-weighted composites were compared with Levene's test, in order to investigate whether the between groups homogeneity of variance assumption was tenable before further analysis. Independent sample *t*-tests were also computed to examine the hypothesized differences between groups on the cognitive composites. Bivariate correlation analysis, compared between groups, was then computed to determine if the relationship between subjective beliefs and cognitive performance differed by group.

In order to determine the role of depression, partial correlation analysis of the same composites controlling for depression was completed. The possibility that depression mediates the relationship between subjective memory beliefs and memory performance was tested using the Baron and Kenny (1986) approach. This was then followed up with the Sobel test (MacKinnon & Dwyer, 1993; Preacher & Leonardelli, 2001) to determine whether depression, the possible mediator, carries the influence of memory performance to subjective memory beliefs. To further test the role of depression in the relationship between subjective memory beliefs and objective memory performance, a moderation model with Capacity beliefs as the dependent variable, with a depression-by-cognition interaction term added to examine whether the relationship between cognition and subjective beliefs was influenced by levels of depression. Interaction terms were created as product terms between depression and cognition, using centered main effects, to reduce multicollinearity between the main effects and the interaction (Aiken & West, 1991).

Results

Two main research questions were posed in this study and the results of the analyses will be presented as follows: (1) does the relationship between subjective memory beliefs and objective measures of memory vary by level of cognitive functioning; and (2) how might depressive symptomatology influence that relationship, including investigating if depression moderates or mediates the relationship. The results of the Levene's test of homogeneity indicated that there was no difference between groups in their variance, except for Overall Cognition ($p = 0.03$, see Table III). For the difference between groups on the composites, it was predicted that persons with MCI would have poorer subjective memory functioning and by diagnosis poorer memory performance. The findings corroborated this hypothesis in that the groups differed significantly on performance in both Verbal and Visual Memory (among other cognitive differences shown in Table III) and those with MCI subjectively reported worse memory Capacity than the noMCI group.

Does relationship between subjective memory beliefs and objective cognition vary by level of cognitive functioning?

One of the major questions of this study, based on previous research, was whether the relationship between objective cognitive performance and subjective memory beliefs might vary by impairment status (see Table IV). It was predicted that the MCI group would display a stronger congruence between their beliefs and performance than the unimpaired elders. The results of bivariate correlations in this study supported this prediction, as those classified as noMCI had no significant relationships between any subjective and objective composites ($p < 0.05$), yet the MCI group had a strong and significant relationship between the Capacity

composite and the Verbal Memory (0.67) and Trails (−0.52) composites. Furthermore, follow-up examination of the correlations of Verbal Memory and Capacity were compared between groups, using Fisher's *R*-to-*Z* transformation for the comparison of independent correlations, and this analysis revealed that there was a significant difference between groups ($p = 0.03$) on the Verbal Memory-Capacity correlation. Specifically, there was a substantially higher correlation between Verbal Memory and Capacity in persons with MCI than in the noMCI group. Follow-up examination of the correlations of Trails and Capacity was also compared between groups and revealed a significant difference between groups ($p = 0.03$). Again, there was a higher correlation in the MCI group than those without impairment.

To address the concern that cognitive and subjective measures used in the consensus conference for group assignment were also used in the examination of group differences, we pursued corroboration of the study findings using independent data. Seventy participants from the current study participated in a follow-up study approximately two weeks after their neuropsychological assessment. This second study, which examined daily variability in cognitive performance (McCoy, 2004), included a list-learning measure. This measure consisted of participants' recall of a list of 15 non-semantically related items, presented for three trials. We examined the correlation of participants' total recall on this 15-item word list over three trials with their subjective memory capacity beliefs from the baseline assessment session. Again, a stronger relationship between subjective memory and recall performance was found in participants with MCI; in the noMCI group, the correlation was not statistically significant ($r = 0.20$, $p = 0.15$); but in the MCI group, the correlation was significant ($r = 0.55$, $p = 0.03$).

How does depression affect the relationship between objective and subjective memory?

Because of the known relationship between depression and subjective memory beliefs, the role that depressive symptoms may have played in the relationship between subjective memory beliefs and objective cognition was explored, even though the earlier analyses showed no differences in mean level or variability of depression in the two groups. A unit-weighted composite of the depression measures was used to control for depressive symptomatology. Thus, all of the subjective-cognition correlations were re-examined as partial correlations, controlling for depressive symptomatology. The correlations were relatively unchanged, with an identical pattern of relationships, as shown in Table V with all of the significant subjective memory and objective performance correlations remaining, except for the relationship between Capacity and Trails in the MCI group. In addition, the External Motivation composite was now mildly significantly related ($p = 0.05$) to Verbal Memory and Trails composites in the noMCI group. Importantly, a Fisher's *R*-to-*Z* transformation confirmed that the significant between-groups difference in the relationship between Verbal Memory and Capacity beliefs ($p < 0.01$) and the relationship between Trails and Capacity beliefs ($p = 0.03$) remained, even after controlling for depressive symptoms. Thus, in this sample, depressive symptoms were not 'driving' the relationship between subjective beliefs and objective cognitive performance, and do not substantially alter it.

We next conducted a series of follow-up analyses, in which we examined whether depression might either influence or moderate the memory belief and memory performance relationship. In these models, we focused solely on the Capacity factor of memory beliefs, since there was no evidence of cognitive relationships with the other two memory belief factors.

Depression as mediator

Using the Baron and Kenny approach (1986), the regression model with Verbal Memory alone predicting Capacity beliefs was significant (Verbal Memory standardized $\beta = 0.39$, $t = 3.60$, $p < 0.01$) as well as the model with both Verbal Memory and depression predicting Capacity

beliefs (Verbal Memory standardized $\beta = 0.32$, $t = 2.94$, $p < 0.01$). There was little change in the standardized beta weights; and a Sobel test did not reach significance (1.71 , $p = 0.09$), suggesting that depression had an independent influence and did not appear to mediate cognition-related variance on the outcome. The regression model with Visual Memory alone predicting Capacity beliefs was significant (Visual Memory standardized $\beta = 0.28$, $t = 2.46$, $p < 0.02$). However, there was only a trend for the model with both Visual Memory and depression predicting Capacity beliefs (Visual Memory standardized $\beta = 0.21$, $t = 1.90$, $p = 0.06$). Again, there was little change in the standardized beta weights and a non-significant Sobel test (1.57 , $p = 0.12$). Depression had an independent influence on Capacity beliefs and did not mediate cognition-related variance.

Depression as moderator

In the moderator models, centered depression-by-cognition interaction terms were added to regression models containing only depression and cognition main effects and memory beliefs as dependent variables. The model with Verbal Memory as a predictor explained 24% of the variance ($F = 7.32$, $p < 0.01$). While depression and Verbal Memory alone significantly predicted Capacity beliefs ($p = 0.03$, $p = 0.01$, respectively), the interaction of Verbal Memory and depression was not a significant (Interaction Standardized $\beta = 0.14$, $t = 1.31$, $p = 0.20$) predictor. The model with Visual Memory, which explained 18% of the variance ($F = 5.01$, $p < 0.01$), revealed a similar pattern. Depression alone was a significant predictor of Capacity beliefs ($p = 0.01$) and there was a trend for Visual Memory ($p = 0.06$), but again their interaction was not a significant predictor (Interaction Standardized $\beta = 0.11$, $t = 1.01$, $p = 0.32$).

Discussion

The main focus of the study was to examine the relationship between subjective memory beliefs and objective cognitive performance by level of cognitive functioning. Our motivating question was whether patients with memory problems are unaware of their deficits (Freidenberg et al., 1990). Drawing on previous studies, our hypothesis had been that correlations would be stronger for those in the MCI group, since it is predicted that they would have more recent, episodically-based memory complaints (and these, in turn, would be negative self-evaluations on our subjective belief measures). Since the assumed more negative self-evaluations of persons with MCI, by this line of thinking, would also have greater accuracy—because they were based on a recent history of real functional memory failures in the everyday world, and since (by diagnosis), persons with MCI would be expected to perform more poorly on our memory measures, the expected finding was a higher correlation between objective and subjective memory in the cognitively impaired. This hypothesis was supported, as the impaired group had a significant relationship between the Capacity self-rating composite and both the Verbal Memory and Trails composites, and each was significantly different from the noMCI group. It is important to note that, while only suggestive because of our low sample size, we believe this finding represents the first in the recent literature that explicitly examines correlational differences between objective and subjective memory between normal and mildly impaired elders. While not conclusive, our results might suggest that—with increasing memory difficulty—older participants may become increasingly accurate in their specific memory self-judgments.

One concern was that group differences in the correlation between Verbal Memory and Capacity beliefs might be due to restricted variability (i.e., ceiling effects on cognitive functioning) in the noMCI group. Several indicators did not support this concern. First, as shown in Table III, Levene's tests on all cognitive and self-evaluation variables (except for Overall Cognition, comprised of the MMSE and EPT) could not reject the null hypothesis of equal variance between MCI and noMCI participants. We also examined whether participants

experienced ceiling effects (defined as maximum possible scores) on any of the verbal or visual memory tests. Rates of ceiling effects were low and equivalent between MCI and noMCI groups on all memory measures, with the exception of the Delayed Recall score of the HVLT. Here, 10.5% of noMCI participants, but none of the MCI participants, evinced ceiling effects. Thus, there was little evidence for differential variability as the explanation of the differential correlations observed in this study. Thus, our results provide preliminary support for the hypothesis that, when experiencing pre-clinical memory impairment, persons with amnesic MCI might be more accurate in their specific memory self-judgments.

It is interesting to speculate why visual memory was unrelated to subjective beliefs in this study. One reason may have to do with measurement. Norms for the visual memory task used (BVMT) are not representative of very old adults, and cannot be used to readily differentiate between impairment levels in the age range most likely to experience AMCI. Also, in our sample, the visual memory task appeared to be more difficult. Thus, in this study, it seems that subjective memory questionnaires perform better in identifying verbal, rather than visual, memory problems—especially in those identified as AMCI.

Another interesting finding is that External memory beliefs, representing degree of perceived reliance on external mnemonics or strategies is related to Verbal Memory and Trails performance in the noMCI group when depression is controlled. It is important to note that without depression controlled, there is still a trend ($p = 0.06$, $p = 0.08$, respectively) for this relationship. If veridical, the greater use of mnemonics in unimpaired elders does not seem to support memory compensation in persons with MCI, and may reflect metacognitive weaknesses (e.g., the lack of recognition of the potential utility of mnemonics) that either contribute to, or emerge as a consequence of, MCI status.

Despite previous findings (e.g., Elliott & Lachman, 1989; Ponds & Jolles, 1996) that depression plays a significant role in the relationship between memory beliefs and cognitive performance, the current study found that mild depressive symptoms did not substantially alter the relationship. This may have been the case because none of the participants endorsed depressive symptoms to the extent that would be indicative of a clinical depression. Perhaps subjective beliefs only become mediated by depression once it reaches a certain threshold that the current participants did not reach. It would be of interest to determine if these findings persist, particularly that those with MCI have a stronger relationship between memory beliefs and performance, using a population of older adults with MCI who also meet clinical criteria for depression.

There are several limitations to the present study. The first limitation was the use of a convenience sample from a larger study and consisted mainly of healthy, highly educated elders, which is not representative of the general elder population. However it is similar to that of most cognitive aging studies in the literature. It is also recognized that the size of the sample was relatively small, especially the MCI group. However in such a small sample of participants, the proportion of those with MCI was greater than expected (based on normative prevalence estimates), likely due to recruitment strategies which emphasized this as an ‘aging and memory’ study. A second limitation of the study is the absence of a medical or neurological examination to rule out other potential causes of memory problems, such as a vitamin B deficiency or untreated hypothyroidism (Petersen et al., 2001). Without such examinations, it cannot be certain that the memory problems displayed by the AMCI participants are caused solely by brain pathology changes. Thus, to the extent that the memory concerns seen in this study might represent more reversible or transitory conditions, this could have attenuated the relationship between our relatively dispositional memory self-ratings and actual performance. Furthermore, recent findings (Minett et al., 2005) suggest that subjective memory complaints are related to severity of cerebral white matter on magnetic resonance imaging; thus other nonreversible

pathological correlates not observed in the current study may be involved in perception of functioning.

Another limitation is that there has been no investigation of the overlap between ratings on subjective memory belief measures and spontaneous memory complaints. It is not certain that the kind of spontaneous memory complaint that Petersen mentions as definitional for MCI is well captured by the subjective memory questionnaires. It could be that participants with memory complaints base these complaints on specific recent, episodic failures, but nonetheless focus on their overall positives in answering more general self-belief questionnaires. Lastly, while depressive symptoms have been looked at as a possible mediating factor in the objective and subjective memory relationship, there are other factors that we have failed to consider, such as ageist beliefs.

In summary, this study found that there is a relationship between subjective memory beliefs and objective cognitive performance, but only in those older adults with MCI and this was limited to relationships between Capacity beliefs and Verbal Memory and Trails. Importantly, the relationship with Verbal Memory remained significant after controlling for depressive symptoms, which is often found to mediate subjective beliefs and objective performance relationships.

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Table IMean (SD) or *N* (%) of demographic data of the two groups.

	Total sample (<i>N</i> = 73)	No MCI (<i>n</i> = 57)	MCI (<i>n</i> = 16)	<i>p</i>-value
Age	75.25 (5.71)	74.77 (5.03)	76.94 (7.62)	0.18
Education	16.15 (2.67)	16.00 (2.64)	16.69 (2.77)	0.45
Sex				0.02
Males	32 (43.80)	21 (36.80)	11 (68.80)	
Females	41 (56.20)	36 (63.20)	5 (31.20)	
Race				0.60
White	67 (91.80)	52 (91.20)	15 (93.80)	
Other	6 (8.20)	5 (8.80)	1 (6.20)	
MMSE	28.25 (1.59)	28.70 (1.18)	26.63 (1.82)	0.00
GDS	3.84 (3.49)	3.74 (3.29)	4.19 (4.29)	0.65
CES-D	5.95 (5.03)	5.26 (4.85)	8.38 (5.02)	0.03

MCI, Mild cognitive impairment; No MCI, persons without mild cognitive impairment; MMSE, Mini-Mental Status Examination (Folstein, Folstein, & McHugh, 1975); GDS, Geriatric Depression Scale (Yesavage & Brink, 1983); CES-D, Center for Epidemiological Studies Depression Scale (Radloff, 1977). *p*-values refer to t-test (for age, education, and MMSE) or chi-squared tests of differences between MCI and no-MCI groups.

Table II

Measures administered to participants by domain assessed.

Cognitive domain	Measure	Source	Measures used in analyses (Range)
Subjective Memory Beliefs	Memory Functioning Questionnaire (MFQ)	Gilewski et al., 1990	See Aggregates information in Methods
	Metamemory in Adulthood Questionnaire (MIA)	Dixon, Hultsch, & Hertzog, 1988	See Aggregates information in Methods
Daily Functioning	Clinical Dementia Rating Scale (CDR)	Morris, 1993	Total Score (0–3)
Memory	Hopkins Verbal Learning Test (HVLT)	Brandt & Benedict, 2001	Total recalled (0–36), Delay recall (0–12), Retention (Delay/higher of Tr 2 or 3) 100
	Rivermead Behavioral Memory Test (RBMT)	Wilson, Cockburn, & Baddeley, 1985	Total paragraph recall (0–21)
	Brief Visuospatial Memory Test (BVMt)	Benedict, 1997	Total recalled (0–36), Delay recall (0–12), Learning (Higher of Tr 2 or 3 minus Tr 1)
Overall Cognitive Functioning	Mini-Mental Status Exam (MMSE)	Folstein et al., 1975	Total score using serial 7's (0–30)
	Telephone Interview for Cognitive Status (TICS)	Brandt, Spencer, & Folstein, 1988	Total score (0–50)
Pre-morbid Intelligence	North American Adult Reading Test (NAART)	Blair & Spreen, 1989	Number correctly pronounced (0–61)
Language	Boston Naming Test (BNT)	Kaplan, Goodglass, & Weintraub, 2001	Total score (0–60)
	Control Oral Word Association (COWA)	Benton & Hamsher, 1989	Sum of C, F, and L fluency (variable), total number of animals named (variable)
Attention, Psychomotor Speed	Trail Making Test A and B (Trails A, Trails B)	Reitan, 1992	Time of Trails A, Time of Trails B (variable)
Everyday Problem Solving Ability	Everyday Problems Test (EPT)	Willis & Marsiske, 1993	Total score (0–28)
Mood	Geriatric Depression Scale (GDS)	Yesavage & Brink, 1983	Total score (0–30)
	Center for Epidemiological Studies-Depression Scale (CES-D)	Radloff, 1977	Total score (0–60)

Table III

Standardized means and variable characteristics.

	Mean			SD		Levene's test of homogeneity of variance		Independent samples t-test for group mean differences	
	noMCI	MCI		noMCI	MCI	F	p-value	t	p-value
Visual memory	0.30	-0.82		0.65	0.82	0.83	0.36	5.74	0.00
Verbal memory	0.43	-1.01		0.46	0.69	3.03	0.09	9.81	0.00
Trails	-0.09	-0.01		0.90	0.76	0.01	0.92	-0.34	0.74
Language	0.18	-0.34		0.69	0.60	0.48	0.49	2.76	0.01
Overall cognition	0.31	-0.68		0.58	0.80	4.69	0.03	5.48	0.00
Capacity	0.07	-0.28		0.51	0.55	0.05	0.95	2.39	0.02
External	-0.03	0.11		0.41	0.39	0.34	0.56	-1.14	0.26
Internal	0.02	-0.02		0.76	0.58	1.38	0.24	-0.01	0.99
Depression	0.84	0.88		0.11	0.22	0.33	0.57	-1.45	0.14

MCI, Mild cognitive impairment (n = 16); noMCI, persons without mild cognitive impairment (n = 57).

Relationship between subjective memory beliefs and objective performance measures by cognitive status without controlling for depressive symptoms.

Table IV

	Capacity factor	external Factor	Internal factor	Visual memory	Verbal memory	Trails	Language	Overall cognition
Capacity factor		-0.25	0.09	0.20	0.14	-0.01	0.15	0.11
External factor	-0.19		0.20	0.14	0.26	-0.23	0.15	0.11
Internal factor	-0.13	0.10		-0.09	0.04	-0.03	-0.17	-0.01
Visual memory	0.04	-0.19	0.01		0.60*	-0.41*	0.41*	0.41*
Verbal memory	0.67*	-0.30	-0.06	0.55*		-0.41*	0.34*	0.53*
Trails	-0.52*	0.22	-0.16	-0.31	-0.54*		-0.11	-0.17
Language	0.08	-0.22	0.31	0.73*	0.33	-0.34		0.27*
Overall cognition	-0.04	0.18	0.14	0.49	0.22	-0.24	0.37	

* p -value < 0.05, those correlations above the diagonal are for no mild cognitive impairment group ($n = 57$) and those below diagonal are for mild cognitive impairment group ($n = 16$).

Table V

Relationship between subjective memory beliefs and objective performance measures by cognitive status controlling for depressive symptoms.

	Capacity factor	External factor	Internal factor	Visual memory	Verbal memory	Trails	Language	Overall cognition
Capacity factor		-0.25	0.12	0.14	0.08	0.10	0.12	0.07
External factor	-0.15		0.20	0.16	0.27*	-0.27*	0.16	0.12
Internal factor	-0.24	0.11		-0.06	0.06	-0.07	-0.16	0.01
Visual memory	0.23	-0.23	0.04		0.58*	-0.34*	0.39*	0.38*
Verbal memory	0.74*	-0.29	-0.07	0.60*		-0.36*	0.31*	0.51*
Trails	-0.45	0.20	-0.14	-0.42	-0.53*		-0.06	-0.10
Language	0.21	-0.24	0.33	0.72*	0.36	-0.41		0.25
Overall cognition	0.09	0.16	0.17	0.46	0.25	-0.31	0.35	

* p -value < 0.05, those correlations above the diagonal are for no mild cognitive impairment group ($n = 57$) and those below diagonal are for mild cognitive impairment group ($n = 16$).