Relationship Between Control Beliefs, Strategy Use, and Memory Performance in Amnestic Mild Cognitive Impairment and Healthy Aging

Rachel L. Hutchens,¹ Glynda J. Kinsella,¹,² Ben Ong,¹ Kerryn E. Pike,¹ Linda Clare,¹ David Ames,⁴,⁵ Michael M. Saling,⁶,⁷ Elsdon Storey,⁸ Elizabeth Mullaly,² Elizabeth Rand,² and Samuel Parsons¹

¹School of Psychological Science, La Trobe University, Melbourne, Victoria, Australia.
²Department of Psychology, Caulfield Hospital, Victoria, Australia.
³School of Psychology, Bangor University, Gwynedd.
⁴Department of Psychiatry, University of Melbourne, Parkville, Victoria, Australia.
⁵School of Psychological Sciences, University of Melbourne, Parkville, Victoria, Australia.
⁶Department of Clinical Neuropsychology, Austin Health, Heidelberg, Victoria, Australia.
⁷Department of Neuroscience (Medicine), Monash University, Alfred Hospital Campus, Melbourne, Victoria, Australia.

Objectives. Little information is available regarding the extent of strategy use and factors that affect strategy use in amnestic mild cognitive impairment (aMCI). This study aimed to compare spontaneous strategy use and beliefs about the controllability of memory between aMCI and healthy older adult (HOA) samples and to explore the relationships between beliefs, strategy use, and memory performance for both groups.

Method. The aMCI and HOA groups each composed of 60 individuals matched for age and education. The Memory Controllability Inventory was used to assess control beliefs, and the extent of semantic clustering on a list-learning task provided a measure of spontaneous strategy use.

Results. The aMCI group endorsed lower control beliefs and demonstrated poorer semantic clustering and memory performance compared with the HOA group. Although strategy use partially mediated the control beliefs-memory performance relationship for the HOA group, this was not replicated for the aMCI group.

Discussion. Despite the weak relationship between control beliefs and strategy use, and control beliefs and memory performance for the aMCI group, the strong relationship between strategy use and memory performance provides impetus for further research into factors that can be used as a means of enhancing strategy use in interventions for aMCI.

Key Words: Beliefs—Memory—Mild cognitive impairment—Successful aging—Strategy.

Mild cognitive impairment (MCI) is characterized by concerns about cognitive decline, substantiated by neuropsychological testing, despite retained independence in daily functioning and absence of dementia (Albert et al., 2011). The term amnestic MCI (aMCI) refers to changes in episodic memory (Petersen, 2004) and is the most common presentation of individuals with MCI who later develop Alzheimer’s disease (Albert et al., 2011). As aMCI has proven to be relatively resistant to pharmacological intervention thus far (Raschetti, Albanese, Vanacore, & Maggini, 2007), alternatives—such as psychological interventions—are important. Although most psychological interventions have revolved around memory strategy training, little is known about the extent of spontaneous strategy use and factors affecting strategy use in aMCI.

The few studies comparing strategy use between aMCI and healthy aging have consistently identified poorer spontaneous semantic clustering (clustering of words according to semantic categories) on list-learning tasks (Hutchens et al., 2012; Price et al., 2010; Ribeiro, Guerreiro, & De Mendonça, 2007) and positive correlations between semantic clustering and memory performance (Hutchens et al., 2012; Price et al., 2010). Despite this preliminary evidence of poorer spontaneous strategy use in the aMCI, and of a relationship between strategy use and memory performance, the outcomes of strategy training interventions on memory performance have been inconsistent. For example, postintervention improvements have been identified on tests of everyday prospective memory (remembering to complete given tasks at specified times; Kinsella et al., 2009) and on tests of episodic memory (e.g., object-location associations, word-list recall, and face-name associations) in some studies (Belleville et al., 2006; Hampstead et al., 2012) but not others; for example, Rapp, Brenes, and Marsh (2002) failed to find improvements on tests of word-list recall, grocery-list recall, paragraph recall, and face-name associations. Methodological differences (e.g., whether control groups...
were employed) and substantial variability in interventional approaches between studies (varying from an exclusive focus on memory strategy training to a wide-ranging multifaceted intervention) are likely to have contributed to these discrepant intervention effects across similar memory tasks. To develop more targeted and efficacious interventions, it is necessary to identify the specific factors that contribute to strategy use and that can be manipulated through intervention.

In this respect, self-efficacy (an individual’s beliefs regarding their ability to produce an outcome) and control beliefs (beliefs regarding the controllability of memory) may be prime candidates. Theoretical arguments by Bandura (1977) and Borkowski, Carr, Rellinger, and Pressley (1990) implicate these factors in the implementation and persistence of coping behaviors, the exertion of effort on challenging tasks, memory encodability, and the acquisition and transfer of memory strategies. This study will employ Miller and Lachman’s (1999) definition of control beliefs as a broader concept incorporating both self-efficacy and beliefs regarding other factors that may affect outcomes (e.g., situational factors).

A reduced sense of control over memory in older age has consistently been identified in nonclinical samples, with older adults attributing their memory performances to uncontrollable factors (e.g., age) more so than young and middle-aged adults, who typically attribute performance to controllable factors such as strategy use or effort (Devolder & Pressley, 1992). Nevertheless, interventions targeting control beliefs in older adults have demonstrated that such beliefs are malleable (Lachman, Weaver, Bandura, Elliott, & Lewkowicz, 1992) and have been linked to sustained improvements in memory in some studies (Caprio-Prevette and Fry, 1996), although not universally (Lachman et al., 1992).

Although much literature exists exploring the relationship between control beliefs and memory performance in older age, effect sizes vary substantially, from \( r = .07 \) to \( r = .45 \) (Devolder & Pressley, 1992; Goodman & Zart, 1995; Hertzog, McGuire, & Lineweaver, 1998; West & Yassuda, 2004). In an attempt to understand this variability, Beaudoin and Desrichard (2011) recently conducted a meta-analysis of 107 studies, identifying a significant but small (weighted mean \( r = .15 \)) correlation between self-efficacy and episodic memory performance. Furthermore, a number of earlier findings (Luszcz & Hinton, 1995) and arguments by Berry (1999) and Miller and Lachman (2000) suggest that the relationship between memory performance and control beliefs should be strongest for older adults, due to the increased salience of memory in older adulthood and the greater influence of motivational and strategic factors on age-sensitive tasks.

Despite the substantial amount of research examining the relationship between control beliefs and memory performance, less attention has been given to the processes linking these two factors. Miller and Lachman (1999) have proposed a theoretical framework outlining a number of factors that might mediate the control beliefs-memory performance relationship, one of which is strategy use. They suggest that actual or perceived decline in memory ability leads to a reduced sense of control, which decreases effort, persistence, and strategy use, in turn compromising memory performance and reinforcing the reduced control beliefs.

West, Bagwell, and Dark-Freudeman (2008) provided preliminary support for this proposed relationship between control beliefs, strategy use, and memory performance, by evaluating an intervention (targeting self-efficacy and memory strategies) that resulted in improved self-efficacy, strategy use, and memory performance. Both self-efficacy and strategy use were related to memory performance, however, West and colleagues did not examine the relationship between self-efficacy and strategy use. Other studies directly examining the relationships between control beliefs, strategy use, and memory performance have identified positive correlations between these variables in healthy older adult (HOA) samples (Hertzog et al., 1998; Lachman, Andreoletti, & Pearman, 2006; Riggs, Lachman, & Wingfield, 1997), but results and effect sizes have varied according to the memory tests and measures of strategy use employed (Devolder & Pressley, 1992; Riggs et al., 1997).

Few studies have statistically tested whether strategy use mediates the relationship between control beliefs and memory performance. Lachman and Andreoletti (2006) specified and tested such a model (Figure 1) and found that a cognitively demanding strategy (semantic clustering) significantly mediated the relationship between control beliefs and immediate recall of a word-list in HOAs. If this finding could be replicated in a sample with aMCI, it would provide a framework for designing interventions for this population. No research to date has attempted to compare control beliefs between aMCI and healthy aging or to examine the relationship between control beliefs, strategy use, and memory performance in aMCI. The theoretical framework provided by Miller and Lachman (2000), however, suggests that individuals with aMCI would have a weaker sense of control over their memory (due to repeated memory failures) and that these beliefs would negatively impact on strategy use and memory performance. Although Rapp and colleagues (2002) provided preliminary support for control beliefs as a viable target in future interventions (by demonstrating that control beliefs can be increased in an aMCI sample), it remains unclear whether the pattern of relationships typical for healthy aging will be upheld in an aMCI population and therefore whether increasing control beliefs will result in the desired increase in strategy use and memory performance.

In summary, the aim of the current, exploratory study was to replicate Lachman and Andreoletti’s (2006) finding that strategy use significantly mediates the relationship between control beliefs and memory performance for HOAs and to extend this work by applying the model to...
an aMCI sample. By examining the relationships between control beliefs, strategy use, and memory performance in an aMCI sample, we endeavored to provide an insight into whether the Lachman and Andreoletti model might provide a useful framework for the further development of targeted interventions for older adults with significant challenges in memory processing. It was expected that (a) the aMCI group would demonstrate lower control beliefs, strategy use, and memory performance compared with a HOA group and (b) the strategy use would significantly mediate the relationship between control beliefs and memory performance for both HOA and aMCI groups.

**METHOD**

**Participants**

Participants were recruited from a multicentre memory intervention study in Victoria, Australia, and were assessed prior to intervention. The sample composed of 60 HOA volunteers who responded to study advertisements and 60 participants diagnosed with aMCI by experienced age care specialists or Cognitive Dementia and Memory Services (memory clinics), based on neurological, radiological, psychiatric, neuropsychological, and functional assessment according to Petersen’s (2004) and Albert and colleagues’ (2011) criteria. The HOA and aMCI groups were matched for age and education and were statistically equivalent in terms of age, years of education, and premorbid intelligence as measured by the Wechsler Test of Adult Reading (Wechsler, 2001; Table 1) and gender distribution. χ²(1, N = 120) = 3.57, p = .059.

Inclusion criteria included the following: (a) aged more than 60 years, (b) community dwelling, (c) English as the preferred language, and (d) absence of impairment in basic activities of daily living (ADLs), defined as requiring occasional assistance on no more than two of the basic (personal) ADL items on the Alzheimer’s Disease Functional Assessment and Change Scale (Mohs et al., 2001). The groups were comparable in their independence in basic ADLs (86% of the HOA and 83% of the aMCI groups did not require any assistance). Furthermore, aMCI participants necessarily had (a) sought professional investigation due to subjective memory concerns/change; (b) objective memory impairment (performance of 1.5 SD less than the mean according to age-matched norms on at least one of the four screening measures assessing delayed recall: Hopkins Verbal Learning Test - Revised [HVLT-R], Brandt & Benedict, 2001; Logical Memory, Wechsler, 1997; Verbal Paired Associates, Wechsler, 2009; and Complex Figure of Rey, Meyers & Meyers, 1995); (c) a Clinical Dementia Rating (CDR; Morris, 1993) of 0.5 (questionable dementia); and (d) absence of dementia according to National Institute of Neurological Communicative Disorders and Stroke and the Alzheimer’s Disease and Related Disorders Association (NINCDS-ADRDA) criteria (McKhann et al., 1984). Comparably, HOA participants (a)

![Figure 1. Lachman and Andreoletti’s (2006) final path model for their healthy older adult (HOA) sample with age and education allowed to covary. Solid lines indicate significant paths (p < .050). The “+” and “–” signs denote positive and negative relationships, respectively. This model provided the initial path model for testing in this study, except that additional negative paths were expected between age and both control beliefs and strategy use.](image-url)
had not sought professional investigation due to a subjective memory concern/change; (b) did not demonstrate evidence of objective memory impairment (to meet this criterion, participants could not have any of their performances falling more than 1.5 $SD$ below the mean according to age norms on any of the four screening measures assessing delayed recall [HVLT-R, Logical Memory, Verbal Paired Associates, and Complex Figure of Rey]. If performance on only one of the memory tests was below criterion, an alternate version of the test was administered and the participant included in the HOA group if they did not perform more than 1.5 $SD$ below age-matched norms on the alternate version); and (c) received a CDR score of 0 (no dementia). Exclusion criteria for all participants entailed (a) significant comorbidities likely to impact on cognitive ability (e.g., neurological disorders), (b) significant psychiatric history or current treatment for an acute psychiatric episode, and (c) significant and uncorrected visual or auditory impairment.

**Materials and Procedure**

Ethics approval was received from all participating sites and written consent was obtained from all participants. Only the measures relevant to this study are described subsequently; however, additional data on performances across other cognitive domains are available in Table 1. Participants were assessed individually at their nearest memory clinic or another appropriate location of their choice (e.g., at La Trobe University or their own home). Questionnaires were posted to participants to complete prior to the assessment. Occasionally, participants failed to complete the questionnaires prior to the assessment and so these were completed at a later time or the information was collected over the phone in an attempt to minimize missing data. All assessors were blind to participants’ group membership.

**Control beliefs.**—Beliefs regarding memory ability and controllability of memory were assessed using the Memory Controllability Inventory (MemCo; Lachman, Bandura, Weaver, & Elliott, 1995). The MemCo is a 12-item self-report instrument composed of four subscales measuring the following beliefs: Present Ability (current memory ability), Potential Improvement (the relationship between strategy use and memory performance), Effort Utility (the relationship between effort expenditure and memory performance), and Inevitable Decrement (the extent to which memory inevitably declines with age). Each subscale consists of three statements that participants rate on a 7-point Likert scale (from 1 = strongly disagree to 7 = strongly agree), with higher scores on the first three subscales denoting stronger beliefs in memory ability and controllability and higher scores on the Inevitable Decrement scale reflecting weaker beliefs in the controllability of memory. Previous research has demonstrated reasonable internal consistency for each of the four subscales (Lachman et al., 1995), and this study identified adequate internal consistency when a single control beliefs score was calculated by the method described later (standardized Cronbach’s $\alpha = 0.78$ for each group).

**Memory performance and strategy use.**—Memory performance was assessed using the California Verbal Learning Test–Second Edition (CVLT-II; Delis, Kramer, Kaplan, & Ober, 2000). This task requires participants to learn and recall a 16-item word-list (composed of four words from each of four semantic categories, pseudorandomly ordered) over five trials, with recall assessed after each learning trial and after a short and an extended delay. In this study, immediate recall (the total number of words recalled over the five learning trials) was selected as the measure of memory performance to maintain consistency with Lachman and Andreoletti’s (2006) model, as well as for its clinical relevance. Individuals with aMCI have demonstrated impaired acquisition (as measured by immediate recall) that is relatively independent of their impairment in consolidation (Moulin, James, Freeman, & Jones, 2004). Therefore, targeting this area in the aMCI represents an important first step in addressing their memory difficulties. Possible scores ranged from 0 to 80.

Strategy use on the CVLT-II was operationalized as the extent to which participants used semantic clustering during recall. Previous studies have demonstrated the validity of this measure of strategy use (Baldo, Delis, Kramer, & Shimamura, 2002; Savage et al., 2000). The extent of semantic clustering over the five learning trials was calculated using the CVLT-II Comprehensive Scoring System software, which controls for the amount of clustering expected due to chance. Possible scores ranged from −3.0 to 9.0, with higher scores denoting greater semantic clustering.

**Statistical Analyses**

Complete data were available for all participants on all variables. Prior to analysis, the items comprising the Inevitable Decrement subscale of the MemCo were inverted so that higher scores across all subscales were indicative of greater beliefs in control over memory. Participants’ scores across the four subscales were then added to create a total control beliefs score. Internal consistency for this measure was equivalent and adequate for both groups (standardized Cronbach’s $\alpha = 0.78$).

In accordance with Tukey (1977), univariate outliers were trimmed back to the value that was two interquartiles greater than or less than the median. After handling outliers in this manner, the standardized skewness and kurtosis indices of all variables met the normality of distribution criterion of being within $\pm 3.0$ (i.e., $\alpha = 0.001$).

Between-group differences were examined using $t$ tests. If the assumption of homogeneity of variance was violated according to Levene’s test, the unequal variances $t$ test was employed to determine statistical significance. Path
analyses, using maximum likelihood estimation, were undertaken independently for the HOA and aMCI groups (due to heterogeneity of relationships within each group) in order to examine the relationships between age, education, control beliefs, strategy use, and memory performance. Root mean square error of approximation (RMSEA) values less than or equal to 0.06 and comparative fit index (CFI) values greater than 0.95 were considered indicative of good-fitting models by Hu and Bentler (1999). The CFI index was reported due to its ability to accurately estimate model fit in small samples (Bentler, 1990). Bootstrapping the sampling distribution of the indirect effect of control beliefs on memory performance (using 5,000 resamples) was employed to examine whether strategy use mediated the relationship between control beliefs and memory performance for each of the groups. Preacher and Hayes (2004) have suggested that this nonparametric approach is more appropriate for small samples than the alternative parametric methods. Assumptions were met for all analyses, including the assumptions of linearity, normality, and multicollinearity for all path analyses, with all variables having a tolerance greater than 0.50.

Effect sizes are reported as Cohen’s $d$, defined as small (0.20), medium (0.50), or large (0.80) effects, or $R^2$, defined as small (.01), medium (.09), or large (.25) effects.

**RESULTS**

**HOA and aMCI Group Comparisons**

Independent sample $t$ tests revealed significant group differences on measures of control beliefs, strategy use, and memory performance (Table 1). The HOA group reported stronger belief in their ability to control their memory than the aMCI group with a medium effect size, $t(118) = -3.32$, $p = .001$, $d = 0.60$, and used significantly more semantic clustering across learning trials on the CVLT-II than the aMCI group, $t(66.017) = -7.29$, $p < .001$, $d = 1.34$, with a large effect size. Similarly, the HOA group recalled more words across the learning trials of the CVLT-II than the aMCI group, $t(105.694) = -9.86$, $p < .001$, $d = 1.80$. The significant group difference in control beliefs remained when the subscale Present Ability was omitted from the control beliefs measure, indicating that the effect was not simply an artifact of the aMCI group accurately reporting a lower level of memory functioning compared with the HOA group.

**Path Analyses**

The path model initially proposed for both groups is based on the Lachman and Andreoletti (2006) model (as seen in Figure 1) regarding the relationships between age, education, control beliefs, strategy use, and memory performance. Contrary to Lachman and Andreoletti’s model, however, age was included as possible a predictor of both control beliefs and strategy use, given the evidence of a relationship between these variables in previous research (Hertzog et al., 1998; Hess & Hinson, 2006). Prior to conducting the path analyses, zero-order correlations between each of the variables were examined, and it revealed a different pattern of results for the HOA and aMCI groups (Table 2). When regression weights were constrained across both groups, the fit indices were not adequate, the fit indices were not adequate, $\chi^2(11, n = 120) = 21.48$, $p = .029$, CFI = 0.79, and RMSEA = 0.09, indicating that separate models were required for each group.

**HOA group.**—The initial model for the HOA group failed to meet criteria for the RMSEA index using maximum likelihood estimation, $\chi^2(1, n = 60) = 1.38$, $p = .239$, CFI = 0.99, and RMSEA = 0.08. Therefore, post hoc model modifications were made in an attempt to develop a more parsimonious and better fitting model. Regression paths with a small direct effect size (i.e., standardized regression coefficient ≤ 0.10) were removed in order to achieve this aim (Figure 2A) and resulted in the fit indices improving to meet criteria, $\chi^2(3, n = 60) = 1.51$, $p = .680$, CFI = 1.00, and RMSEA < 0.01. Predictors explained 6% of the variance in control beliefs, 13% of the variance in strategy use, and 47% of the variance in memory performance. Both control beliefs and strategy use were significantly and positively related to memory performance (Figure 2A). Bootstrap estimates examining whether strategy use was a significant mediator of the relationship between control beliefs and memory performance revealed that the indirect relationship was significantly different from zero at $p < .050$, 95% CI (0.003, 0.413) with a medium effect size of $R^2 = .09$, as calculated using Fairchild, MacKinnon, Taborga, and Taylor’s (2009) method. After controlling for strategy use, the relationship between control beliefs and memory performance remained significant, indicating that strategy use was a partial mediator.

**Table 2. Zero-Order Correlations Between Demographics, Control Beliefs, Strategy Use, and Recall for amnestic Mild Cognitive Impairment (aMCI) and Healthy Older Adult (HOA) Groups**

<table>
<thead>
<tr>
<th></th>
<th>HOA</th>
<th>Education</th>
<th>Control beliefs</th>
<th>Strategy use</th>
<th>Memory performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>.15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control beliefs</td>
<td>-0.13</td>
<td>.16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategy use</td>
<td>-0.29*</td>
<td>-0.01</td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory performance</td>
<td>-0.30*</td>
<td>0.04</td>
<td>0.35**</td>
<td>0.65**</td>
<td></td>
</tr>
</tbody>
</table>

**aMCI**

<table>
<thead>
<tr>
<th></th>
<th>Education</th>
<th>Control beliefs</th>
<th>Strategy use</th>
<th>Memory performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Education</td>
<td>0.05</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control beliefs</td>
<td>-0.01</td>
<td>-0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategy use</td>
<td>0.13</td>
<td>-0.07</td>
<td>-0.19</td>
<td></td>
</tr>
<tr>
<td>Memory performance</td>
<td>-0.02</td>
<td>0.21</td>
<td>-0.04</td>
<td>0.39**</td>
</tr>
</tbody>
</table>

*Note. *$p < .05$, **$p < .01$.  

The initial model for the aMCI group with all fit indices reaching criteria, achieved significant group difference in control beliefs remained when the subscale Present Ability was omitted from the control beliefs measure, indicating that the effect was not simply an artifact of the aMCI group accurately reporting a lower level of memory functioning compared with the HOA group.
CONTROL BELIEFS, STRATEGY USE, AND MEMORY PERFORMANCE

χ²(1, N = 60) = 0.14, p = .711, CFI = 1.00, and RMSEA < 0.01. The specified predictors explained only a small proportion of the variance in control beliefs and strategy use (2% and 6%, respectively) and 22% of the variance in memory performance. As distinct from the HOA group, the pathway from education to memory performance reached significance, with a small to medium effect; furthermore, only the pathway from strategy use, and not from control beliefs, to memory performance reached significance, with a moderate-to-large effect size (Figure 2B). Bootstrapping results did not identify strategy use as a significant mediator in the relationship between control beliefs and memory performance for the aMCI group, 95% CI (−0.203, 0.043), with very little of the variance in memory performance accounted for by the indirect effect, R² < .01.

DISCUSSION

Group Differences in Control Beliefs, Strategy Use, and Memory Performance

As hypothesized, the aMCI group endorsed a weaker sense of control over their memory and demonstrated poorer strategy use (semantic clustering) and memory performance compared with the HOA group. Although the HOA group clustered beyond chance levels (consistent with previous research; Hutchens et al., 2012; Woods, Delis, Scott, Kramer, & Holdnack, 2006), the aMCI group did not. There is now accumulating evidence for decreased use of the semantic clustering strategy on word-list learning tasks by individuals with aMCI, as demonstrated in a previous study with an independent sample of individuals with aMCI (Hutchens et al., 2012) and also by Price and colleagues (2010) and Ribeiro and colleagues (2007). However, it is still unclear whether this finding is specific to semantic clustering or reflects a more widespread failure to employ strategies. Providing some support for a more generalized effect, Hutchens and colleagues (2012) also reported impaired subjective clustering (clustering words in an undefined but systematic manner) by an aMCI group compared with a HOA group, although interestingly the groups displayed equivalent note-taking during a prospective memory task. This discrepancy was hypothesized to reflect difficulty with internal (self-reliant) strategies (e.g., semantic clustering) due to their cognitively demanding nature, but a retained ability to use less demanding external (environmental or other-reliant) strategies (e.g., external prompts resulting from note-taking).
The weaker sense of control over memory reported by the aMCI group could reflect an accurate appraisal due to the memory deterioration associated with the condition, a negative influence of stereotypes and perceptions of dementia, or a synergistic effect of both factors. Corner and Bond (2006) identified widespread negative perceptions of dementia that included an inevitable loss of control, and Banningh, Vernooij-Dassen, Rikkert, and Teunisse (2008) documented similar negative themes expressed by individuals recently diagnosed with MCI. In addition to reducing perceptions of control, Sabat (2006) has argued that this stigma could ultimately lead to a state of learned helplessness. Therefore, in order to explore the impact of control beliefs on strategy use and memory performance, path analyses were conducted for each group.

Relationships Between Control Beliefs, Strategy Use, and Memory Performance for HOAs

Given that the model in this study was based on Lachman and Andreoletti’s (2006) model, an indirect comparison of results was possible between the two studies. In terms of demographic factors, this study identified negative (but nonsignificant) relationships between increasing age and both control beliefs and memory performance in the HOA group. These findings within an older age sample (61 to 90 years old) contribute to preexisting literature comparing young and old adults (Devolder & Pressley, 1992; Sanders, Murphy, Schmitt, & Walsh, 1980). Similarly, Lachman and Andreoletti (2006) reported a negative (and significant) relationship between age and memory performance, and the standardized path coefficients are very similar in both studies. Our further finding of a significant and negative relationship between age and observed strategy use (unreported in the Lachman and Andreoletti [2006] study) is consistent with Bouazzou and colleagues’ (2010) finding that decreases in self-reported internal strategy use emerge from approximately 60 years of age onward.

Surprisingly, education was unrelated to memory performance in the HOA group, which may reflect the consistently high level of education attained in this older adult sample (the majority of the group had attained at least 12 years of education). However, education was positively (but nonsignificantly) related to control beliefs, as found by Lachman and Andreoletti (2006) and in investigations of control over other domains of life (e.g., health; Lachman & Weaver, 1998). Nevertheless, education was unrelated to strategy use for both the HOA and aMCI groups in this study and also for the older adult group in Lachman and Andreoletti (2006), suggesting that other factors (e.g., preference or familiarity) may play a more important role in memory strategy use in older age.

After accounting for the effects of age and education, and consistent with previous studies, we found positive relationships of a small-to-medium effect size between control beliefs and both strategy use and memory performance (Hertzog et al., 1998; Lachman et al., 2006; Riggs et al., 1997) and a large and significant relationship between strategy use and memory performance. Although Lachman and Andreoletti (2006) similarly identified positive relationships between these three factors, they found stronger relationships between control beliefs and both strategy use and memory performance, and a somewhat weaker relationship between strategy use and memory performance than that in this study. This may reflect differences in methodologies, whereby although both studies examined semantic clustering on word-list learning tasks, Lachman and Andreoletti displayed their 30-item word-lists on a computer screen for periods ranging from 1 to 3 min and asked participants to write down the words that they could recall. This longer study time might have resulted in the weaker relationship between semantic clustering and immediate recall by giving individuals more time to employ other strategies (not captured by the clustering measure). Furthermore, the visual support of the task (with words displayed on a computer screen and responses written down) may have reduced the reliance on higher order attentional abilities (which underlie both semantic clustering and immediate recall) and allowed a stronger influence of control beliefs to emerge.

Despite the methodological differences, both Lachman and Andreoletti (2006) and this study found that strategy use significantly, but only partially, mediated the relationship between control beliefs and memory performance, suggesting that additional mediators contribute to the link between control beliefs and memory performance. Therefore, although manipulation of control beliefs may help to improve strategy use and memory performance for HOAs, a multifactorial approach will potentially provide greater impact in changing memory performance.

Relationships Between Control Beliefs, Strategy Use, and Memory Performance in aMCI

This initial exploration of the relationships between age, education, control beliefs, strategy use, and memory performance revealed a very different pattern of results for the aMCI group compared with the HOA group, with the exception of the positive relationship between semantic clustering and memory performance. Age was not significantly related to control beliefs, strategy use, or memory performance, suggesting that condition-related factors (e.g., length of deterioration, severity of impairment, or extent of pathology) play a greater role in determining beliefs, behavior, and cognitive functioning than do chronological age in a memory-impaired group. Interestingly, education was significantly and positively related to memory performance in the aMCI group but not in the HOA group, possibly providing support for Stern’s (2009) theory of cognitive reserve wherein lifetime experiences affect how neuropathology is clinically
expressed. A significant relationship of a similar magnitude to that in the aMCI group was, however, identified in the healthy older age group in the Lachman and Andreoletti (2006) study. It is therefore possible that the nonsignificant finding in the current HOA sample was an anomaly and that greater education generally assists performance on memory tests (due to previous exposure to such tasks). Clearly, further research will be necessary to examine the relationship between education and memory performance in both HOAs and individuals with aMCI. Nonsignificant negative relationships were found between education and both control beliefs and strategy use and between control beliefs and strategy use for the aMCI group. Furthermore, strategy use did not significantly mediate the positive but nonsignificant control beliefs–memory performance relationship.

A number of factors could account for this lack of a discernible pattern of relationships between control beliefs, strategy use, and memory performance in the aMCI group compared with the HOA group. Substantial individual variability in level of awareness has previously been identified in aMCI (Roberts, Clare, & Woods, 2009). Although it is not considered that reduced awareness affected on participants’ ability to report their control beliefs (given that beliefs do not require reference against any external sources of information and that internal consistency of the MemCo was equivalent for the aMCI and HOA groups), heterogeneity in levels of awareness may have clouded the relationships between control beliefs and both strategy use and recall. For example, individuals with good awareness of their condition may have had lower control beliefs but employed more strategies in an attempt to compensate, whereas those with limited awareness retained higher control beliefs but failed to employ strategies. Alternatively, an inability to select or employ the semantic clustering strategy despite attempts to do so, due to the commonly identified impairments in executive functioning in aMCI (Brandt et al., 2009), may have resulted in the weak relationship with control beliefs. Asking participants about their strategy use following task completion would have provided insightful information in this regard but was avoided due to the impact it may have had on subsequent memory tasks. Finally, the measure of control beliefs employed in this study may not have been sensitive enough to reveal existent relationships for an aMCI sample. Beaudoin and Desrichard (2011) found that control beliefs and memory performance were most strongly related when control beliefs were measured in relation to a specific task rather than memory in general (as in this study).

Given that this is the first study to both compare memory control beliefs between the aMCI and HOA groups and to explore the impact of control beliefs on memory behaviors in the aMCI group, further research will be important to confirm or disconfirm the current pattern of results. Using a variety of measures of control beliefs, strategy use, and memory performance, will assist in understanding whether the current results accurately reflect the impact of aMCI in the relationships between these factors or are specific to the sample and measures employed in this study. The significant and positive relationship between semantic clustering and memory performance in this study, however, has been demonstrated across two other aMCI samples, one employing a different word-list task (Hutchens et al., 2012; Price et al., 2010), and therefore, encouragingly, suggests that individuals with aMCI can benefit from using memory strategies (to a similar degree as HOAs) and that further research should focus on identifying ways of increasing spontaneous strategy use in this population.

Methodological Limitations

Limitations include the relatively small sample size for the use of path analysis techniques due to the focus on a clinical sample (aMCI). To account for this, we opted to focus on presenting the effect sizes of the relationships and employed bootstrapping methods to examine the mediation effects; however, additional research with larger samples and a variety of measures will be necessary to further understanding of these relationships in healthy aging. Although a direct comparison was unable to be made between the HOA samples in this study and Lachman and Andreoletti’s (2006) study due to the use of different measures, this study gave an initial insight into how different measures might impact on the relationships between these factors. It would be of particular interest to examine how control beliefs relate to the use of strategies that aMCI participants are able to use competently (e.g., external strategies).

Conclusion

In summary, the study revealed a weaker sense of control over memory (independent of beliefs about memory ability), as well as poorer strategy use and memory performance, in the aMCI group compared with the HOA group. Exploration of the relationships between control beliefs, strategy use, and memory performance using path analysis revealed a very different pattern of results for the HOA and aMCI groups. Although Lachman and Andreoletti’s (2006) finding, that strategy use partially mediates the control beliefs–memory performance relationship, was replicated in the HOA group, it could not be extended to an aMCI group. Strategy use did contribute to predicting memory performance, but there was a minimal relationship between control beliefs and memory performance and between an interaction of control beliefs, strategy use, and memory performance in the aMCI group. This study provides an important initial insight into the impact of aMCI on the relationships between these factors. Further replication with larger samples and a variety of measures of control beliefs, strategy use, and memory performance is needed to establish the generalizability of these results. Nevertheless, encouragingly the aMCI group
showed a strong positive relationship between strategy use and memory performance, and therefore, determining viable methods to increase strategy use should be a priority in ongoing intervention research for this population.

**Funding**

This work was supported by a National Health and Medical Research Council of Australia grant (Project ID 487318).

**Acknowledgments**

We would like to thank Dr. Sarah Price, Dr. Nadia Petruccelli, and Fenny Muljadi for their involvement in the study’s organization and the research assistants who aided in data collection. We would also like to acknowledge the Cognitive Dementia and Memory Services (CDAMS) at Austin Health, Barwon Health, Bendigo Health, Bundoora Extended Care Centre, Caulfield Field Hospital, Melbourne Health, St. George’s Hospital, and Wantirna Hospital, as well as Associate Professor Michael Woodward and Dr. Alasdair Mander for their referral of aMCI participants to the study. This study was completed by the first author in partial fulfillment of the requirements for the degree of Doctor of Clinical Neuropsychology. No conflicts of interest are reported.

**Correspondence**

Address correspondence to Glynda Kinsella, PhD, School of Psychological Science, La Trobe University, Melbourne, Victoria, Australia 3086. E-mail: g.kinsella@latrobe.edu.au.

**References**


