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Does Prospective Memory Influence Quality of Life in Community-Dwelling Older Adults?

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ABSTRACT

Objectives: Older adults commonly experience declines in prospective memory, which describes one's ability to "remember to remember", and can adversely affect instrumental activities of daily living and healthcare compliance. However, the extent to which prospective memory failures may influence quality of life in typically-aging older adults is not well understood. ***Methods:*** One-hundred and four community-dwelling older Australians (aged 50 to 82 years) were administered a comprehensive, neuropsychological battery that included the Memory for Intentions Screening Test (MIST), Prospective and Retrospective Memory Questionnaire (PRMQ), Instrumental Activities of Daily Living Questionnaire (IADLQ), and World Health Organization Quality of Life-8 (WHOQoL-8). ***Results:*** Multiple regressions controlling for negative affect, medical comorbidities, and other neurocognitive functions revealed an interaction between prospective memory and instrumental activities of daily living in the concurrent prediction of quality of life. Among the 39 older adults who reported multiple problems on the IADLQ, lower performance-based prospective memory (MIST) and higher self-reported prospective memory failures in daily life (PRMQ) were significantly associated with lower quality of life (WHOQOL-8). Conversely, no significant associations were observed between prospective memory and quality of life in the 65 participants without IADL problems. ***Conclusion:*** Prospective memory difficulties adversely impact quality of life in community-dwelling older adults who experience problems independently managing their instrumental activities of daily living. These findings extend prior literature showing that prospective memory plays a unique role in the real-world outcomes of older adults and clinical populations and highlight the need to develop effective strategies to enhance prospective memory functioning in these vulnerable groups.

Keywords. Episodic memory; Well-being; Disability; Neuropsychological assessment; Geropsychology

INTRODUCTION

Maintaining a high level of quality of life (QoL) is a fundamental aspect of "successful" aging (e.g., Gabriel and Bowling, 2004) and one that has received considerable attention in the literature as the prevalence of older adults increases globally. Although older adults tend to perceive comparable (and sometimes better) QoL than their younger counterparts (Diener and Suh, 1997), there are nevertheless considerable individual differences in QoL across the lifespan (Wrosch et al., 2005). QoL is multifactorial among older adults (e.g., Bentley et al., 2013) and can be influenced by emotions (e.g., depression, anxiety), health status (e.g., presence and severity of medical conditions), and psychosocial variables (e.g., social support, socioeconomic status) (e.g., Gabriel and Bowling, 2004). Cognitive decline may also play a role in perceived quality of life among non-demented, community-dwelling older adults, but research thus far has been limited both in number of studies and methodological approaches employed. Specifically, the few existing studies in older adults have used IQ estimates or brief cognitive screening measures such as the Mini Mental State Examination (MMSE) rather than more sensitive and specific approaches such as comprehensive neuropsychological batteries or domain-specific metrics (e.g., episodic memory or executive functions). Results so far nevertheless support at least a modest relationship between these factors; for example, higher IQ is related to better environmental aspects of QoL (i.e., living circumstances including access to services; Brett *et al*., 2012), and MMSE scores are positively associated with subjective well-being in older adults with hypertension (Degl'Innocenti et al., 2002). In a 5-year randomized controlled trial of cognitive interventions in community-dwelling elders, interventions focused on improving memory, reasoning and processing speed were all found to be protective against significant declines in health-related QoL (Wolinsky et al., 2006).

To date, however, no studies have specifically evaluated whether prospective memory (PM) is relevant to QoL among older adults. PM is a higher-order, neurocognitive ability that involves one's capacity to successfully execute a future intention, or "remember to remember."

Examples of PM in daily life might include remembering to take a prescribed medication after a meal or deliver a message to a friend. Exploring the association between QoL and PM is worthwhile because PM is separable from other neurocognitive abilities like retrospective memory (e.g., passage and design recall) and executive functions (e.g., planning, cognitive flexibility) at the conceptual, neuropsychological, and neurobiological, levels (e.g., Gupta et al., 2010). Older adults are subject to moderate declines in PM (e.g., Henry, MacLeod, and Phillips, 2004), which are thought to be driven by age-related changes in the integrity of the prefrontal cortex, particularly Brodmann's area 10 (e.g., Burgess, Gonen-Yaacovi, and Volle, 2011). Over 25 years of research on aging and PM shows that older adults are vulnerable to PM failures on tasks with higher strategic demands (e.g., self-initiated executive control of monitoring and cue detection), such as when the cue to perform an intended action is based on time (e.g., remembering to check for a message in 15 min) or an event that is not focal to the ongoing activity (e.g., remembering to buy stamps when withdrawing cash from the automated teller machine) (e.g., Henry et al., 2004; McDaniel and Einstein, 2000). From a more practical perspective, PM failures are common in the daily lives of older adults (e.g., Tam and Schmitter-Edgecombe, 2013) and PM abilities are moderately associated with daily functioning in older adults (e.g., Smits et al., 1997). In fact, recent studies show that PM provides incremental ecological validity in predicting problems in activities of daily living (e.g., Woods, Weinborn, Velnoweth, Rooney, and Bucks, 2012), medication mismanagement (Woods et al., 2014), and healthcare compliance (Kamat et al., 2014) among older adults, above and beyond the effects of psychosocial factors, emotions, and other neurocognitive functions.

Findings from a small, but growing clinical literature provide further clues that PM may be relevant to the QoL of typically-aging adults. In the first published study on this topic, Doyle et al. (2012) found that self-reported symptoms of PM in everyday life (i.e., Prospective and Retrospective Memory Questionnaire; PRMQ) were uniquely associated with lower health-related QoL (i.e., SF-36) among both younger and older persons infected with HIV disease

(Spearman's rho values -0.38 to -0.65). Performance-based PM, as measured by the time-based scale of the Memory for Intentions Screening Test (MIST) was uniquely associated with lower mental QoL only in the younger HIV+ sample (Spearman's rho = 0.32). A later study by Pirogovsky, Woods, Filoteo, and Gilbert (2012) found large correlations (Pearson r coefficients -0.54 to -0.56) between the PRMQ PM scale and health-related QoL (i.e., Parkinson's Disease Questionnaire-39) in a sample of 33 subjects with Parkinson's disease (PD); however, the correlations between performance-based PM (i.e., MIST) and QoL in this study were small (*r*s. 0.21 to 0.25) and non-significant. Most recently, Xiang et al. (2014) reported similarly small (*r*s 0.02 to 0.19) and non-significant correlations between performance-based PM (Cambridge Prospective Memory Test) and physical, psychological, social, and environmental QoL (World Health Organization Quality of Life [WHOQoL]-BREF) in 47 younger, euthymic, bipolar subjects. Taken together, these prior studies suggest that perceived failures in PM in daily life are strongly associated with lower QoL, whereas the relationship between performance-based PM abilities and QoL may be more variable and complex across clinical populations.

The aim of the current study was to examine the strength and uniqueness of the association between PM and QoL in community-dwelling older adults. In doing so, we also considered the possibility that the level of functional problems older adults experience may influence the association between PM and QoL. Our approach was influenced by the Wilson and Cleary (1995) model of QoL, which provides a rich and adaptable conceptual framework within which to evaluate these complex real-world concepts. In brief, Wilson and Cleary propose that biological factors (e.g. neural injury) can lead to overt symptoms (e.g., cognitive impairment, such as PM) that increase the risk of functional disability (e.g., dependence in instrumental activities of daily living), which in turn diminish health perceptions and lower QoL. Each of these five factors may be influenced by individual (e.g., personality, motivation) and/or environmental (e.g., social and psychological supports) variables. The model specifies that variability in an individual's manifestation of these five factors may alter their interrelationships, which in this case raises the possibility that the presence of even mild functional difficulties may affect the relationship between PM (i.e., an overt symptom in the model) and QoL. In the current study, we tested the hypothesis that there are stronger correlations between measures of PM (viz., overt symptoms, per the Wilson and Cleary model) and QoL in individuals experiencing problems in instrumental activities of daily living (IADL) as compared to individuals with no IADL complaints. Per the Wilson and Cleary model, the analyses designed to test these hypotheses will control for biological factors (e.g., medical conditions) and relevant individual variables (e.g., key demographics, mood, and other neurocognitive functions

METHOD

Participants and procedures: Potential study participants were 110 community-dwelling older adults, aged 50 to 82, recruited via flyers and word-of-mouth, as well as from the Western Australia Participant Pool (RAB, Director). Note that in an effort to capture adults transitioning into later life, the Western Australia Participant Pool enrolls individuals in their 50s and early 60s. In the current study, approximately 20% of the sample was younger than age 65. As the study was focused on typical aging among community-dwelling older adults, participants were excluded if they scored less than 24 on the MMSE, given concerns about the scientific veracity of quality of life measures among persons with dementia who may have limited insight (e.g., Brandt, 2007). We also excluded participants who reported a history of significant neurological (e.g., traumatic brain injury, stroke, seizure disorder, Parkinson's disease; n = 5) or psychiatric (Schizophrenia, Bipolar disorder, n = 1) conditions, resulting in a final sample of 104 individuals. Basic descriptive data regarding the demographic, neurocognitive, and medication-related characteristics of the 104 study-eligible participants are provided in Table 1.

[Insert Table 1 about here]

The study procedures were approved by the Human Research Ethics Committee at the University of Western Australia, and written informed consent was obtained from all participants.

All participants completed a comprehensive neuropsychological assessment, including measures of prospective memory, standard clinical tests of cognitive and executive functions, and self-report measures of emotions, memory and daily functioning. Fifteen dollars was offered to defray travel expenses.

Prospective Memory Measures. Participants were administered the research version (Woods *et al*., 2008) of the Memory for Intentions Screening Test (MIST; Raskin et al., 2010), which is a standardized measure of PM with good reliability (e.g., Woods et al., 2008) and construct validity in an aging population (e.g., Kamat et al., 2014). It takes approximately 30 minutes to administer and includes four time-based and four event-based items, during which the participant is engaged in an ongoing task (i.e., a standardized word search). Time- and event-based scales are matched on delay interval (i.e., 2 min vs. 15 min delays) and response modality (i.e., action vs. verbal responses). Error scores include: 1) no response (i.e., an omission error), 2) task substitution (i.e., providing an incorrect response to a cue), 3) loss of content (i.e., correct recognition of a cue without adequate retrieval of the intention), and 4) loss of time (i.e., executing the correct intention at the wrong time). In addition, scores reflecting performance on the ongoing task and post-test recognition of the eight PM intentions are produced. Lower scores reflect worse PM performance.

Self-reported prospective and retrospective memory failures in everyday life were assessed with the well-validated, 16-item Prospective and Retrospective Memory Questionnaire (PRMQ; Crawford, Smith, Maylor, Della Sala, and Logie, 2003). This scale uses a 5-point response scale (1 = never, 5 = very often) with 8 items assessing the frequency of retrospective memory (RM scale) lapses, and 8 items assessing the frequency of prospective memory (PM scale) lapses (range = 0-40). These two scales can be further divided into self-cued and environmentally-cued memory problems (range = 0-20). Higher scores reflect greater PM failures in daily life. Self-reported PM and performance-based PM were evaluated separately, as prior studies suggest that they are not strongly related and likely measure different, but important aspects of PM (e.g., manifest functioning vs. capacity, respectively).

Quality of Life Measure. Quality of life was measured with the 8-item version of the World Health Organization Quality of Life scale (WHOQoL-8), which is an abbreviated version of the WHOQoL-BREF that has solid evidence of reliability and construct validity (e.g., Schmidt, Mühlan, and Power, 2006). Scores range from 8-40 with higher scores reflecting greater well-being over the previous two weeks. Cronbach's alpha for the WHOQoL in the current sample was .85.

Instrumental Activities of Daily Living Measure. Instrumental Activities of Daily Living (IADLs) were assessed with a modified form of the Activities of Daily Living Questionnaire (ADLQ; Johnson, Barion, Rademaker, Rehkemper, and Weintraub, 2004). The scale includes 28 items measuring independence in a variety of basic self-care skills (e.g., bathing and dressing) as well as higher-level instrumental activities of daily living (e.g., money and medication management skills). As the present study focused on a nonclinical, community-dwelling sample of older adults, the scale was modified from its usual 4-point response format (behavior-specific variations of "no problem", "independent, but frequent problems", "needs help to complete", and "completely dependent") in order to allow for reporting of more subtle difficulties with these tasks. Specifically, an additional response option was included for all items allowing participants to endorse "minor" or "occasional" problems in each area (e.g., for money handling, "I sometimes have difficulty paying the proper amount, counting."). As the present study was focused on higher-level IADLs, the approach taken by Woods et al., 2012) was adopted, in which 11 of the 28 items assessing money management, medication adherence, home maintenance, shopping, transportation and communication were extracted and used to generate a summary scale (IADLQ, range 0-11) of items endorsed as being at least a minor or occasional problem (i.e., scores > 0). The IADLQ scale demonstrated acceptable reliability (Cronbach's alpha = .71) and response variability (35% denied any difficulty, 28% endorsed one problem area, and 37% endorsed between 2 and 9 problem areas). Construct validity of this self-report measure was supported by a significant correlation ($r = .46$, $p < .001$) observed with an informant version of the IADLQ completed for 72 of the 104 study participants.

Other Neuropsychological Measures. The National Adult Reading Test (NART) was administered to estimate premorbid intelligence. Total errors on the NART reading task were converted to predicted WAIS-R Full Scale IQ scores (Nelson and Willison, 1991). General cognitive function was assessed with the Total score of the Repeatable Battery for the Assessment of Neuropsychological Status-Form A (RBANS), which is a well-validated composite that includes measures of immediate and delayed memory (both verbal and visual), attention, language, and visuospatial skills. We also assessed executive functions with a brief battery that included the Trail Making Test and Delis Kaplan Executive Function System (D-KEFS) Fluency Switching to assess set-shifting ability, the Trennery Stroop Neuropsychological Screening Test to assess response inhibition, the Executive Clock Drawing Task (CLOX) to assess planning, and the Digit Span subtest (i.e., longest digit backwards) of the Wechsler Adult Intelligence Scale-Third Edition (WAIS-III) to assess verbal working memory. Sample-based z-scores were calculated for each of the executive functions measures separately and then averaged to produce an overall executive domain score, with positive scores indicative of better performance.

Emotions, Health, and Demographic Measures. Depression was assessed with the Patient Health Questionnaire-9 (PHQ-9) and anxiety was assessed with the Generalized Anxiety Disorder scale-7 (GAD-7). In order to reduce the number of variables in our models, sample-based z-scores were calculated for each measure and then averaged to produce a single negative affect score, with higher scores suggesting greater levels of affective distress. Finally, a demographic and medical history questionnaire was administered to collect educational history, age, gender and relevant medical history (i.e., number and types of chronic medical and psychiatric conditions). The most common medical conditions were cardiovascular disease (e.g., hypertension, hypercholesterolemia, atrial fibrillation, 55%), arthritis (30%), cancer

(24%), sleep disorder (15%), and diabetes (4%).

RESULTS

Correlational analyses revealed that quality of life (QoL) was not significantly related to any demographic variables, including age, education, gender or estimated Full Scale IQ (all *p*s > .20), but was related to negative affect ($r = -.52$, $p < .001$), self-reported IADLs ($r = -.51$, $p < .001$) and number of chronic medical conditions ($r = -.37$, $p < .001$). We subsequently conducted separate multiple regressions predicting QoL from: 1) Objectively measured prospective memory (the MIST Summary score), IADL problems, and the interaction of PM and IADL; and 2) self-reported everyday prospective memory failures (PRMQ- PM scale), IADL problems and the interaction of self-reported PM and IADL problems. In each regression, the model included negative affect, number of medical conditions, executive functions, and general cognitive function as covariates, with the latter two measures included to ensure that the associations between PM and the outcome were not solely an artifact of these important, related neurocognitive constructs.

The overall model for the first regression predicting QoL from objective PM and IADL status (Table 2) was significant, F (7,98) = 12.67, $p < .001$, adjusted $R^2 = .46$. IADL status ($p < .01$) was a significant independent predictor, but the MIST Summary score was not ($p = .10$). However, the interaction of IADL and MIST was a significant predictor in the model ($p < .01$). To determine the nature of the interaction, the sample was divided based on a median split of IADLQ scores, with those reporting no, or only one area of IADL difficulty classified as the IADL Normal group and those reporting two or more IADL difficulties as the IADL Problems group (see Table 1 for details on the demographic, negative affect, health, and cognitive functioning of these subgroups).

As can be seen in Figure 1, a significant correlation was seen between QoL and the MIST Summary Score in the IADL Problem group ($r = .42$, $p < .01$). Conversely, all correlations between QoL and PM were non-significant in the IADL Normal group (all *p*s > .20). Analysis of subscale and error patterns on the MIST revealed that only omission errors (that is, no response to the PM cue) were significantly related to QoL in the IADL Problems group (r = -.36, p < .05), with strong trend level correlations observed for the Time-based (r = .32 p = .05) and Event-based subscales (r = .32 p = .05). Correlations for all other error types (e.g., loss of content, task substitutions) were non-significant (all *r*s < .20, *p*s > .15).

In the second regression, which predicted QoL from self-reported PM, IADL problems and the interaction of these variables, the overall model was significant, F (7,97) = 11.09, p < .001, adjusted R^2 = .42. Self-reported PM was not an independent predictor (p = .43) and IADL problems fell at trend level (p = .07); however the interaction term was significant (p < .05). Post-hoc correlations were conducted in the IADL Normal and IADL Problem groups as defined above (see Figure 1). In the IADL Problems group, a significant correlation was observed between the PRMQ-PM and QoL (r = -.50, p < .01). Significant correlations were also seen between QoL and the subscales of the PRMQ-PM, Self-cued PM (r = -.46, p < .01) and Environmentally-cued PM (r = - .50, p < .01). No significant relationship was found for the PRMQ-PM and QoL in the IADL Normal group (all *p*s > .20).

Finally, in an effort to determine the specificity of the PM interaction with IADLs in predicting QoL, we also evaluated the possible contributions of delayed retrospective memory as measured by the RBANS. The primary findings were unchanged when the RBANS Delayed Memory Index (entered as a replacement for the RBANS Total) was included in the regression models detailed above predicting QoL. We also ran two parallel models inverting the roles of PM and retrospective memory, wherein PM was the covariate and the interaction between the RBANS Delayed Memory Index and IADLs in predicting QoL were of primary interest. These models did not reveal any main effects for the RBANS Delayed Memory Index or any interactions with IADLs in predicting QoL (all *p*s > .10).

DISCUSSION

Older adults commonly experience moderate declines in PM, which can have adverse effects on real-world outcomes (e.g., Smits et al., 1997), including healthcare compliance (e.g., Kamat et al., 2014; Woods et al., 2012). However, the extent to which such PM failures and their effects on functional status in turn influence quality of life in typically aging older adults is not well understood. In the present study, we observed that elevated PM symptoms in daily life and poorer PM abilities were associated with lower general QoL in community-dwelling older adults with mild IADL problems. Effect sizes for the associations between PM and QoL in this subgroup were medium-to-large and independent of negative affect, health status, and related neurocognitive abilities, such as retrospective memory (as measured within the RBANS) and executive functions. Its independence as a correlate of QoL suggests that PM captures a distinct aspect of well-being in older adults. These findings are commensurate with prior literature showing that PM plays a unique role in the daily lives of older adults (e.g., medication mismanagement; Woods et al., 2014) and clinical populations, including neurological (e.g., Parkinson's disease), medical (e.g., HIV infection), and psychiatric (e.g., schizophrenia) cohorts. Our findings also extend this prior literature by going beyond simple linear associations between PM and real-world outcomes and beginning to examine the myriad and inevitably complex factors that may impact this unique, clinically relevant relationship between PM deficits and QoL (e.g., compensatory strategies, motivation, etc.).

Specifically, worse PM was significantly and strongly associated with lower QoL among the older adults who reported multiple IADL problems, but not among those with apparently normal IADL functioning. The differences in the correlations between PM and QoL across functional status are consistent with the predictions of the Wilson and Cleary (1995) QoL model and suggests that the pathway from PM deficits to lower perceived QoL may depend on intermediary factors, which in this instance was the presence of mild IADL problems. It is possible that the presence of mild functional problems provides a window of opportunity for minor PM failures to influence one's perception of well-being; for example, an older adult who has noticed a decline in their capacity to effectively manage their medication regimen due to PM lapses may experience lower physical and mental QoL. In contrast, an older adult who is fully independent in their medication management may not be as affected by such PM lapses, perhaps as a function of successful disease management, better health perceptions, and/or deploying effective compensatory strategies (e.g., salient reminders, social supports).

The demonstration of significant, medium-to-large correlations between PM and QoL in our older adults with IADL problems across both performance-based and self-report measures of PM highlights the robustness of this association. Thus, the observed correlations between PM and QoL cannot be solely attributed to shared method variance. The performance-based MIST score can be viewed as a measure of PM capacity, whereas the self-report PRMQ is considered a measure of manifest PM functioning in daily life (see Blackstone et al., in press). There is admittedly some controversy about the extent to which self-report measures of PM reflect "true" ability (see Uttl & Kibreab, 2011), as their correlations with performance-based PM measures are commonly (e.g., Woods et al., 2007), but not always (e.g., Weinborn et al., 2011) weak. But such critiques focus primarily on experimental studies rather than the prediction of real-world outcomes, such as QoL, which oftentimes necessitates a multimodal approach (Woods et al., 2008).

At the level of cognitive processes, the association between PM and QoL in the older adults with IADL problems appears to be driven by a general effect of strategic cue monitoring and detection. Successful PM involves a multistage process of: 1) encoding/planning of the cue-intention pairing (i.e., the "what-when"); 2) retention of the cue-intention pairing over time, during which ongoing activities interfere with active rehearsal; 3) monitoring for the cue that triggers retrieval of the planned intention; and 4) retrieval and execution of the intended action (Kliegel *et al*., 2008). We can confidently rule out a primary encoding and retention interpretation of our PM-QoL associations, as there were no relationships with post-test recognition on the MIST and we covaried performance on the RBANS, which assesses retrospective learning and retention. It is also unlikely that retrospective memory retrieval failures primarily explain the PM-QoL correlations, as we did not see relationships with task substitution (e.g., the wrong response to a successfully detected cue) or loss of content (i.e., an empty verbal response to a successfully detected cue) errors, as has been shown with other aspects of real-world outcomes in older adults, particularly on event-based paradigms (e.g., Woods et al., 2012; 2014). Instead, we observed a significant correlation for omission errors (i.e., no response to a cue) and nearly identical effect sizes across time-based and (non-focal) event-based cues showed similar effect sizes, which suggests that the more likely faulty mechanism occurred in the complex process of monitoring for and detecting the PM cues. This is consistent with the profile of PM deficits in older adults, which can involve deficiencies in strategic monitoring and cue detection processes (Henry et al., 2004). Moreover, this pattern of findings aligns with those of Doyle et al. (2012) who reported that the relationship between time-based PM and health-related QoL in their sample of younger adults infected with HIV was driven by omission errors.

Strengths of this study include a moderately large, well-characterized sample that allowed us to determine the incremental ecological relevance of well-validated measures of both self-report and performance-based PM in association with QoL. The most notable limitation of this study was its use of a brief, general measure of QoL. Although prior studies support the reliability and validity of the WHOQoL-8 (e.g., Schmidt et al., 2006), it is necessarily limited in the dimensions of QoL that it measures. Future studies may therefore wish to examine the associations between PM and QoL in older adults across dimensions of QoL, including mental, physical, and social. Indeed, Doyle et al. (2012) found stronger relationships between PM and mental versus physical QoL in HIV disease. Another limitation of this study was its cross-sectional and observational design. Longitudinal approaches are needed to determine, for example, if age-related declines in PM are associated with reductions in QoL across the IADL spectrum. Similarly, intervention studies may allow investigators to determine if improvements in

PM functioning and/or the deployment of PM-based compensatory strategies help to improve QoL in older adults. Finally, we acknowledge there were elements of the Wilson and Cleary QoL model that were not assessed. Most notably, general health perceptions and various individual (e.g., motivation) and environment (e.g., social support) factors, all of which may nevertheless play an important part in the PM-QoL story. We also had a fairly cursory measure of medical comorbidity to assess biological symptoms in this community-dwelling sample, which shows reasonable evidence of construct validity (e.g., Duff et al., 2007), but our study would have nevertheless been stronger if we had used standardized, well-validated medical comorbidity instrument (e.g., Charlson et al., 1994).

SUMMARY AND CONCLUSION

The present study extends prior aging research by determining the relationship between PM (i.e., objectively measured by the MIST and self-reported in the PRMQ) and measures of functional problems (i.e., IADL) and quality of life (WHOQOL-8) in a sample of community-dwelling older adults. After controlling for negative affect, medical comorbidities and other neurocognitive functions, we observed that poorer scores on the MIST and higher self-reported PM failures were significantly associated with lower quality of life only in older adults who reported more problems with IADL. This highlights the relevance of PM function to real-world outcomes and suggests that routine assessment of PM may be of clinical value among older adults. A major challenge therefore is the development of accessible, affordable, time efficient assessments of PM with appropriate normative data and strong evidence of reliability, construct validity, and sensitivity to change. Finally, strategies to enhance PM performance (e.g., implementation intentions, goal management training) could potentially have a positive impact on older adults’ functional capacity and enhance their quality of life.

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Table 1. *General descriptive data for the overall study sample and subgroups differing on reported problems with Instrumental Activities of Daily Living (IADL).*

	Total Sample (N=104)	**IADL Problems (n=39)**	**IADL Normal (n=65)**
Variable	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Biopsychosocial Variables			
Age (years)	69.4 (6.0)	69.7 (6.6)	69.2 (5.7)
Education (years)	14.2 (2.7)	14.3 (2.2)	14.1 (2.9)
Gender (% Male)	32.7%	41%	28%
Estimated Verbal IQ	112 (9.0)	113.7 (8.4)	112.5 (9.4)
PHQ-9 Depression*	2.5 (3.3)	4.2 (4.4)	1.4 (1.8)
GAD-7 Anxiety*	1.9 (3.2)	3.1 (4.4)	1.2 (1.7)
Modified ADLQ*	1.7 (1.9)	3.7 (1.7)	.45 (.50)
Number of chronic medical conditions	1.5 (1.3)	1.7 (1.3)	1.4 (1.2)
WHOQOL-8*	33.2 (5.0)	30.5 (5.7)	34.9 (3.6)
Neurocognitive Variables			
Mini Mental Status Examination	28.7 (1.4)	28.7 (1.4)	28.6 (1.4)
RBANS Total Score	104.8 (13.5)	104.4 (15.5)	105.1 (12.2)
RBANS Delayed Memory	104.1 (14.7)	103.8 (14.2)	104.3 (15.1)
Stroop Color-Word Task (raw score)	99.0 (16.5)	98.3 (18.6)	99.5 (15.3)
Trail Making Test B (sec)	77.9 (35.9)	79.9 (40.1)	76.7 (32.8)
CLOX Executive Clock Drawing Task	1.5 (2.5)	1.33 (2.0)	1.5 (2.8)
Verbal Fluency Switching	15.7 (3.7)	16.1 (3.9)	15.4 (3.7)
Digit Backwards (Longest Span)	4.4 (1.2)	4.5 (1.4)	4.4 (1.2)
Memory for Intentions Screening Test			
Summary Score	36.3 (6.5)	35.2 (6.9)	36.9 (6.2)
Time-Based Score	5.5 (1.3)	5.3 (1.5)	5.6 (1.2)
Event-Based Score	6.6 (1.4)	6.4 (1.5)	6.7 (1.4)
Recognition	1.8 (1.0)	6.7 (1.3)	6.7 (.95)
Ongoing Wordsearch Task	11.2 (4.6)	11.6 (5.2)	11.0 (4.1)
Prospective and Retrospective Memory Questionnaire			
Prospective Memory*	18.9 (4.7)	21.0 (5.9)	17.7 (3.3)
Environmentally-Cued*	9.1 (2.3)	10 (3.1)	8.5 (1.6)
Self-Cued*	9.9 (2.6)	11.0 (3.1)	9.2 (2.1)
Retrospective Memory*	16.5 (4.3)	18.0 (5.1)	15.4 (3.5)

*$p < .05$

Note. Values are means (SD) except as noted. Estimated VIQ based off the National Adult Reading Test and Demographics-Predicted WAIS-R Full Scale IQ Score. GAD-7 = Generalized Anxiety Disorder Assessment-7, PHQ-9 = Patient Health Questionnaire-9, ADLQ = Modified Activities of Daily Living Scale, WHOQOL-8= World Health Organization Quality of Life scale-8, RBANS = Repeatable Battery for the Assessment of Neuropsychological Status

Table 2. *Hierarchical regressions predicting the World Health Organization Quality of Life-8 (WHOQOL-8) from objective and self-reported prospective memory and Instrumental Activities of Daily Living (IADLs), controlling for negative affect symptoms, neurocognitive factors and number of medical conditions.*

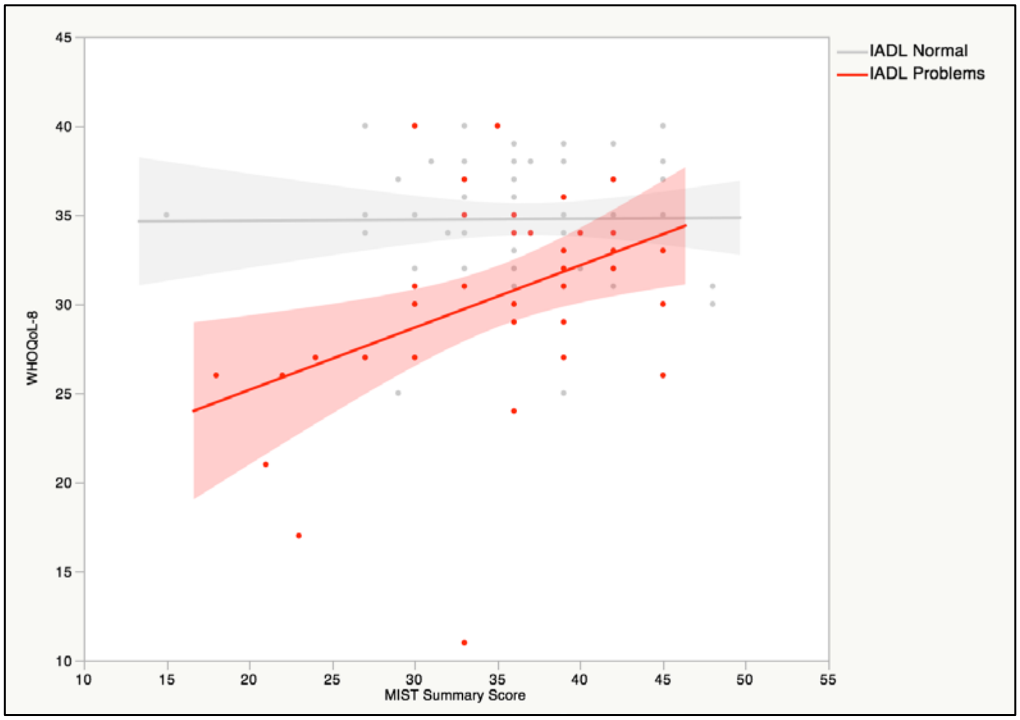
Predictors	B	B 95% CI		β	R^2	Adj. R^2
1) **Objective Prospective Memory**						
Model:					0.49***	0.46
Negative affect	-1.30	-2.22,	-0.38	-0.25**		
Number of medical conditions	-1.18	-1.8,	-0.54	-0.29***		
RBANS total score	0.03	-0.03,	0.09	0.08		
Executive functions	-0.11	-1.07,	0.85	-0.02		
IADL	-0.64	-1.10,	-0.18	-0.25**		
MIST Summary Score	0.10	-0.02,	0.22	0.13		
MIST x IADL	1.23	0.48,	2.10	0.25**		
2) S**elf-report Prospective Memory**						
Model					0.46***	0.42
Negative affect	-1.06	-2.04	-0.09	-0.20*		
Number of medical conditions	-1.19	-1.85,	-0.52	-0.29**		
RBANS total score	0.01	-0.05,	0.08	0.04		
Executive functions	0.36	-0.72,	1.43	0.05		
IADL	-0.49	-1.04,	0.05	0.19#		
PRMQ-Prospective Memory	-0.09	-0.32,	0.14	-0.09		
PRMQ-PM x IADL	-0.49	-0.97,	-0.01	-0.21*		

#*p*< .10, **p*< .05, ***p*<.01 *** P < .001 Note: RBANS = Repeatable Battery for the Assessment of Neuropsychological Status, Emotions is the averaged sample-based Z score for the GAD-7 = Generalized Anxiety Disorder Assessment-7, PHQ-9 = Patient Health Questionnaire-9, Executive Domain Z Score is the averaged Z Score for Trail Making Test B, CLOX (executive dysfunction index), Wechsler Adult Intelligence Scale–third edition Digit Span, longest backward span length, Delis-Kaplan Executive Function System Fluency Switching Total score, MIST=Memory for Intentions Screening Test, PRMQ = Prospective and Retrospective Memory Questionnaire (Prospective Memory scale).

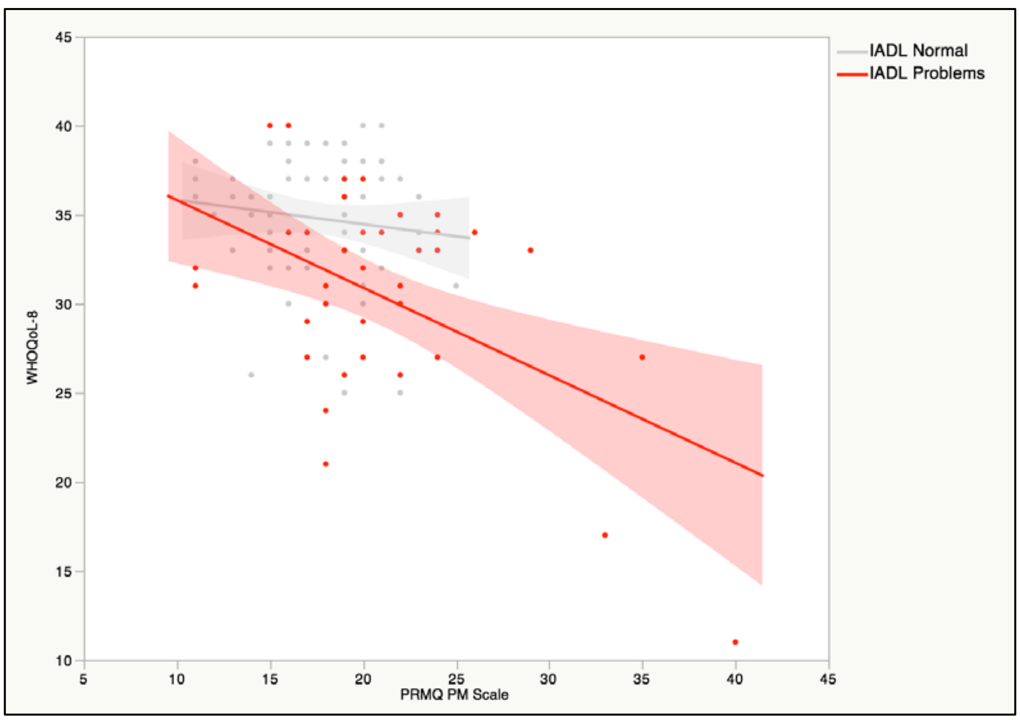
FIGURE CAPTIONS.

Figure 1. Scatterplot showing the association between quality of life (QoL) and prospective memory (PM) across levels of instrumental activities of daily living (IADL) functioning in 104 older adults. Among 39 older adults with at least one IADL problem, lower performance-based PM (Memory for Intentions Screening Test, Panel A) and higher self-reported PM symptoms (Prospective and Retrospective Memory Questionnaire, Panel B) were significantly associated with lower QoL (WHOQOL-8). No significant associations were observed between PM and QoL in the 65 IADL normal participants.

Figure 1.


IADL Normal
IADL Problems
WHOQoL-8
MIST Summary Score
45
40
35
30
25
20
15
10
10 15 20 25 30 35 40 45 50 55

A


IADL Normal
IADL Problems
WHOQoL-8
PRMQ PM Scale
45
40
35
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B