Edith Cowan University

Research Online

1-1-2012

Age and premorbid intelligence suppress complaint-performance congruency in raw score measures of memory

Matthew Merema

Craig Speelman
Edith Cowan University

Elizabeth Kaczmarek
Edith Cowan University

Jonathan Foster
Edith Cowan University

Follow this and additional works at: https://ro.ecu.edu.au/ecuworks2012

Part of the Psychology Commons

This Journal Article is posted at Research Online.
https://ro.ecu.edu.au/ecuworks2012/311

Age and premorbid intelligence suppress complaint–performance congruency in raw score measures of memory

Matt R. Merema,[1] Craig P. Speelman,[1] Elizabeth A. Kaczmarek[1] and Jonathan K. Foster[2]

[1] *School of Psychology and Social Science, Edith Cowan University, Joondalup, Australia*
[2] *School of Psychology and Speech Pathology, Curtin University, Bentley, Australia*

ABSTRACT

Background: We aimed to examine the role of age and premorbid intelligence (IQ) in suppressing the relationship between subjective memory complaints (SMCs) and raw score memory performance.

Methods: We used a community sample of older adults aged 66–90 years ($N = 121$) to test whether the inclusion of age and a premorbid IQ measure in multiple regression analyses increased semipartial correlations of raw score memory performance in predicting SMCs. Rank contrast correlations were also carried out to observe how age and premorbid IQ are related to complaint–performance congruency. Measures utilized in the study included the Memory Functioning Questionnaire (for SMCs), Visual Reproduction and Logical Memory Subtests (memory performance), and the National Adult Reading Test (premorbid IQ).

Results: Inclusion of age and premorbid IQ in the multiple regression analyses increased semipartial correlations for all raw score measures of memory. Both age and premorbid IQ were significantly related to complaint–performance congruency, whereby older participants and those with lower premorbid IQ scores rated their memory abilities more leniently than younger and higher premorbid IQ participants.

Conclusion: The results suggest differences in age and premorbid IQ play a small role in suppressing the relationship between SMCs and memory performance when utilizing raw score measures of memory.

Key words: subjective memory complaint, older adults, classical suppression, suppressor variable, visual memory, verbal memory

Introduction

The relationship between subjective memory complaints (SMCs) and memory performance has been of considerable interest to researchers over the past 30 years. The interest generated in this relationship is not surprising given the important role SMCs could play in the early identification of memory problems associated with Alzheimer's disease and other dementias. However, it is often found that little or no relationship exists between SMCs and memory performance on objective tests (e.g. Schmidt *et al.*, 2001; Minett *et al.*, 2008). Instead, it is frequently reported that memory complaints are more indicative of psychological distress (e.g. Zandi, 2004; Potter *et al.*, 2009) or aspects of personality (Pearman and Storandt, 2004; 2005).

The literature suggests that depression in particular is often found to be a prominent predictor of SMCs (e.g. Levy-Cushman and Abeles, 1998; Jorm *et al.*, 2001). Jorm *et al.* (2001) report that while memory complaints do appear to precede future memory decline, they are more often reflective of the presence of negative affect (particularly depression). Anxiety has also been reported to play a role in people's beliefs about their own memory functioning (Stein *et al.*, 1983; Jorm *et al.*, 2001), whereby greater levels of anxiety are associated with reports of more memory problems. Potter *et al.* (2009) also recently demonstrated that SMCs are associated with stress. In a study of 54 female older adults, Potter *et al.* found stress to be significantly associated with SMCs, even after variance associated with symptoms of depression and anxiety was removed.

While it is not surprising that affect might play a central role in determining the severity of SMCs, the typically weak relationship found between memory complaints and memory performance is somewhat intriguing. One issue that has received little attention in the literature is the possibility that this relationship may be restrained somewhat by one or more suppressor variables. Maassen and Bakker (2001) discuss three types of suppressor variables, of which one might play a role in mediating the relationship between SMCs and performance on objective tests of memory. A "classical" suppressor in a regression analysis is a predictor variable related to another predictor variable but not to the outcome variable. Given obvious differences between the actions of judging one's own memory performance and recalling, for example, episodic information over relatively short periods of time, it is perhaps not surprising that a number of variables might be associated with one and not the other. Two variables in the literature that appear to fit this definition of classical suppression in the context of memory complaint–performance congruency are age and premorbid intelligence (IQ). We use the phrase "complaint–performance congruency" throughout this paper to represent the strength of the relationship between SMCs and performance on objective tests of memory.

Although performance on many objective tests of memory declines with age (Sinnett and Holen, 1999), the severity of SMCs is often found to remain consistent (Mendes *et al.*, 2008). Thus, it may be the case that many older adults often judge their memory performance against what they expect it should be for someone their age. The product of this in a correlational analysis examining the relationship between SMCs and memory performance is that age may act in a manner that Maassen and Bakker (2001) define as "classical suppression". Likewise, premorbid IQ also appears to be unrelated to memory complaints (Jorm, 2004) but strongly related to memory performance (Frick *et al.*, 2011). Thus, it may be the case that both age and premorbid IQ suppress the strength of the relationship between memory complaints and memory performance. For age, this effect would only be present in research utilizing raw score measures of memory, since age-normed data would effectively remove the relationship between age and memory performance, which would likely remove the effect of suppression.

If age and premorbid IQ were found to act as suppressor variables in the relationship between SMCs and memory performance, such a result would be noteworthy given that raw score measures of memory continue to be utilized in SMC research (e.g. Mendes *et al.*, 2008; Minett *et al.*, 2008).

To examine this possibility, the current study utilized a correlational design to assess whether the relationship between SMCs and memory performance was suppressed by age and premorbid IQ. Given that, according to previous research, age and premorbid IQ appear to meet the criteria for classical suppression developed by Maassen and Bakker (2001), it was anticipated that the relationship between SMCs and memory performance will be strengthened by partialing out the effect of age and premorbid IQ on memory performance.

Methods

Participants

The participants comprised 121 community-dwelling older adults (81 females, 40 males) aged between 66 and 90 years (M = 73.83, SD = 6.34). Mean years of formal primary, secondary, and postsecondary education was 12.64 (SD = 3.08, range = 8–24) and all participants spoke fluent English. Participants were invited to take part in the study via advertisements in local newspapers distributed around Perth, Western Australia. All participants were asked about any vision or hearing impairments, current medications, previous head injuries, stroke, and whether they had sought assistance for any difficulties relating to memory or language. However, participants were only excluded from the present study when testing was not feasible (e.g. due to vision or hearing impairments) or when they had previously sought professional help for problems with memory or language (since the relationship between SMCs and memory performance might be artificially inflated by feedback provided by any formal testing carried out previously).

Apparatus

Subjective memory complaints were assessed using the Memory Functioning Questionnaire (MFQ) (Gilewski *et al.*, 1990). The MFQ is a 64-item, self-report questionnaire that assesses various aspects of memory through a general rating of memory problems and four scales: (1) General Frequency of Forgetting, (2) Seriousness of Forgetting, (3) Retrospective Functioning, and (4) Mnemonics. All items are assessed on a seven-point Likert scale and scores on the MFQ range from 0 to 448, with higher scores indicating subjective beliefs of better memory functioning.

Memory performance was assessed using raw scores from the Visual Reproduction (VR) and Logical Memory (LM) subtests of the Wechsler Memory Scale – Fourth Edition (WMS-IV)

(Wechsler, 2009). These subtests provide scores for immediate (VR-I and LM-I) and delayed (VR-II and LM-II) measures of memory for both visual and verbal information. Scores for these tests range from 0 to 43 (VR-I and VR-II), 0 to 53 (LM-I), and 0 to 39 (LM-II). Premorbid IQ was estimated using the National Adult Reading Test (NART) (Nelson, 1982). To maintain consistency with the MFQ and WMS-IV measures (so that higher scores imply better functioning), scores for the NART were calculated as the number of correctly pronounced irregular words out of 50.

Given that severity of depression is often found to be a pre-eminent predictor of SMCs, depression was assessed using the Depression Scale from the Depression Anxiety Stress Scales (DASS) (Lovibond and Lovibond, 1995). The DASS is a 42-item, self-report questionnaire; the Depression Scale comprises 14 of the 42 items and measures characteristics such as self-disparagement, pessimism about the future, life dissatisfaction, and inertia. Items are scored on a four-point Likert scale that reflects the extent to which the participant has experienced such characteristics of depression over the past two weeks. Scores on the Depression Scale range from 0 to 42, with higher scores reflecting a greater degree of distress.

Procedure

After providing informed consent, participants gave their date of birth and details regarding their education, any vision or hearing problems, current medications, previous head injuries, strokes, and any language or memory impairments about which they had spoken to a health professional. Participants then completed the immediate recall component of the VR and LM subtests (VR-I and LM-I). After 25 minutes, the delayed components of the VR and LM subtests were completed (VR-II and LM-II). In between the immediate and delayed components of the VR and LM subtests, participants completed the MFQ, DASS, and one other questionnaire used for a related study (NEO-Five Factor Inventory; Costa and McCrae, 1992). Participants generally did not finish all three questionnaires within 25 minutes, in which case they were put aside to be completed later in the session. However, the MFQ was given first and completed within the allocated time by all participants. Participants then undertook categorical fluency and picture description tasks, also being used in a related study. Finally, participants completed the NART. The session typically took around 100 minutes but ranged from approximately 90 to 120 minutes.

Data analysis

All analyses were conducted using SPSS (version 17). Zero-order correlations were carried out between all variables, which were then followed by two main sets of analyses: multiple regression and rank contrast correlations.

MULTIPLE REGRESSION ANALYSES

Hierarchical regression analyses were carried out to observe whether age and premorbid IQ suppress the relationship between SMCs and memory performance. There are many definitions of what constitutes a suppressor variable and much debate has taken place with regard to how and why suppression occurs. However, the concept fundamentally represents a situation whereby the predictive value of an independent variable increases, rather than decreases, after variance associated with an additional independent variable is partialed out (Conger, 1974; Velicer, 1978).

To test whether age and premorbid IQ increase the predictive value of the memory performance measures in predicting MFQ scores, four separate hierarchical regression analyses were conducted. We chose to conduct a separate regression analysis for each measure of memory rather than conduct a single regression analysis that incorporated all four memory measures as predictors for two reasons. First, there is likely to be considerable shared variance (possibly multicollinearity) between the four memory measures which, if entered into the same regression model, would likely return distorted regression weights and correlations that do not truly reflect the nature of their relationship with MFQ scores (this would be particularly problematic for predictors that typically show such weak zero-order correlations with SMCs). Second, any effect of suppression from age and premorbid IQ on complaint–performance congruency identified in the current study would depend on correlations among the four memory measures (which would be illogical given different studies incorporate different measures of memory). While the memory measures could be collapsed together to produce a single "memory" predictor, we felt this was inappropriate given they each assess theoretically distinct facets of memory functioning. For each regression analysis, the measure of memory performance, depression, and education were entered into the model first (model 1), followed by age (model 2), and then NART scores (model 3). Model 1 represents an analysis one might typically carry out when examining the unique relationship between SMCs and memory performance (i.e. with depression and education partialed out). Models 2 and 3 provide

Table 1. Zero-order correlations among MFQ scores, memory performance, age, and NART scores

MEASURE	1	2	3	4	5	6	7	8	M	SD
1. MFQ	–								278.22	42.53
2. VR-I	0.050	–							31.48	7.38
3. VR-II	0.116	0.775***	–						22.17	9.77
4. LM-I	0.195*	0.419***	0.378***	–					32.13	7.87
5. LM-II	0.191*	0.358***	0.360***	0.787***	–				17.33	6.67
6. Dep	−0.280**	−0.080	−0.111	−0.106	−0.040	–			5.38	7.76
7. Edu	0.029	0.028	0.146	0.253**	0.184*	−0.070	–		12.64	3.08
8. Age	0.053	−0.442***	−0.487***	−0.315***	−0.250**	−0.096	−0.091	–	73.83	6.34
9. NART	−0.088	0.292**	0.269**	0.374***	0.317***	0.074	0.397***	−0.217*	39.96	4.92

Note: MFQ = Memory Functioning Questionnaire, VR-I = Visual Reproduction I, VR-II = Visual Reproduction II, LM-I = Logical Memory I, LM-II = Logical Memory II, Dep = Depression Scale scores, Edu = years of education, NART = National Adult Reading Test. *$p < 0.05$, two-tailed. **$p < 0.01$, two-tailed. ***$p < 0.001$, two-tailed.

an indication of whether age and premorbid IQ suppress this unique relationship.

RANK CONTRAST CORRELATIONS
Correlations were then carried out to observe how complaint–performance congruency was related to age and premorbid IQ. To obtain a measure of congruency between complaints and performance, a set of "rank contrast" scores was calculated for each participant, which reflects the difference between each participant's rank on the MFQ and their ranks on each of the four measures of memory performance. For example, a rank of 75 on the MFQ and 55 on LM-II (where ranks of 1 and 121 correspond to the worst and best functioning, respectively) would provide a rank contrast score of 20 for LM-II for that participant (i.e. 75−55 = 20). When two or more raw score values were tied, mean rank values were used. The rank contrast scores provide an indication of the discrepancy between a participant's rating of their own memory in relation to their actual memory performance on each of the memory measures, relative to the rest of the sample. Rank contrast scores greater than 0 indicate that the participant's MFQ rank is higher than their rank on a particular measure of memory, suggesting they rated their memory as better than their performance suggests, relative to the rest of the sample. On the contrary, rank contrast scores of less than 0 indicate that the participant's MFQ rank is lower than their rank on a particular memory measure, suggesting they rated their memory as poorer than their performance suggests, relative to the rest of the sample.

Results

Means and standard deviations for MFQ, VR-I, VR-II, LM-I, LM-II, the Depression Scale,

education, age, and NART, as well as all zero-order Pearson correlations between them, are provided in Table 1.

Two-tailed Pearson correlations among the measures of memory performance were all positive, medium to very large (r between 0.358 and 0.787), and significant at $p < 0.001$. Correlations between age and measures of memory performance were all negative, medium to large (r between −0.250 and −0.487), and also generally significant at $p < 0.001$ (age and LM-II were significant at $p = 0.006$), suggesting that raw score memory performance declines with aging. Of the four measures of memory performance, only LM-I (r = 0.195) and LM-II (r = 0.191) were significantly related to MFQ scores ($p = 0.032$ and 0.036, respectively). However, all correlations between memory performance and MFQ scores were in the expected direction. Correlations between NART scores and all memory performance measures were significant and of medium strength (r between 0.269 and 0.374), suggesting that memory performance is positively associated with premorbid IQ. Scores on the NART correlated significantly and negatively with age (r = −0.217, $p = 0.017$), suggesting that estimates of premorbid IQ decline with increasing age. However, NART scores did not correlate significantly with MFQ scores (r = −0.088, $p = 0.335$), suggesting little relationship with memory complaints. Finally, no significant relationship was found between MFQ scores and age (r = 0.053, $p = 0.561$).

Regression analyses

Table 2 provides a summary of the semipartial correlations, R^2 and ΔR^2 values for each model in each of the four regression analyses. While correlations were generally small for all memory measures across all three models, the semipartial correlations for all four measures of memory

Table 2. Semipartial correlations, R squared (R^2), and R squared change (ΔR^2) values for each model in each hierarchical regression analysis

REGRESSION ANALYSIS

MODEL	VR–I			VR–II			LM–I			LM–II		
	1	2	3	1	2	3	1	2	3	1	2	3
VR-I	0.028	0.045	0.067	—	—	—	—	—	—	—	—	—
VR-II	—	—	—	0.086	0.114	0.130	—	—	—	—	—	—
LM-I	—	—	—	—	—	—	0.170	0.188*	0.218*	—	—	—
LM-II	—	—	—	—	—	—	—	—	—	0.181*	0.193*	0.218*
Dep	−0.275**	−0.265**	−0.251**	−0.268**	−0.250**	−0.236**	−0.262**	−0.247**	−0.227**	−0.273**	−0.263**	−0.248**
Edu	0.008	0.013	0.048	−0.003	0.000	−0.036	−0.033	−0.032	0.016	−0.024	−0.020	−0.027
Age	—	0.045	0.040	—	0.081	0.073	—	0.085	0.072	—	0.074	0.057
NART	—	—	−0.089	—	—	−0.096	—	—	−0.132	—	—	−0.124
R^2	0.079*	0.081*	0.089	0.086*	0.092*	0.101*	0.107**	0.114**	0.132**	0.111**	0.116**	0.132**
ΔR^2	—	0.002	0.008	—	0.006	0.009	—	0.007	0.017	—	0.005	0.015

Note. VR-I = Visual Reproduction I, VR-II = Visual Reproduction II, LM-I = Logical Memory I, LM-II = Logical Memory II, Dep = Depression Scale scores, Edu = years of education, NART = National Adult Reading Test.
*$p < 0.05$, two-tailed. **$p < 0.01$, two-tailed.

performance increased after adding both age and NART scores to each regression analysis. Semipartial correlations for memory performance measures in model 1 ranged from 0.028 to 0.181, with only LM-II reaching significance ($p = 0.040$). Semipartial correlations for memory measures in model 2 (age included) ranged from 0.045 to 0.193, with both LM-I and LM-II reaching significance ($p = 0.034$ and $p = 0.029$, respectively). Semipartial correlations in model 3 (age and NART scores included) ranged from 0.067 to 0.218, with LM-I and LM-II reaching significance (both $p = 0.014$).

Depression Scale scores were consistently related to MFQ scores across the three models in all regression analyses. Across the four regression analyses, semipartial correlations for Depression Scale scores ranged between −0.262 ($p = 0.003$) and −0.275 ($p = 0.002$) in model 1, between −0.247 ($p = 0.006$) and −0.265 ($p = 0.004$) in model 2, and between −0.227 ($p = 0.010$) and −0.251 ($p = 0.006$) in model 3. In contrast, years of education, age, and NART scores were not related to MFQ scores. For all three models in all four regression analyses, semipartial correlations for years of education, age, and NART scores were not significant ($p > 0.05$).

Overall, each of the regression models accounted for a relatively small amount of variance in MFQ scores, with R^2 values ranging from 0.079 to 0.132. The R^2 values for regression models that contained LM-I and LM-II (ranging from 0.107 to 0.132) were larger than the R^2 values for regression models that contained VR-I and VR-II (ranging from 0.079 to 0.101), suggesting that models incorporating verbal memory performance better predicted MFQ scores than models incorporating visual memory performance. All R^2 values were significant (ranging from $p = 0.003$ to $p = 0.042$), with the exception of model 3 for the VR-I regression analysis ($p = 0.054$). However, none of the R^2 change values were significant for any model in any of the regression analyses, suggesting that while the inclusion of age and NART scores improves the predictive value of each of the memory measures, it does not improve the ability to predict MFQ scores in general.
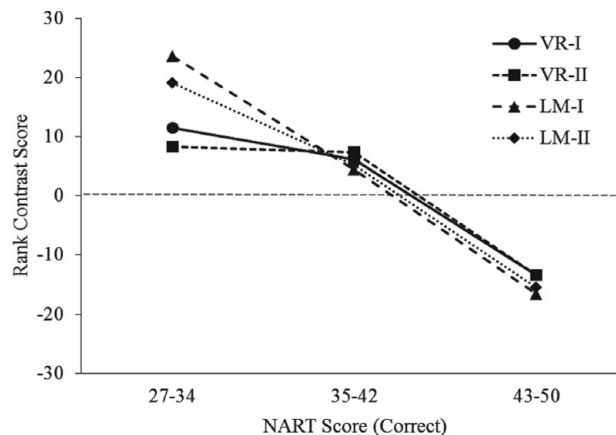
Rank contrast correlations

Given that the inclusion of both age and NART scores increased semipartial correlations for memory measures across all four regression analyses, rank contrast correlations were carried out to observe how age and NART scores were related to complaint–performance congruency. Two-tailed Spearman correlations were carried out between the participant's age and the rank contrast scores
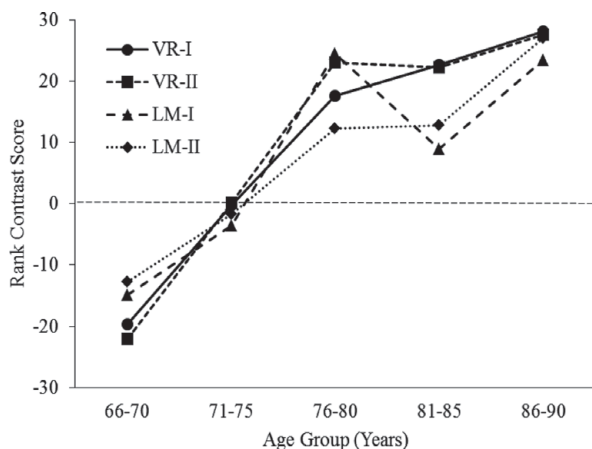
Figure 1. Mean rank contrast scores across age groups for each measure of memory.

Figure 2. Mean rank contrast scores across NART score groups for each measure of memory.

for each of the memory measures. Age was significantly related to rank contrast scores for all four measures of memory. Rank contrast scores were most strongly related to age for VR-II (Spearman's $\rho = 0.409$, $p < 0.001$), followed by VR-I (Spearman's $\rho = 0.361$, $p < 0.001$), LM-I (Spearman's $\rho = 0.290$, $p = 0.001$), and LM-II (Spearman's $\rho = 0.252$, $p = 0.005$). The correlations suggest medium to large positive relationships between complaint–performance congruency and age, whereby younger participants rated their memory more stringently relative to their performance in comparison to older participants. To provide further indication of how complaint–performance congruency is related to age, the mean contrast scores across five age bands for each of the four measures of memory are displayed in Figure 1.

To determine how complaint–performance congruency was related to premorbid IQ, two-tailed Spearman correlations were carried out between NART scores and each of the rank contrast scores. As with age, NART scores were significantly related to rank contrast scores for all four measures of memory. Congruency was most strongly related to NART scores for LM-I (Spearman's $\rho = -0.356$, $p < 0.001$), followed by LM-II (Spearman's $\rho = -0.319$, $p < 0.001$), VR-II (Spearman's $\rho = -0.279$, $p = 0.002$), and VR-I (Spearman's $\rho = -0.253$, $p = 0.005$). The correlations suggest medium-strength negative relationships between complaint–performance congruency and NART scores, whereby participants with higher NART scores rated their memory more stringently relative to their performance compared to participants with lower NART scores. To provide further indication of how complaint–performance congruency is related to NART scores, the mean contrast scores across three groups for each of the four measures of memory are displayed in Figure 2.

Discussion

As hypothesized, the strength of the relationship between SMCs and memory performance increased after partialing out variance in memory performance associated with age and premorbid IQ. In all four regression analyses predicting MFQ scores, semipartial correlations for each of the memory performance measures increased after adding both age (model 2) and NART scores (model 3). These increases in semipartial correlations were small but consistent. Semipartial correlations for Depression Scale scores were considerably stronger than for the memory performance measures in model 1, although this discrepancy reduced after partialing out variance associated with age and NART scores. Indeed, the strength of the semipartial correlations for LM-I and Depression Scale scores were comparable in model 3 (0.218 and −0.227, respectively). The contrasting effect of partialing out age and premorbid IQ on semipartial correlations for the memory performance measures and Depression Scale scores is worth noting given depression is generally accepted as the pre-eminent predictor of SMCs. It is also worth noting that partialing out variance associated with age and premorbid IQ had almost no effect on the overall R^2 value for any of the regression models (no R^2 change statistics were significant). Thus, differences in age and premorbid IQ partly explain why memory performance is generally a poor predictor of SMCs but they do not appear to improve the overall predictability of memory complaints.

Different types of suppressor variables have been depicted in the literature, although according to the definition of Maassen and Bakker (2001), age and premorbid IQ act as classical suppressor variables in the relationship between memory performance and SMCs. That is, both are related to other predictor variables but are not associated

with the outcome variable. Age, for example, was significantly correlated with all memory performance measures (r between −0.250 and −0.487) but not significantly correlated with MFQ scores (r = 0.053). Likewise, NART scores also correlated significantly with all memory performance measures (r between 0.269 and 0.374) but not significantly with MFQ scores (r = −0.088). Given that age and premorbid IQ fit the description of a classical suppressor, it is possible that they have contributed to an underestimation of the value of memory performance measures in predicting SMCs in previous research, even if this contribution is small. However, as far as we are aware, age and premorbid IQ have not been identified as suppressor variables in memory complaint–performance congruency beyond this study and this result may be dependent on the use of the MFQ or WMS-IV measures. Further research or re-analysis of available data could help to clarify whether this result extends to different measures of subjective and objective memory.

The rank contrast correlations help to further explicate the manner in which age and premorbid IQ are related to complaint–performance congruency. The significant, positive, and medium-strength Spearman correlations between age and complaint–performance congruency, as well as the mean rank contrast scores plotted in Figure 1, suggest that younger participants rated their memory more stringently relative to their performance compared to older participants. This result does not indicate that people over a certain age tend to overestimate their memory performance per se; rather it suggests that when using the MFQ (and possibly other SMC questionnaires) subjective appraisals of one's own ability appear to become more lenient with increasing age. This is presumably a consequence of the strong effect of aging on memory performance but lack of a relationship with memory complaints. Thus, while aging is clearly associated with decreases in raw score memory performance, it appears to be taken into account when subjective estimates are made about one's own memory (at least on the MFQ). This might explain the age-related differences in complaint–performance congruency found by Mendes *et al.* (2008) and why older participants appeared to overestimate their memory performance in the study by Frerichs and Tuokko (2006). The significant, negative, and medium-strength Spearman correlations between NART scores and complaint–performance congruency, as well as the mean rank contrast scores plotted in Figure 2, also suggest that participants with a higher premorbid IQ score rate their memory more stringently relative to their performance than

participants with a lower premorbid IQ score. Again, this result does not suggest that participants over a certain premorbid IQ score underestimate their memory performance; it simply suggests that subjective appraisals of memory are more lenient in those with lower premorbid IQ scores.

An outcome of these relationships is that by increasing variance in age and premorbid IQ in a sample, variance is introduced into memory performance that is not shared with SMCs. An important consequence of this that extends to previous literature and future research is that the strength of correlations between SMCs and raw score measures of memory will depend partly on the ranges of age and premorbid IQ of participants in the sample. Studies with samples of greater age and premorbid IQ ranges are likely to have more variance in memory performance not shared with SMCs and should expect, all other things being equal, to find weaker correlations with SMCs. Given that correlations between SMCs and memory performance are often weak but in the expected direction, this might account for some degree of inconsistency in the literature regarding whether or not memory performance is classified as a meaningful predictor of SMCs.

It is also unlikely that age and premorbid IQ are the only variables that act to suppress the relationship between memory performance and SMCs. For example, situational fatigue may be negatively related to memory performance but not related to SMCs (given that SMCs are typically based on past experiences). As a result, it may be premature at this stage to conclude that memory complaints are not a good indicator of current memory functioning and it raises the question of what other variables might suppress complaint–performance congruency by introducing variance into memory performance that is not shared with SMCs.

In terms of future research, there are several strategies that can be adopted to limit the effect of suppression on complaint–performance congruency resulting from differences in age and premorbid IQ. One option is to utilize norms, where available, to provide participants with a standard score for memory that is adjusted for age and IQ (although norms adjusted for both are rarely available). A second option is to utilize SMC questionnaires that incorporate norms, such as the Memory Assessment Clinics Self-rating Scale (MAC-S) (Crook and Larrabee, 1992). It would be interesting to repeat the current study with the MAC-S (rather than the MFQ) to observe any differences in complaint–performance congruency when raw scores and scores based on normed data for the MAC-S are used. A third option to minimize

suppression in correlational studies is to use the method employed in the current study; that is, to record age and take a measure of premorbid IQ and to take these variables into account when observing correlations between memory performance and SMCs. This third option is a quick and simple solution, given that a measure of premorbid IQ can be obtained from most participants via the NART in less than five minutes.

The results obtained in the present study need to be considered within the context of a few limitations. First, screening for previous testing of memory or language in participants was based exclusively on self-reports, which may have been unreliable. Participants may have forgotten about testing carried out in the past (although, in this case, the effect of previous testing on SMCs might have been small or nonexistent) or may have omitted details of previous testing due to associated feelings of embarrassment or distress (which likely would have inflated correlations between SMCs and memory performance, since feedback from formal testing would presumably influence beliefs about one's own memory abilities).

Second, mean NART scores were unusually high for an Australian sample (cf. Kiely *et al.*, 2011), as were years of education relative to other SMC studies (cf. Schmidt *et al.*, 2001; Zandi, 2004; Minett *et al.*, 2008). However, we expect that these differences in premorbid IQ and education had little influence on the results reported here and may, in fact, be attributable to the sampling procedures used. Given the sample was recruited via newspaper advertisements, those with a greater interest in research and education might have been more likely to respond. Likewise, we may have recruited participants who, on average, were more concerned about their memory than other similarly aged people in the community. We also feel, however, that this would have had little or no effect on these results.

Finally, it is standard procedure to administer the Verbal Paired Associates subtest of the WMS-IV (Wechsler, 2009) between the immediate and delayed parts of the VR and LM subtests, though this was replaced with three questionnaires in the current study. As a result, mean raw scores on the delayed component of the VR and LM subtests (i.e. VR-II and LM-II) should be interpreted with caution, given that the questionnaires may exhibit more or less interference than the Verbal Paired Associates subtest. Again, however, we feel that these factors were unlikely to have much effect on the results presented here.

Another issue worth pointing out is that the current study compared four theoretically distinct measures of memory with a single, overall measure of subjective complaint. While some aspects of the MFQ more closely reflect visual and verbal memory (e.g. remembering names and faces), the questionnaire is not designed to delineate between visual and verbal or immediate and delayed aspects of memory functioning. If the measures of memory performance were compared against SMC questions that matched these measures of performance, it is likely that stronger relationships would have been reflected between complaints and performance. While we can only speculate on this point, we see no reason why age and premorbid IQ would not also act as suppressor variables when using SMC questions that are matched to each of the four measures of memory utilized in this study.

In summary, the results of the present study suggest that age and premorbid IQ act as suppressor variables in the relationship between memory performance and memory complaints. For immediate and delayed measures of visual and verbal memory, semipartial correlations increased after adding both age and NART scores to regression analyses designed to predict scores on the MFQ. Zero-order correlations indicated that age and premorbid IQ act in a manner consistent with what Maasen and Bakker (2001) describe as classical suppression. Finally, rank contrast correlations demonstrated memory complaint–performance congruency to be related to age and premorbid IQ, whereby older participants and those with a lower premorbid IQ judged their memory ability more leniently than younger participants and those with a higher premorbid IQ. An important consequence of these relationships is that congruency between SMCs and raw score memory performance in correlational research will depend partly on the range of age and premorbid IQ in the sample. This may account in part for whether or not the typically weak associations between SMCs and memory performance are deemed significant. The effect of suppression from age and premorbid IQ on complaint–performance congruency in correlational studies can easily be avoided by taking these variables into account, measures of which can usually be obtained in less than five minutes.

Conflict of interest

None.

Description of authors' roles

Matt Merema helped design the study, collected the data, conducted the analysis, and wrote the

References

Conger, A. J. (1974). A revised definition for suppressor variables: a guide to their identification and interpretation. *Educational and Psychological Measurement*, 34, 35–46.

Costa, P. T. and McCrae, R. R. (1992). *Professional Manual: Revised NEO Personality Inventory (NEO PI-R) and NEO Five-Factor Inventory (NEO-FFI)*. Lutz, FL: Psychological Assessment Resources, Inc.

Crook, T. H. and Larrabee, G. J. (1992). Normative data on the self-rating scale for evaluating memory in everyday life. *Archives of Clinical Neuropsychology*, 7, 41–51.

Frerichs, R. J. and Tuokko, H. A. (2006). Reliable change scores and their relation to perceived change in memory: implications for the diagnosis of mild cognitive impairment. *Archives of Clinical Neuropsychology*, 21, 109–115.

Frick, A., Wahlin, T. R., Pachana, N. A. and Byrne, G. J. (2011). Relationships between the National Adult Reading Test and memory. *Neuropsychology*, 25, 397–403.

Gilewski, M. J., Zelinski, E. M. and Schaie, K. W. (1990). The memory functioning questionnaire for assessment of memory complaints in adulthood and old age. *Psychology and Aging*, 5, 482–490.

Jorm, A. F. (2004). The Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE): a review. *International Psychogeriatrics*, 16, 1–19.

Jorm, A. F., Christensen, H., Korten, A. E., Jacomb, P. A. and Henderson, A. S. (2001). Memory complaints as a precursor of memory impairment in older people: a longitudinal analysis over 7–8 years. *Psychological Medicine*, 31, 441–449.

Kiely, K. M., Luszcz, M. A., Piguet, O., Christensen, H., Bennett, H. and Anstey, K. J. (2011). Functional equivalence of the National Adult Reading Test (NART) and Schonell reading tests and NART norms in the Dynamic Analyses to Optimise Ageing (DYNOPTA) project. *Journal of Clinical and Experimental Neuropsychology*, 33, 410–421.

Levy-Cushman, J. and Abeles, N. (1998). Memory complaints in the able elderly. *Clinical Gerontologist*, 19, 3–24.

Lovibond, S. H. and Lovibond, P. F. (1995). *Manual for the Depression Anxiety Stress Scales*. Sydney, Australia: Psychology Foundation.

Maassen, G. H. and Bakker, A. B. (2001). Suppressor variables in path models: definitions and interpretations. *Sociological Methods and Research*, 30, 241–270.

Mendes, T. *et al.* (2008). Memory complaints in healthy young and elderly adults: reliability of memory reporting. *Aging and Mental Health*, 12, 177–182.

Minett, T. S., Da Silva, R. V., Ortiz, K. Z. and Bertolucci, P. H. (2008). Subjective memory complaints in an elderly sample: a cross-sectional study. *International Journal of Geriatric Psychiatry*, 23, 49–54.

Nelson, H. E. (1982). *National Adult Reading Test (NART): Test Manual*. Windsor, ON, Canada: NFER-Nelson.

Pearman, A. and Storandt, M. (2004). Predictors of subjective memory in older adults. *Journals of Gerontology*, 59B, 4–6.

Pearman, A. and Storandt, M. (2005). Self-discipline and self-consciousness predict subjective memory in older adults. *Journals of Gerontology*, 60B, 153–157.

Potter, G. G., Hartman, M. and Ward, T. (2009). Perceived stress and everyday memory complaints among older adult women. *Anxiety, Stress, and Coping*, 22, 475–481.

Schmidt, I. W., Berg, I. J. and Deelman, B. G. (2001). Relations between subjective evaluations of memory and objective memory performance. *Perceptual and Motor Skills*, 93, 761–776.

Sinnett, E. R. and Holen, M. C. (1999). Assessment of memory functioning among an aging sample. *Psychological Reports*, 84, 339–350.

Stein, S., Linn, M., Stein, E. M. and Linn, B. S. (1983). The impact of environment on perception of stress and symptoms of the elderly. *Activities, Adaptation, and Aging*, 3, 39–48.

Velicer, W. F. (1978). Suppressor variables and the semipartial correlation coefficient. *Educational and Psychological Measurement*, 38, 953–958.

Wechsler, D. (2009). *WMS-IV: Administration and Scoring Manual*. Sydney, Australia: Pearson.

Zandi, T. (2004). Relationship between subjective memory complaints, objective memory performance, and depression among older adults. *American Journal of Alzheimer's Disease and Other Dementias*, 19, 353–360.