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Self-assessments of memory correlate with neuroticism and conscientiousness, not memory span performance.

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Abstract

Self-report measures of cognitive problems may have value, but there are indications that scores on such measures are influenced by other factors such as personality. In an online correlational study, 523 non-clinical volunteers completed measures of personality, digit span, and the Prospective and Retrospective Memory Questionnaire. Self-reported prospective and retrospective memory failures were associated positively with neuroticism and negatively with conscientiousness, but not with digit span performance. These findings are consistent with other indications that conscientiousness and neuroticism may underpin self-reports of cognitive problems.

Keywords: prospective memory, retrospective memory, self-report, digit span, neuroticism, conscientiousness, personality

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Introduction

A number of self-report questionnaires have been developed to assess everyday experience of different types of cognitive problems. They provide a convenient way to investigate cognitive function and failures in everyday life, and may also have a role to play in clinical practice (Crawford, Smith, Maylor, Della Salla & Logie, 2003; Thompson, Henry, Rendell, Withall & Brodaty, 2015). However, questions have been raised as to whether such self-report questionnaires genuinely do assess cognitive failures, or are rather influenced by other variables such as personality. For example, Buchanan (2016) found evidence that self-report measures of problems with executive function appeared to be influenced by personality (neuroticism and conscientiousness) rather than objectively measured cognitive tasks. There are indications that the same may be true of other aspects of cognitive function.

The Prospective and Retrospective Memory Questionnaire (PRMQ; Smith, Della Sala, Logie & Maylor, 2000) is a popular measure of two different aspects of memory: Prospective Memory, the ability to remember things one needs to do at the appropriate point; and Retrospective Memory, which is the ability to remember things that have happened in the past. Using this questionnaire, Thompson et al (2015) found that self-rated prospective memory problems did not correlate with objectively measured prospective memory. Nor did self-ratings of prospective and retrospective memory differ across groups of participants with diagnoses of dementia, mild cognitive impairment, or no diagnoses.

Uttl and Kibreab (2011), in an article focused on the validity of self-report questionnaires of prospective memory, examined correlations of several self-report prospective memory scales

with objective memory tests in a sample of 240 students. Their general conclusion was that correlations between self-assessments and objective measures of memory were typically weak, leading them to challenge the validity of self-report measures of prospective memory. While Uttl and Kibreab focused primarily on prospective memory, one of the measures they used was the PRMQ which also includes a retrospective memory scale. Among their objective measures, they included a retrospective memory test: A verbal learning measure that involves remembering word lists. PRMQ retrospective memory scores did not correlate at all with the verbal learning measure, again undermining the notion that self-assessments reflected real ability level. In addition to the memory measures, Uttl and Kibreab's respondents completed Costa and McCrae's (1992) NEO FFI personality inventory. They noted that substantive variance in scores was associated with the personality dimensions neuroticism and conscientiousness. These findings are reminiscent of those reported by Buchanan (2016) for self-report measures of executive function.

Taken together, these findings suggest that the amount of variance in self-reports of prospective and retrospective memory that is accounted for by actual memory problems may be limited. Instead, they may be influenced by the personalities of respondents.

This project set out to address the question of whether self-reports of memory problems are associated with personality. The specific aims were to assess the extent to which scores on the PRMQ were associated with personality and with objectively-measured retrospective memory. This will extend the work of Uttl and Kibreab (2011) by using a different retrospective memory task, and a larger and more diverse sample. It is hypothesized that PRMQ self-reports of prospective memory problems will be associated positively with neuroticism (H1) and negatively with conscientiousness (H2). Similarly, PRMQ self-reports of retrospective memory

problems will be associated positively with neuroticism (H3) and negatively with conscientiousness (H4).

Method

Materials

This study was conducted wholly online. Ethical approval came from the host University's Psychology Research Ethics Committee. Participants were recruited, and personality and demographic data acquired, using the long-established personality testing website www.personalitytest.org.uk.

Personality was measured with an online Five Factor personality inventory providing indices of Extraversion, Neuroticism, Openness to Experience, Agreeableness and Conscientiousness, as operationalized in the Five Factor Model of Costa and McCrae (1992). This 41-item inventory was derived from an International Personality Item Pool measure (IPIP; Goldberg, 1999) that correlates well with Costa and McCrae's domains. It has been validated for use on the internet (Buchanan, Johnson & Goldberg, 2005). In this inventory, Extraversion is assessed by 9 items such as ''Am skilled in handling social situations''. Agreeableness is assessed by 7 items such as ''Have a good word for everyone''. Conscientiousness is assessed by 10 items such as ''Pay attention to details''. Neuroticism is assessed by 8 items such as ''Have frequent mood swings''. Openness to Experience is assessed by 7 items such as ''Believe in the importance of art''. Participants rate the accuracy of statements about their typical behavior on a 5-point scale from 1 ''very inaccurate'' to 5 ''very accurate''. The website was attracting over three thousand users per week at the time the study was conducted. No attempt is made to recruit respondents or otherwise attract them to the site--they are referred by other sites or find it through search engines. Many complete the test as part of some class, being

asked to do so by their teacher or professor.

Self-reports of memory problems were obtained using the 16-item Prospective and Retrospective Memory Questionnaire (PRMQ, Smith et al 2000). This is a brief measure of the extent to which people experience problems with different aspects of memory, responded to using a 5-point scale from “very often” to “never”. Retrospective memory (ability to remember things that have happened in the past) is measured by 8 items such as “Do you fail to recognize a place you have visited before?”, while prospective memory (ability to remember things one needs to do in the future) is measured by 8 items such as “Do you decide to do something in a few minutes’ time and then forget to do it?”. This measure was hosted on the Qualtrics online survey platform.

Digit span tasks assess participants’ ability to reproduce strings of digits presented to them, normally in either forward or reverse order. Increasingly longer spans are presented, until participants are unable to reproduce them. Maylor, Smith, Della Sala and Logie (2002) consider forward span to address retrospective memory, while reverse span is argued to involve additional cognitive processes. A computerized version of the digit span task was implemented on the Qualtrics online survey platform, as previously used by Buchanan (2016). Buchanan (2016) had noted that an unexpectedly high proportion of respondents had zero scores (12.2% for forward span, 13% for reverse span). In the current study, the task was modified to include a practice trial at the beginning of the task (if participants failed at it, the practice trial was repeated up to two more times). This led to much lower rates of zero scores: 1.3% for forward, and 3.1% for reverse span.

Prior to each trial, participants saw the words “Ready” and then “Go” for 0.5 seconds each. They then saw a series of digits between 1 and 9, one at a time, for one second each. At

the end of the series, they saw a cue reading either ‘FORWARD’ or ‘BACKWARD’. They then typed the numbers they had seen, in either forward or backward sequence as instructed, putting an ‘x’ in the place of any number they could not recall. The trials began with forwards recall, starting with two and rising to a maximum of 9 digits. There were two trials at each sequence length. The forward trials terminated when either all had been successfully completed, or the participant had failed twice at a given sequence length. The reverse recall trials that followed these again began with two digits and rose to a maximum sequence length of 8 digits. Participant scores were the total number of correct responses across each of the forward and reverse sets of trials. This is the same scoring method as used by the WAIS IV implementation of the task (Wechsler, 2008).

Procedure.

Participants first saw a page describing the inventory, and details of the ethical approval of the research project. Clicking a button to indicate that they consented to participate led them to a second page with brief instructions and the 41 items of the inventory. Radio button response formats on a 5-point scale (‘Very Inaccurate - Very Accurate’) were used for the personality items. Participants then responded to a series of other items using drop-down menus: age group (in 5-year increments); current location (a comprehensive list of nations); gender; highest level of education; main occupational status. Following this, participants were asked how they came to be taking the test (e.g. as part of a class). Finally, participants were asked whether their data could be used in analyses (they were instructed to answer ‘no’ if they had not answered the questions seriously, or did not give consent). Those who had completed all the personality items then saw a debriefing page thanking them for their participation, and providing their scores on each of the scales (those who had not were sent back to complete the missing items). They were

also shown information to help interpret the scores, including a brief description of the meaning of each of the scales, and normative information about their scores relative to others who had completed the inventory to date (top third, middle, bottom third). Links were provided to contact the researcher, and to information about personality research elsewhere on the internet.

Respondents who had indicated that their data could be used for research purposes then saw an invitation to take part in the second part of the study, described as involving a memory questionnaire and recall task. People who followed the link to the second part, which was hosted on the Qualtrics online research platform, saw a further participant information / consent page outlining the second phase. Those who indicated they wished to participate then saw the items of the PRMQ, responded to using radio button format. On completing the PRMQ items, participants then moved on to the digit span tasks. Finally, they saw a debriefing page telling them what their scores were and outlining the purpose of the project.

Data Screening and Processing

Over a period of five weeks, 15,320 data submissions were recorded where people completed the online personality inventory, indicated their data could be used, and were shown the invitation to participate in the second part of this study. Of these, 532 went on to fully complete the PRMQ and digit span tasks, and give consent for their data to be used in the second phase. They form the sample for this study.

Data quality for these 532 participants was assured in three ways. First, Qualtrics' proprietary methodology was used to screen out multiple submissions: instances where a person participated twice, either on purpose or accidentally by clicking the submit button more than once. Second, 9 people who reported their age as below 16 were removed from the sample due to ethical concerns about whether they could be considered to have given valid consent. Third,

the file was examined for unrealistic combinations of demographic data (e.g. people claiming to be aged 16-20 and have doctoral degrees) that might suggest inauthentic responding. None were found.

Following these checks, 523 responses remained in the datafile. All further analyses are based on these. All participants had answered all the personality questions (the website ensures this). There was a small amount of missing data where participants omitted one or more of the PRMQ items. These participants were retained in the sample, but excluded casewise from analyses involving those variables.

Participants

Sample size was initially planned to exceed 350 participants, on the basis that this would give over 95% power to detect an effect size of r=.2 This threshold is suggested by Ferguson (2009) as a 'minimum practical effect size', defined as an effect that will have real-world importance, as opposed to just statistical significance (Faul, Erdfelder, Lang & Buchner's 2007 application, G*Power 3.1, indicated 314 participants are required to detect r=.2 with 95% power). The achieved sample size of 523 exceeded this planned minimum. Demographic characteristics for the 523 participants are shown in Table 1, which suggests the sample is biased towards relatively young North American women, over half of whom had at least some higher education, who had most often found the personality inventory by following a link from some other site.

Results

Descriptive statistics for all variables are shown in Table 2. Links between personality variables, digit span performance, and self-reported memory problems were assessed using both Pearson's and Spearman's correlations, also included in Table 2. This shows that self-reported memory problems had correlations greater in magnitude than r=.2 with personality;

Conscientiousness (negative) and Neuroticism in particular, but not with digit span performance. These correlations support the notion that personality may influence responses to self-report measures of cognition.

Multiple regression analyses with simultaneous entry of all predictors were used to evaluate the independent relationship between each personality and digit span variable, and prospective and retrospective memory scores. Age group was also included as a predictor in these analyses, given the known links between age and memory. Table 3 demonstrates that only Conscientiousness and Neuroticism had independent effects on retrospective memory scores, while for prospective memory Agreeableness, Conscientiousness and Neuroticism had statistically significant effects.

Effect sizes were considered to evaluate whether these relationships were sufficiently large to be practically meaningful (as opposed to statistically significant but actually trivial). Ferguson (2009) suggests that effects of magnitude of β=.2 or greater can be considered 'practically significant' in social science data. Conscientiousness and Neuroticism both met this criterion. Overall, the picture emerging from the analysis is that self-reports of both prospective and retrospective memory are related to the personality variables Conscientiousness and Neuroticism, but not to memory performance assessed using the digit span test.

It is worth noting that the PRMQ items are divided into a number of categories assessing different aspects of memory, in addition to the distinction between prospective and retrospective memory. These are: prospective short-term self-cued, prospective short-term environmentally-cued, prospective long-term self- cued, prospective long-term environmentally-cued, retrospective short-term self-cued, retrospective short-term environmentally-cued, retrospective long-term self-cued, and retrospective long-term environmentally-cued. Crawford et al (2003)

argued that these divisions do not explain a significant proportion of covariance among the PRMQ items. However, one might reason that the objective memory task used here - digit span - would be especially related to the experience of short-term, rather than longer-term memory problems. This is because the time period over which the digit span task measures memory performance is very short indeed.

In total, four items assess short-term retrospective memory (two environmentally-cued, two internally-cued): Forgetting something one was told a few minutes before; failing to recognize a character on radio or TV from scene to scene; mislaying something one has just put down; looking at something without realizing one has seen it moments before. These would appear to be more closely related to the performance assessed by the digit span task than items asking about more long-term retrospective memory failures, such as failure to recognize a place one has visited before. Therefore, an index comprising the four short-term retrospective items was created to enable exploratory analyses of its link with digit span performance and personality. Alpha for this set of items was less than ideal, at .63. While this is unsurprising for such a short scale, it means conclusions should be treated as tentative. However, correlational analyses indicated that this set of short-term retrospective memory items did not correlate with digit span performance, either forward (r=-.032, p=.48, n=506) or reverse (r=-.037, p=.402, n=506). It did correlate positively with Neuroticism (r=.217, p<.0005, n=506) and negatively with Conscientiousness (r=-.279, p<.0005, n=506). Overall, the pattern of relationships for the short-term retrospective memory questions is the same as for the larger set of all retrospective memory items.

Discussion

The overall picture that emerges from this study is that self-reports of prospective and retrospective memory problems obtained using the PRMQ are associated with personality, and not performance on the digit span test. For all four hypotheses proposed – that self-reports of prospective memory problems would be associated positively with neuroticism (H1) and negatively with conscientiousness (H2), and that self-reports of retrospective memory problems would be associated positively with neuroticism (H3) and negatively with conscientiousness (H4) – evidence inconsistent with the null hypothesis was found. Furthermore, there was no evidence of a relationship between self-reported retrospective memory and performance on the forward digit span task, despite the study having over 95% power to detect any meaningful effect.

These findings are consistent with those of previous work by Buchanan (2016) and Uttl and Kibreab (2011). Buchanan found that self-report measures of problems with executive function were associated with neuroticism and (negatively) with conscientiousness, not objective cognitive tasks. The same pattern was found here for self-reported memory problems. Uttl and Kibreab (2011) also found that PRMQ scores (both prospective and retrospective) correlated with neuroticism, and negatively with conscientiousness, with correlations of a similar magnitude. Furthermore, PRMQ scores were uncorrelated with the retrospective memory task used by Uttl and Kibreab (a verbal learning test). Here, PRMQ scores were uncorrelated with a different retrospective memory task.

Rather than being a direct replication of Uttl and Kibreab's results, the present findings serve to increase confidence in their generalizability. The current study used a more heterogenous sample, a different measure of personality, a different measure of memory performance, and was conducted in a different medium (online rather than in a supervised

setting). Despite all these differences, the same pattern of results was observed. This suggests the effects observed reflect a real phenomenon.

The effect sizes observed here, while exceeding Ferguson's (2009) 'practically significant' criteria, are still relatively small and reflect a limited degree of shared variance between personality and self-reported problems. The key point to be made is perhaps that even though these relationships are small, the relationship of self-reported problems with actual performance appears to be smaller still. In that case, what variables actually do underpin the greater proportion of variance in self-assessments? Further work is needed to identify other factors that may have systematic effects.

Extrapolating further, there may be practical implications of these findings. Self-reports of cognitive problems are used clinically, as well as in research settings. Given the extent to which these self-assessments are problematized by findings such as those of Thompson et al (2015) and Uttl & Kibreab (2011), is their use in such contexts sound? Furthermore, given the parallels between the results reported here, and those noted by Buchanan (2016) for executive function, do the potential problems extend to self-assessments of other aspects of cognitive performance as well?

Of course, the current findings are derived from cognitively normal - or relatively high-functioning – respondents. This makes it unsafe to extrapolate to clinical populations without further evidence. While Thompson et al's (2105) sample did include participants with diagnoses of dementia, that study did not assess personality. Uttl and Kibreab (2015), and the present study, did assess personality but did not include participants with clinically significant memory problems. There is thus a missing piece in this jigsaw puzzle that needs to be addressed by further work.

Limitations

A number of limitations must be acknowledged with the current work. First, the memory test used here was a text-based version of a digit span task that required answers to be entered using a keyboard. This differs from standard implementations, which are based on verbal presentation of stimuli. However, other work has shown a similar online implementation of the digit span task to be valid in comparison with a standard laboratory version (Tractenberg & Freas, 2007). Furthermore, Buchanan (2016) found the same pattern of results with this online implementation as with the verbally-administered WAIS-IV Digit Span test, used under laboratory conditions. These observations provide some reassurance that the task 'works'. However, the digit span task only measures one very specific aspect of memory performance. The current results do not enable one to say that PRMQ self-reports would not correlate with other objective measures of memory performance. However, even if that were the case, it does not diminish the finding that PRMQ scores are associated with personality variables, no matter what else they are related to.

As this study was conducted online with a non-probability volunteer sample, it is important to consider potential biases arising from that methodology. In comparison to the general population, it is biased with respect to demographic makeup, and potentially psychological variables such as motivation and personality. Again however, the similarity of these findings with those from Uttl and Kibreab's (2011) student sample provides some reassurance. That study incorporated different demographic and motivational biases. In their case, all the participants were students compared to only 30.4% here. All were participating for class credit, while only 22.8% were doing it as part of a class in the current study. Despite the differences between the samples, the findings were essentially the same.

As the sample used in this study was non-clinical, no conclusions can be drawn about the utility of the PRMQ or other self-report measures in clinical settings. However, given Thompson et al's (2015) cautions about clinical use of self-report measures, the study may raise issues worth reflecting on.

Finally, only one self-report measure of memory problems was used here. It is possible that other questionnaires would have different associations with personality and memory performance.

Conclusions

This paper contributes to a body of evidence suggesting that the personality variables neuroticism and conscientiousness account for a meaningful proportion of variance in self-reports of everyday problems with cognitive function. The extent to which this compromises the usefulness of such tools remains to be assessed. However, the magnitude of the relationships, in comparison to the relationships between self-reports and objectively measured cognitive performance, is such that the effect should be taken seriously.

This study has limitations, but taken together with work such as Buchanan (2016) and Uttl and Kibreab (2011) it suggests that conscientiousness and neuroticism may have an important role to play in driving responses to a range of self-report measures of cognitive problems. Future work should focus on understanding the processes and implications associated with this phenomenon.

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Tables

Table 1

Demographic Data

Measure		
N		523
Sex		
	Men	136 (26.0%)
	Women	368 (70.4%)
	Unanswered	19 (3.6%)
Age		
	Modal age group	16-20 (19.9%)
	Age range	16-75
	Unanswered	0
Location		
	USA	220 (42.1%)
	UK	105 (20.1%)
	Other	196 (37.4%)
	Unanswered	2 (0.4%)
Route to participation		
	Followed link from another site	219 (41.9%)
	Doing as part of some class	119 (22.8%)
	Found through search engine	102 (19.5%)
	Got link from a friend	31 (5.9%)
	Other	47 (9.0%)
	Unanswered	5 (1.0%)
Highest level of education		
	Primary Education	18 (3.4%)
	Secondary Education	103 (19.7%)
	Vocational / Technical college	48 (9.2%)
	Some college / University	136 (26.0%)
	College / University Graduate	121 (23.1%)
	Some Postgraduate	55 (10.5%)
	Postgraduate / Professional Degree	42 (8.0%)
	Unanswered	0 (0%)
Occupation		
	Employed for Wages	225 (43.0%)
	Self-employed	46 (8.8%)
	Unemployed	34 (6.5%)
	Home-maker	17 (3.3%)
	Student	159 (30.4%)
	Retired	13 (2.5%)
	Unable to work	15 (2.9%)
	Unanswered	14 (2.7%)

Note. Percentages may not sum exactly to 100% due to rounding errors.

Table 2

Descriptive Statistics, Pearson's r and Spearman's rho Correlations of Personality and Memory Span with Self-Reported Memory Problems

Variable	*n*	*M*	*SD*	α	Range		Skew	Correlation with PRMQ (Retrospective)		Correlation with PRMQ (Prospective)	
					Potential	Actual		*r*	*rs*	*r*	*rs*
PRMQ Retrospective	503	18.32	5.03	.79	8-40	8-38	0.68	-	-	.72***	.71***
PRMQ Prospective	508	21.79	5.67	.84	8-40	9-40	0.54	.72***	.705***	-	-
Extraversion	523	28.14	7.45	.86	9-45	9-45	-0.12	-.11*	-.09*	-.04	-.03
Agreeableness	523	28.22	4.08	.69	7-35	14-35	-0.68	-.09	-.10*	.02	.01
Conscientiousness	523	34.76	7.13	.83	10-50	13-50	-0.37	-.33***	-.32***	-.35***	-.33***
Neuroticism	523	22.22	6.90	.84	8-40	8-40	0.19	.25***	.21***	.26***	.22***
Openness to Experience	523	28.02	4.80	.72	7-35	12-35	-0.63	-.04	-.01	.05	.06
Digits forward	523	9.91	2.93	-	0-16	0-16	-0.63	-.03	-.03	-.06	-.016
Digits backward	523	8.65	3.16	-	0-14	0-14	-0.62	-.03	-.03	-.01	-.01

**p<.05, **p<.005, ***p<.0005*

Table 3

Regression of Retrospective and Prospective Memory scores on Age Group, Personality and Digit Span

	Retrospective				Prospective			
Variable	*B*	*SE*	*β*	*t*	*B*	*SE*	*β*	*t*
(Constant)	24.29	2.80		8.69	18.42	3.05		6.04
Age group	-0.11	0.08	-0.06	-1.39	0.12	0.09	0.06	1.37
Extraversion	0.00	0.03	0.00	-0.04	0.06	0.03	0.07	1.59
Agreeableness	0.03	0.06	0.03	0.58	0.17	0.06	0.12	2.78***
Conscientiousness	-0.19	0.03	-0.27	-5.84***	-0.25	0.04	-0.32	-7.07***
Neuroticism	0.11	0.04	0.15	2.93***	0.18	0.04	0.22	4.51***
Openness to Experience	-0.05	0.05	-0.05	-1.05	0.01	0.05	0.01	0.24
Digits Forward	0.01	0.09	0.00	0.07	0.17	0.10	0.09	1.66
Digits Backward	-0.07	0.09	-0.05	-0.84	-0.13	0.09	-0.07	-1.36
R^2	0.13				0.17			
F	9.51				12.96			

***p<.0005