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Comparison of the Memory Complaints Inventory and the PAI Cognitive Bias Scale in a Military Sample

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Abstract

Objective: The Memory Complaints Inventory (MCI) is a stand-alone memory-based symptom validity test (SVT). The measure is promising and has been used with relative frequency, but requires additional research (Armistead-Jehle & Shura, 2022). The current study sought to expand the empirical base of the MCI by comparing it to the Cognitive Bias Scale, a new symptom validity measure assessing cognitive over reporting on the Personality Assessment Inventory (PAI).
Method: Retrospective review of 273 military service members seen for neuropsychological evaluation and administered both the PAI and MCI.
Results: Area under the curve values for the MCI overall mean score and MCI implausible scales for a PAI Cognitive Bias Scale (CBS) cut score of >14 were large in effect (0.77 and 0.78, respectively). The effect size between those that passed and failed the CBS on the mean of MCI scales was also large ($d = 1.13$). Classification statistics indicated that a cut score of 52% on the mean MCI scales and 29% on the mean MCI implausible subscales indicated specificities of 0.94 and 0.93 and sensitivities of 0.30 and 0.29, respectively.
Conclusions: These data support the MCI as a cognitive SVT relative to the PAI CBS. We offer guidance on how to integrate these SVT measures in military samples.

Introduction

Performance and symptom validity testing are now considered fundamental aspects of neuropsychological assessment (Sweet et al., 2021). Regarding the latter, various measures have been devised to address this construct. However, most of these are included in broadband instruments with means to purportedly address cognitive, somatic, and psychological over reporting. Indeed, there are relatively few standalone self-report symptom validity tests (SVTs) that address cognitive exaggeration. One exception to this lack of standalone SVTs for cognitive concerns is the Memory Complaints Inventory (MCI; Green, 2004, 2019). The MCI is a brief, 58-item computer-administered measure of potential cognitive complaints, which is scored on nine content scales.

The psychometric properties of the MCI have been established and the instrument has been employed in various research trials. Although there is a robust literature on the MCI and Performance Validity Test (PVT) performance, relatively few studies have examined the criterion validity of the MCI on broadband SVTs (see the review by Armistead-Jehle & Shura, 2022).

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In these studies, the MCI is often contrasted with SVTs on the Minnesota Multiphasic Personality Inventory (MMPI) family of measures. The MMPI's Response Bias Scale (RBS) is an embedded SVT with items selected as a function of PVT failure discrimination. The RBS has a stronger relationship with the MCI than does other over reporting scales, which target psychopathology and somatic concerns (Gervais, Ben-Porath, Wygant, & Green, 2008; Gervais, Ben-Porath, Wygant, & Sellbom, 2010). There is also some research examining the MCI's relationship with the Personality Assessment Inventory (PAI; Morey, 2007). Armistead-Jehle and colleagues (2016) found that elevated MCI scores are associated with more frequent failure on embedded SVTs and that MCI scores are more strongly associated with SVTs than PVTs. Across the MMPI and PAI SVTs evaluated in this study, acceptable specificity (≥0.90) was observed with cut scores between 20 and 40%; however, classification accuracy was not distinctly improved for the RBS over other SVT scales. In general, between pass and fail groups, the MCI demonstrated moderate to large area under the curve (AUC 0.72–0.86) and effect size differences (e.g., RBS $d_{average} = 0.95$; $d_{\text{Range}} = 0.70$ [Numeric Information Problems /Memory Interferes with Work]–1.24 [Overall Mean]). There were also moderate to large correlations between the MCI scales and the MMPI-2-RF's SVTs (e.g., RBS $r = 0.46$–0.68). To our knowledge, this is the only paper that validated the MCI with the PAI over reporting scales and at the time of publication, no PAI scales had been designed to assess cognitive symptom over reporting.

The current study sought to expand the empirical base of the MCI by comparing it to a recently developed but highly validated cognitive over reporting measure; the 10-item Cognitive Bias Scale (CBS; see Gaasedelen, Whiteside, Altmaier, Welch, & Basso, 2019 for details on the scale's original design). Since its initial development, the CBS has undergone several subsequent validations using various samples and criterion measures. These studies include a military neuropsychological sample, which resulted in population-specific cut score guidance for the measure (Armistead-Jehle, Ingram, & Morris, 2020). Along with acceptable rates of test operating characteristics (e.g., sensitivity, specificity, positive, and negative predictive value; see Sweet et al., 2021), the CBS consistently demonstrates expected small to moderate negative correlations with cognitive testing. Accordingly, the CBS has become recognized as both well validated and the PAI's best cognitively focused validity scale. CBS performance is also consistent with other robust broadband personality measure SVTs and exceeds existing PAI validity scales in terms of predicting cognitive symptom over reporting (see Armistead-Jehle et al., 2020; Gaasedelen et al., 2019; Tylicki, Rai, Arends, Gervais, & Ben-Porath, 2021). Thus, cross validation of the MCI against the CBS not only expands the limited research on the MCI with SVTs (Armistead-Jehle & Shura, 2022), but also provides direct guidance on how the MCI can be integrated with concurrent administration of the PAI to assess possible cognitive symptom over reporting. This study also extends the research on the MCI within broadband measure SVTs by employing an active-duty sample. Active-duty personnel are a unique group of individuals with distinct validity detection needs. In general, they have higher rates of head trauma than civilian populations, and head injury is a frequent reason for compensation and disability service connection at Veteran Affairs following discharge. Thus, providing expanded response validity information about self-identified cognitive symptoms offers to promote better neuropsychological practice in this distinct population.

We hypothesized that the MCI would demonstrate adequate criterion validity relative to the CBS, as demonstrated by areas under the curve (AUC), effect sizes, and classification statistics. Differences between those above and below validated CBS cut scores were expected to fall within a medium to large effect range.

Methods

Sample

The sample consisted of 273 active-duty service members seen for neuropsychological evaluation in a Midwest Army Health Center. Referrals were generally made by primary care or behavioral health providers for service members who had cognitive complaints and a remote history of concussion. Average age was 39.0 (7.9) years, with an average education of 16.0 (2.4) years. The sample was mostly male (83.9%). Regarding ethnicity, 70.0% of the sample was White, 17.2% Black, 8.4% Hispanic, 2.6% Asian, and 1.8% other. Non-mutually exclusive psychiatric diagnosis included depressive disorder (17.8%), PTSD (14.9%), anxiety disorder (27.4%), adjustment disorder (1.5%), attention-deficit hyperactivity disorder (1.9%), other (8.9%), and no psychiatric condition (33.7%). Behavioral health diagnoses were made by the first author, based on clinical interview, medical record evaluation, and neuropsychological test data. Approximately 81.7% of the sample had a remote history of concussion with a mean time since last injury of 92.4 (82.1) months. Concussion was operationalized by the DoD standard of no >30 min loss of consciousness, <24 h post traumatic amnesia, and/or <24 h alternation of consciousness resulting from an external force that induced structural injury and/or physiological disruption of brain function. The diagnosis of concussion was also made by the first author based on clinical interview and medical record review. No participant was diagnosed with a neurodegenerative condition and all were independent in activities of daily living and instrumental activities of daily living. As such, it is highly unlikely that examinee responses were hindered by cognitive impairment or poor understanding of the instruments. To help control potential

secondary gains as an explanation, SMs exclusively undergoing Medical Board ($n = 15$) and Temporary Disability Retired List ($n = 0$) were excluded. There were slightly more Officers (61.2%) than enlisted (38.8%) service members.

Measures

The entirety of the sample was administered the PAI and MCI as part of a larger neuropsychological battery.

MCI. The MCI is a 58-item computer-administered self-report questionnaire of subjective memory complaints. The test taker rates statements related to possible memory problems over the last month on a 0 (*not at all*) to 4 (*Extremely*) scale. The measure consists of nine scales rationally designed to tap specific types of reported memory problems: General Memory Problems, Numeric Information Problems , Visuospatial Memory Problems, Verbal Memory Problems, Pain Interferes with Memory (PIM), Memory Interferes with Work, Impairment of Remote Memory (IRM), Amnesia for Complex Behavior (ACB), and Amnesia for Antisocial Behavior (AAB). The first six scales include plausible memory complaints. In contrast, the latter three scales were intentionally designed to consist of items that would be considered implausible for most individuals with memory problems secondary to an organic etiology. The endorsement of such symptoms in clinical practice is typically thought to reflect either psychiatric origins or exaggerated/feigned memory complaints. The MCI is scored as a percentage of the maximum possible score on each of the nine scales. In past research, the overall mean of all subscales has also been employed.

PAI Cognitive Bias Scale. The PAI (Morey, 1991) is an actuarial measure of personality and emotional functioning consisting of 344 items answered on a 4-point Likert format that render 22 nonoverlapping scales. The measure includes four primary validity scales (Inconsistency [ICN], Infrequency [INF], PIM, and Negative Impression Management [NIM]). Gaasedelen and colleagues (2019) established the CBS, which is a measure of cognitive over reporting. This scale includes 10 PAI items (items 33, 72, 113, 166, 206, 209, 242 [F], 252 [F], 274, and 304 [F]). Per Gaasedelen and colleagues, "The scale itself is unit-weighted, with true items being scored as 0 = false, 1 = somewhat true, 2 = mainly true, and 3 = very true. Items that are keyed as false are reverse scored." The CBS has been validated in subsequent studies, including with Military Personnel (e.g., Armstead-Jehle et al., 2020). There are three validated cut scores for the CBS, including those scores which are greater than or equal to 14, 16, or 19 (Armistead-Jehle et al., 2020; Gaasedelen et al., 2019).

Analyses

Individuals were excluded if their scores on INF, ICN, PIM, or NIM exceeded the recommended values in the PAI's technical manual ($n = 22$). CBS scores were compared with MCI scale scores with the latter broken down by the mean of all scales, mean of plausible scales, and mean of implausible scales. As the implausible subscales (e.g., IRM, ACB, and AAB) were designed to detect over reporting, these scales were also evaluated individually. Measure comparisons took the form of AUC, effect size, and classification analyses. Based on previous research (Armistead-Jehle et al., 2020; Gaasedelen et al., 2019), the CBS cut scores considered for evaluation were < 14, <16, and < 19. For discussion of the validity assessment methods and standards, and how they relate to the analyses conducted, see Sweet et al. (2021).

Results

Table 1 outlines the various MCI scores as a function of CBS results. Regardless of the CBS cut score employed, those above the cut had significantly higher scores across nearly all evaluated MCI measures. Areas under the curve for the means of all scores, plausible subscales, and implausible subscales were greater than 0.75 and effect sizes were large (ranging from Cohen's *d* of 0.96–1.18 and Hedge's *g* of 1.01–1.18). Averaging the implausible subscales generally resulted in larger effects than the individual subscales. Table 2 outlines the classification statistics for the MCI as a function of the identified CBS cut scores. Optimal scores are bolded. When held above 0.90 specificity, the optimal MCI mean score had sensitivities of 0.30 and 0.39 for a CBS cut scores of 14 and 16, respectively. Similar sensitivities were seen for the average of the implausible and plausible subtests. At the CBS cut score of 19, sensitivity improved to 0.55 for the overall MCI mean.

Discussion

Although the MCI has been in existence for nearly 20 years, there is a general lack of research comparing it to other validated measures of symptom validity (Armistead-Jehle & Shura, 2022). This study evaluated the criterion validity of the

Table 1. Descriptive statistics of Memory Complaints Inventory (MCI) and the Cognitive Bias Scale (CBS)

			Receiver operator curve									
	Full Sample ($n = 273$)		CBS < 14 ($n = 213$)		CBS = 14+ ($n = 60$)		Effect Sizes			95% CI		
Scale	M	SD	M	SD	M	SD	*g*	*d*	*t-test* (*df*)	AUC	Lower	Upper
CBS	9.9	4.2	8.1	2.5	16.3	2.3						
MCI												
Mean of all scales	29.5	17.0	27.3	15.6	46.5	18.3	1.18	1.13	7.0 (86.8)**	0.773	0.708	0.838
Mean of plausible scales	32.1	18.0	29.8	16.5	49.7	19.2	1.16	1.11	6.7 (85.8)**	0.757	0.688	0.826
Mean of implausible scales	14.4	11.1	13.1	10.1	24.6	13.1	1.06	0.98	6.5 (84.3)**	0.778	0.714	0.841
IRM	17.7	14.2	15.7	13.3	24.5	15.0	0.64	0.62	4.1 (86.8)**	0.678	0.601	0.756
ACB	19.5	16.8	16.2	14.7	31.2	18.6	0.99	0.96	5.8 (80.9)**	0.752	0.686	0.818
AAB	6.1	8.7	4.3	7.1	12.4	10.8	1.01	0.89	5.5 (73.8)**	0.769	0.703	0.836
			CBS < 16 ($n = 242$)		CBS =16+ ($n = 31$)		*g*	*d*	*t-test* (*df*)	AUC	Lower	Upper
CBS			8.9	3.2	18.1	2.0						
MCI												
Mean of all scales			27.3	15.6	46.5	18.3	1.21	1.13	5.6 (35.8)**	0.785	0.701	0.870
Mean of plausible scales			29.8	16.5	49.7	19.2	1.18	1.11	5.5 (36.0)**	0.780	0.692	0.869
Mean of implausible scales			13.1	10.1	24.6	13.1	1.09	0.98	4.7 (34.7)**	0.768	0.685	0.851
IRM			16.7	13.5	25.3	16.9	0.62	0.56	2.7 (35.2)*	0.759	0.680	0.838
ACB			17.7	15.6	33.5	19.1	0.99	0.91	4.4 (35.3)**	0.655	0.547	0.762
AAB			5.0	7.8	15.1	11.5	1.22	1.03	4.8 (33.4)**	0.792	0.708	0.877
			CBS < 19 ($n = 262$)		CBS = 19+ ($n = 11$)		*g*	*d*	*t-test* (*df*)	AUC	Lower	Upper
CBS			9.5	3.7	20.4	1.6						
MCI												
Mean of all scales			28.7	16.6	47.5	18.7	1.13	1.06	3.3 (10.7)**	0.783	0.641	0.926
Mean of plausible scales			31.3	17.5	50.9	16.6	1.12	1.15	3.3 (10.7)**	0.774	0.626	0.922
Mean of implausible scales			14.0	10.8	24.9	11.9	1.01	0.96	3.0 (10.7)*	0.770	0.640	0.900
IRM			17.2	13.9	29.5	14.9	0.88	0.85	2.7 (10.8)*	0.731	0.604	0.859
ACB			19.0	16.6	32.1	17.9	0.79	0.76	2.4 (10.7)*	0.741	0.618	0.865
AAB			5.8	8.5	13.2	11.1	0.86	0.75	2.2 (10.5)*ns*	0.747	0.614	0.879

Note: M = Mean; SD = Standard Deviation, *d* = Cohen's *d* effect size, *t*-test (*df*) = independent samples *t*-test with equal variances assumed and associated degrees of freedom. $^{*}p < 0.05$, $^{**}p < 0.01$, ns = non-significant; CBS = Cognitive Bias Scale derived from item-scores on the Personality Assessment Inventory (PAI); MCI = Memory Complaints Inventory; IRM = Impairment of Remote Memory; ACB = Amnesia for Complex Behavior; AAB = Amnesia for Antisocial Behavior; AUC = area under curve, 95% CI = 95% confidence interval

MCI by comparing it to the PAI CBS, a well-validated SVT for the PAI which has been employed in active-duty personnel (Armistead-Jehle et al., 2020). Results demonstrated large effect sizes and AUC values for the overall MCI mean, as well as the means of the plausible and implausible scales. Effect sizes and AUC values for the individual implausible scales (IRM, ACB, and AAB) were smaller than the mean of all three, but still had robust effects. Findings also show that the plausible and implausible MCI scales were equally related to the CBS. This could be taken to suggest that the CBS is measuring symptom over report or exaggeration, but not necessarily implausible cognitive symptoms. Classification statistics indicated low to moderate sensitivity, when specificities were held about 0.90 (see Sweet et al., 2021 for the discussion of the 0.90 threshold and why specificity is often considered more important than sensitivity within evaluations).

Broadly, the results of the study support the use of the MCI and provide evidence of good classification accuracy using one embedded broadband cognitively focused SVT (e.g., Gaasedelen et al., 2019). Given the uniqueness of the cognitive symptom domain (see Sweet et al., 2021), convergence between these two measures of cognitive symptom over reporting strengthens the availability of tools for use in neuropsychological evaluations. The large effects observed for the MCI across all CBS are similar in magnitude to classification accuracy of the most common and widely used embedded SVTs. Observed sensitivity estimates also correspond with what is typical in cognitive SVTs, and SVTs more broadly. Given the strong relationship between the CBS and another embedded cognitive SVTs on a different broadband personality measure (Tylicki et al., 2021), results of the MCI's performance are likely to generalize across similar criterions. However, as there is limited research between the MCI and other SVT measures, future work should examine such relationships.

Table 2. Classification statistics for the MCI scales across CBS cut scores ($n = 273$)

		CBS cut score 14		CBS cut score 16		CBS cut score 19	
MCI	Score	Sens.	Spec.	Sens.	Spec.	Sens.	Spec.
Mean of all scales	48	0.38	0.90	0.42	0.88	0.55	0.86
	49	0.37	0.91	0.42	0.88	0.55	0.88
	50	0.35	0.93	0.42	0.90	0.55	0.89
	51	0.32	0.93	0.39	0.91	0.55	0.89
	52	**0.30**	**0.94**	**0.39**	**0.93**	**0.55**	**0.91**
	53	0.25	0.95	0.35	0.94	0.45	0.92
	54	0.23	0.95	0.35	0.94	0.45	0.92
	55	0.22	0.95	0.32	0.95	0.36	0.93
	56	0.20	0.96	0.32	0.96	0.36	0.94
	57	0.18	0.96	0.29	0.96	0.27	0.94
Mean of plausible scales	51	0.42	0.91	0.48	0.88	0.55	0.86
	53	0.40	0.92	0.48	0.89	0.55	0.87
	54	0.33	0.92	0.42	0.90	0.55	0.89
	55	0.32	0.93	0.42	0.91	0.55	0.89
	56	**0.30**	**0.94**	**0.39**	**0.92**	**0.55**	**0.90**
	57	0.30	0.94	0.39	0.93	0.55	0.91
	58	0.27	0.94	0.39	0.93	0.55	0.92
	60	0.22	0.95	0.32	0.94	0.45	0.93
	61	0.20	0.95	0.32	0.95	0.45	0.94
Mean of implausible scales	27	0.30	0.91	0.39	0.88	0.36	0.87
	28	0.30	0.92	0.32	0.90	0.36	0.88
	29	**0.25**	**0.93**	**0.32**	**0.92**	**0.36**	**0.90**
	30	0.22	0.94	0.29	0.93	0.27	0.91
	31	0.22	0.94	0.29	0.93	0.27	0.92
	32	0.22	0.94	0.29	0.94	0.27	0.92
	33	0.18	0.95	0.26	0.94	0.27	0.93
	34	0.17	0.95	0.23	0.95	0.27	0.94
	35	0.15	0.96	0.23	0.95	0.27	0.94
IRM	32	0.28	0.72	0.32	0.86	0.45	0.85
	35	0.22	0.78	0.26	0.88	0.36	0.88
	38	0.20	0.80	0.23	0.91	0.27	0.90
	41	0.20	0.80	0.23	0.93	0.27	0.92
	43	0.13	0.87	0.19	0.95	0.18	0.94
	46	**0.08**	**0.92**	**0.13**	**0.97**	**0.09**	**0.96**
	49	0.05	0.95	0.10	0.98	0.09	0.97
	52	0.03	0.97	0.06	0.98	0.09	0.98
	56	0.03	0.97	0.06	0.99	0.09	0.98
AAS	11	0.47	0.86	0.58	0.83	0.45	0.80
	14	0.33	0.92	0.42	0.90	0.36	0.87
	16	0.33	0.92	0.42	0.90	0.36	0.87
	18	**0.22**	**0.96**	**0.32**	**0.95**	**0.18**	**0.92**
	20	0.22	0.96	0.32	0.95	0.18	0.93
	23	0.15	0.96	0.23	0.96	0.18	0.94
	27	0.13	0.98	0.19	0.97	0.18	0.96
	31	0.10	0.99	0.16	0.99	0.18	0.98
ACB	32	0.45	0.86	0.45	0.55	0.36	0.80
	34	0.40	0.90	0.39	0.61	0.36	0.84
	37	0.35	0.90	0.36	0.87	0.36	0.86
	39	0.32	0.91	0.32	0.88	0.36	0.87
	41	0.27	0.92	0.26	0.90	0.27	0.89
	43	**0.25**	**0.93**	**0.26**	**0.91**	**0.27**	**0.90**
	44	0.25	0.93	0.26	0.91	0.27	0.90
	45	0.25	0.95	0.26	0.93	0.27	0.91
	47	0.25	0.95	0.23	0.93	0.27	0.92
	49	0.20	0.95	0.23	0.94	0.27	0.93
	51	0.17	0.96	0.19	0.95	0.18	0.94
	53	0.15	0.96	0.16	0.95	0.18	0.94
	55	0.15	0.96	0.16	0.97	0.18	0.96

Note: Sens = Sensitivity; Spec = Specificity. Bolded values are those at which specificity of 0.90 is first met across all three CBS cut scores. MCI = Memory Complaints Inventory; CBS = Cognitive Bias Scale derived from item-scores on the Personality Assessment Inventory (PAI); IRM = Impairment of Remote Memory; ACB = Amnesia for Complex Behavior; AAB = Amnesia for Antisocial Behavior.

Limitations of the current study include the use of only military service members, most of whom were male and white. External validity is thus somewhat limited. Moreover, the base rate of SVT failure tends to be higher in forensic and disability evaluations and this study did not include any participants seen exclusively for such a reason. Those undergoing Medical Evaluation Board (MEB) and Temporary Disability Retirement List (TDRL) evaluations were not included and these populations also offer an important area of future study. Future studies would improve the MCI literature base by increasing generalizability in terms of diversified demographics and clinical/forensic contexts. Despite these limitations, the current study provides data to support the MCI as a stand-alone self-report measure of symptom validity and addresses a gap in the current literature on this measure by contrasting it to self-report cognitive symptom over reporting, which has amassed fairly consistent outcomes across different criterion studies. It also expands the growing literature based on the PAI's frontline cognitive SVT (i.e., CBS; Armistead-Jehle et al., 2022; Gaasedelen et al., 2021) by providing a cognitive SVT criterion, rather than existing work focusing exclusively on PVTs.

Conflict of Interest

None declared

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