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Research Letter: TBI Severity Moderates the Association Between Subjective and Objective Attention in Older Veterans

*Peter Rantins; Monica Ly, PhD; Alexandra L. Clark, PhD; Alexandra J. Weigand, MS; Alin Alshaheri Durazo; Victoria C. Merritt, PhD; Katherine J. Bangen, PhD, ABPP; Kelsey R. Thomas, PhD; for the Department of Defense Alzheimer's Disease Neuroimaging Initiative**

Objective: This study examined the moderating effect of traumatic brain injury (TBI) history on subjective and objective cognition across multiple cognitive domains. **Setting, Participants, and Design:** Participants included 242 Vietnam-era veterans with a history of no TBI (n = 86), mild TBI (n = 74), or moderate-to-severe TBI (n = 82) from the observational Department of Defense-Alzheimer's Disease Neuroimaging Initiative (DoD-ADNI) study. **Main Measures:** Objective cognition was the outcome and was measured using neuropsychological measures in the domains of memory, attention/executive functioning, and language. Subjective cognition was measured using the memory, divided attention, and language subscales from the Everyday Cognition (ECog) measure. TBI severity status was the moderating variable. **Results:** Veterans with a history of moderate-to-severe TBI had a stronger negative association between subjective and objective attention relative to participants without a TBI ($P = .002$). Although this association did not differ between mild TBI and no TBI history groups ($P = .100$), the association between

Author Affiliations: *VA San Diego Healthcare System, San Diego, California (Mr Rantins, Drs Ly, Merritt, Bangen, and Thomas and Ms Alshaheri Durazo); San Diego State University, San Diego, California (Mr Rantins and Ms Alshaheri Durazo); Department of Psychiatry, University of California, San Diego, La Jolla (Drs Ly, Merritt, Bangen, and Thomas); Department of Psychology, University of Texas at Austin, Austin (Dr Clark); Joint Doctoral Program in Clinical Psychology, San Diego State University/University of California, San Diego (Ms Weigand); Center of Excellence for Stress and Mental Health, VA San Diego Healthcare System, San Diego, California (Dr Merritt).*

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Corresponding Author: *Kelsey R. Thomas, PhD, VA San Diego Healthcare System, 3350 La Jolla Village Dr (151), San Diego, CA 92161 (kthomas@health.ucsd.edu).*

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subjective and objective attention for the mild TBI group was intermediate to the no TBI and moderate-to-severe TBI history groups. TBI status did not moderate associations between subjective and objective memory or language. **Conclusion:** Results highlight the importance of assessing subjective *and* objective cognition in older veterans and the relevance of attention in the context of TBI history. More work is needed to better understand the intersection of TBI and aging and how these factors may be used to guide individualized assessment and treatment approaches for older veterans. **Key words:** *attention*, *brain injuries*, *cognitive aging*, *executive functioning*, *neuropsychology*, *subjective cognition*, *subjective cognitive decline*, *traumatic*, *traumatic brain injury*, *veterans*

SUBJECTIVE COGNITIVE concerns are often what brings older veterans into a clinic, but it can be unclear how to interpret these concerns, particularly in the context of a history of traumatic brain injury (TBI). The degree of objective cognitive decline following a TBI may vary both across and within TBI severity groups. Prior studies involving TBI have shown mixed findings regarding the extent to which subjective and objective cognition are associated. While some studies demonstrate notable associations,[1,2] some studies also show that factors such as depression or posttraumatic stress disorder (PTSD) may be particularly related to subjective cognitive concerns.[2–4] Veterans with a history of TBI can report experiencing cognitive difficulties, even years after the TBI event, and despite performing within normal limits on objective measures.[5] Studies that have examined the relationship of TBI history with subjective and objective cognition, however, have largely focused on younger veterans.

Although TBI is a risk factor for dementia,[6] very few studies have examined how TBI history may impact the associations of subjective and objective cognition within the context of aging, which has unique considerations, given the many factors that can influence cognition in older veterans (eg, psychiatric symptoms, AD genetic susceptibility, and vascular health). The construct of *subjective cognitive decline* has garnered significant attention in the Alzheimer's disease (AD) literature as a way to identify subtle cognitive changes prior to meeting criteria for mild cognitive impairment (MCI)[7] and is often included in MCI diagnostic criteria.[8] However, similar to TBI literature, evidence of a meaningful relationship between subjective and objective cognition may be impacted by demographic, physical health, and psychiatric factors, which is why it is critical to examine these associations in the context of older veterans with and without TBI history.[9,10]

Using data from the Brain Aging in Vietnam War Veterans/Department of Defense-Alzheimer's Disease Neuroimaging Initiative (DoD-ADNI), we examined associations of subjective and objective cognition among cognitive domains that could be impacted by TBI and/or aging and AD, including memory, attention/executive functioning, and language, and the extent to which TBI severity moderates these relationships. We hypothesized that participants with a TBI history (both mild and moderate-to-severe TBI) would have stronger associations between subjective and objective memory and attention/executive function than the no TBI group.

METHODS

Participants

Data used in this current study were obtained from the publicly available DoD-ADNI database (adni.loni.usc.edu). The main aims/methods of DoD-ADNI and up-to-date information can be found at www.adni-info.org. This research was approved by the institutional review boards of all participating sites within ADNI and written informed consent was obtained for all study participants. The current study included 242 Vietnam-era veterans with available demographic, neuropsychological, psychiatric, TBI history, and health data.

Measures

Neuropsychological outcomes

Three composite scores were calculated using available neuropsychological measures in DoD-ADNI.[11] The *memory* composite included the immediate and delayed recall scores from the Rey Auditory Verbal Learning Test and the Wechsler Memory Scale–Revised Logical Memory. The *attention* (and executive functioning) composite included Trail Making Test, Parts A and B total time. The *language* composite included the total correct scores from the 30-item Boston Naming Test (BNT) and Animal Fluency (adapted from the Consortium to Establish a Registry for Alzheimer's Disease [CERAD]). Composite scores were calculated by converting raw scores to *z* scores for each measure and taking the mean of the measures in each domain; the attention composite was multiplied by −1, so higher scores indicated better performance. Domain composites were each Blom-transformed to reduce skewness.

Subjective cognitive decline

The Everyday Cognition (ECog) measure was used to assess subjective cognition.[12] Participants rate their ability to perform everyday tasks relative to 10 years ago.

The everyday tasks are divided into 6 cognitive domains: memory, language, visuospatial, planning, organization, and divided attention. We focused on the memory (8 items), divided attention (4 items), and language (9 items) domains to mirror the available neuropsychological composite scores. Higher scores are associated with more subjective cognitive decline.

TBI history

TBI severity was based on Veterans Affairs (VA)/DoD criteria 2021 Clinical Practice Guidelines.[13] Each TBI was coded and severity was based on the most severe TBI sustained in their lifetime. Participants with a history of penetrating head injury were excluded from DoD-ADNI during screening. An injury was classified as *mild* if the participant endorsed a loss of consciousness (LOC) of less than 30 minutes, or alteration of consciousness (AOC) or posttraumatic amnesia (PTA) up to 24 hours. The moderate and severe TBI criteria were combined since the information for a PTA of more than 1 day was not available. Thus, the *moderate-to-severe* TBI criteria included an LOC of more than 30 minutes, an AOC of more than 24 hours, or a PTA of more than 1 day. Three participants who reported a hospitalization for a head/neck injury but did not meet criteria for TBI based on their report of LOC, AOC, or PTA were excluded. Based on these VA/DoD criteria, 86 participants had no history of TBI, 74 participants had a history of mild TBI, and 82 participants had a history of moderate-to-severe TBI. For the mild TBI group, on average, most participants had an LOC of less than 5 minutes (56.4%), an AOC less than 5 minutes (42.4%, with 30.5% having an AOC of 30 minutes to 24 hours), and only 8 participants in this group reported any PTA (all PTA was <24 hours). For the moderate-to-severe TBI group, LOC ranged from less than 5 minutes to more than 24 hours (36.5% with an LOC of 30 minutes to 24 hours), and, on average, most had an AOC more than 24 hours (80.9%), and a PTA of more than 24 hours (62.5%). Total number of TBIs was also used as a covariate in follow-up analyses.

Additional variables

Current PTSD symptom severity measured using the Clinician-Administered PTSD Scale (CAPS)[14] was included as a covariate in all models. Additional measures to describe the sample and used as covariates in follow-up analyses included Geriatric Depression Scale to measure depressive symptom severity, pulse pressure (systolic minus diastolic blood pressure; a proxy for arterial stiffening) to measure of vascular health, and apolipoprotein (APOE) ε4 genotype (noncarrier vs carrier) as a measure of genetic susceptibility to AD. The Mini-Mental State Examination was using as a global cognition measure to characterize the sample.

Statistical analyses

Analyses of variance and χ^2 tests were used to characterize the TBI groups. General linear models, adjusting for age, education, PTSD symptom severity, and TBI severity (no TBI was reference group), first examined the associations between domain-specific subjective and objective cognition across the sample (model 1). Specifically, subjective memory was included in the objective memory model, subjective attention in the objective attention model, and subjective language in the objective language model. Next, the models tested whether TBI severity moderated the associations of domain-specific subjective and objective cognition (model 2). Follow-up analyses examined the pattern of results when the following covariates were included both separately and in the same model to adjust for additional factors/comorbidities that could impact these associations: total number of TBIs, race, ethnicity, APOE ε4, pulse pressure, and depressive symptom severity.

RESULTS

Table 1 shows characteristics across the whole sample and by TBI history group. On average, participants were roughly 70 years old with 15 years of education; 44.6% of participants met criteria for PTSD based on the CAPS. The mild TBI group was slightly older than the no TBI and moderate-to-severe TBI groups and had the largest proportion who met criteria for PTSD. The no TBI group performed slightly better on the memory composite than the mild TBI group; they also reported less subjective cognitive difficulties in language and attention than the mild TBI group and less subjective difficulties in attention than the moderate-to-severe TBI group. Many characteristics did not differ across groups.

First, the associations between domain-specific subjective and objective cognition were examined across the sample (model 1; see Table 2). Subjective memory was associated with objective memory ($\beta = -.156$, $P = .013$) and subjective language was associated with objective language ($\beta = -.233$, $p < .001$), but subjective attention was not associated with objective attention ($\beta = -.068$, $P = .299$). Additionally, TBI severity was not associated with any of the objective cognitive domain scores (all Ps $> .05$) after adjusting for the other variables in the model.

Next, the subjective cognition × TBI severity interaction was added to each model (model 2) to determine whether TBI severity moderated the relationship between domain-specific subjective and objective cognition. This interaction was significant for attention

TABLE 1 *Sociodemographic and clinical characteristics by TBI group*

	Total sample	No TBI	Mild TBI	Moderate-to-severe TBI	*P*
n	242	86	74	82	
Age, mean (SD)	69.75 (4.37)	69.23 (4.65)[a]	70.79 (4.86)[b,c]	69.36 (3.37)[a]	.047
Education, mean (SD)	15.21 (2.42)	15.28 (2.28)	15.05 (2.47)	15.27 (2.53)	.809
Men, *n* (%)	240 (99.2%)	86 (100%)	73 (98.6%)	81 (98.8%)	.571
Race, *n* (%)					.305
American Indian/Alaska Native	4 (1.7%)	1 (1.2%)	1 (1.4%)	2 (2.4%)	
Asian	3 (1.3%)	3 (3.5%)	0 (0.0%)	0 (0.0%)	
Black/African American	18 (7.4%)	8 (9.3%)	2 (2.7%)	8 (9.8%)	
White	204 (84.3%)	69 (80.2%)	67 (90.5%)	68 (82.9%)	
More than one	10 (4.1%)	3 (3.5%)	3 (4.1%)	4 (4.9%)	
Unknown	3 (1.2%)	2 (2.3%)	1 (1.4%)	0 (0.0%)	
Ethnicity, *n* (%)					.283
Hispanic/Latino	20 (8.3%)	10 (11.6%)	6 (8.1%)	4 (4.9%)	
Non-Hispanic/non-Latino	222 (91.7%)	76 (88.4%)	68 (91.9%)	78 (95.1%)	
Pulse pressure, mean (SD)	59.53 (14.33)	60.02 (15.14)	59.19 (14.45)	59.32 (13.49)	.923
APOE ε4 carrier, *n* (%)	65 (26.9%)	21 (24.4%)	20 (27.0%)	24 (29.3%)	.777
GDS, mean (SD)	2.78 (2.86)	2.65 (2.18)	2.73 (2.60)	2.95 (2.74)	.783
Current PTSD, *n* (%)	108 (44.6%)	39 (45.3%)	40 (54.1%)[b]	29 (35.4%)[a]	.063
Current CAPS score, mean (SD)	30.28 (26.88)	26.83 (29.07)	34.51 (26.68)	30.09 (24.32)	.196
Lifetime CAPS score, mean (SD)	43.32 (33.06)	38.02 (38.44)	46.99 (32.26)	45.56 (26.75)	.175
Years since most recent TBI, mean (SD)[d]	38.36 (17.84)	...	39.53 (18.08)	37.30 (17.67)	.439
Years since most severe TBI, mean (SD)[d]	40.81 (16.82)	...	39.53 (18.08)	41.81 (15.63)	.368
Number of TBIs, *n* (%)[d]					.146
0	86 (35.5%)	86 (100%)	...	...	
1	93 (38.4%)	...	51 (68.9%)	42 (51.2%)	
2	43 (17.8%)	...	15 (20.3%)	28 (34.1%)	
3	15 (6.2%)	...	7 (9.5%)	8 (9.8%)	
4-5	5 (2.0%)	...	1 (1.4%)	4 (4.8%)	
MMSE, mean (SD)	28.30 (1.58)	28.41 (1.39)	28.27 (1.90)	28.22 (1.45)	.729
Memory, mean (SD)	0.06 (0.95)	0.23 (0.92)[a]	−0.08 (0.86)[c]	0.02 (1.04)	.109
Attention, mean (SD)	−0.02 (0.97)	0.06 (0.95)	−0.07 (0.90)	−0.06 (1.04)	.636
Language, mean (SD)	0.06 (1.00)	0.16 (1.02)	0.02 (1.07)	−0.00 (0.94)	.519
ECog total, mean (SD)	1.66 (0.55)	1.54 (0.50)[a,b]	1.72 (0.58)[c]	1.73 (0.54)[c]	.043
ECog memory, mean (SD)	1.98 (0.70)	1.86 (0.68)	2.05 (0.71)	2.05 (0.69)	.152
ECog attention, mean (SD)	1.82 (0.76)	1.65 (0.69)[a,b]	1.91 (0.78)[c]	1.93 (0.77)[c]	.026
ECog language, mean (SD)	1.72 (0.67)	1.58 (0.59)[a]	1.81 (0.75)[c]	1.78 (0.65)	.060

Abbreviations: APOE, apolipoprotein E; CAPS, Clinician-Administered PTSD Scale; ECog, Everyday Cognition; GDS, Geriatric Depression Scale; MMSE, Mini-Mental State Examination; TBI, traumatic brain injury.
[a]Significantly different than mild TBI.
[b]Significantly different than moderate-to-severe TBI.
[c]Significantly different than no TBI.
[d]No TBI group included in between-group analysis since variable is specific to TBI.

($F_{(2,233)} = 4.79$, $P = .009$, $\eta_p^2 = .039$). Specifically, relative to veterans without a history of TBI, moderate-to-severe TBI ($\beta = -.475$, $P = .002$) showed a stronger negative association between subjective and objective attention such that greater subjective difficulties in attention were more strongly associated with poorer objective attention performance among those with moderate-to-severe TBI (see Figure 1). This result retained significance after Bonferroni correction for the 3-group comparison. While not statistically significant, those with a history of mild TBI had a pattern of a more negative association between subjective and objective attention than the no TBI group ($\beta = -.258$, $P = .100$). TBI severity did not moderate the associations between subjective and objective cognition for memory or language domains. We also examined the above models when total number of TBIs, race and ethnicity, depressive symptoms, APOE ε4 genotype, and pulse pressure

TABLE 2 *Regression weights for associations between domain-specific subjective and objective cognition*

	Memory				Attention				Language			
	Model 1		Model 2		Model 1		Model 2		Model 1		Model 2	
	β	SE	β	SE	β	SE	β	SE	β	SE	β	SE
Age	−.163[a]	.062	−.168[a]	.062	−.148[b]	.066	−.130[b]	.065	−.170[b]	.066	−.163[b]	.067
Education	.267[c]	.059	.269[c]	.060	.053	.063	.062	.062	.178[a]	.064	.180[a]	.064
CAPS	−.057	.066	−.062	.066	−.180[a]	.068	−.196[a]	.068	−.087	.070	−.086	.070
TBI severity												
No TBI	...	...	...	...	...	...	...	...	...	...	...	...
Mild TBI	−.168	.145	−.180	.146	.006	.149	−.054	.154	.033	.156	.028	.158
Moderate-to-severe TBI	−.151	.138	−.169	.139	−.070	.149	−.096	.147	−.079	.149	−.073	.151
ECog score	−.156[b]	.062	−.041	.102	−.068	.065	.195[d]	.116	−.233[c]	.069	−.250[b]	.123
TBI severity × ECog score												
No TBI × ECog	...	...	...	...	...	...	...	...	...	...	...	...
Mild TBI × ECog	...	...	−.198	.142	...	...	−.258[d]	.156	...	...	.088	.158
Moderate-to-severe TBI × ECog	...	...	−.148	.141	...	...	−.475[a]	.153	...	...	−.052	.165

Abbreviations: ECog, Everyday Cognition; CAPS, Clinician-Administered PTSD Scale; TBI, traumatic brain injury.
[a] $P < .01$.
[b] $P < .05$.
[c] $P < .001$.
[d] $P < .10$.

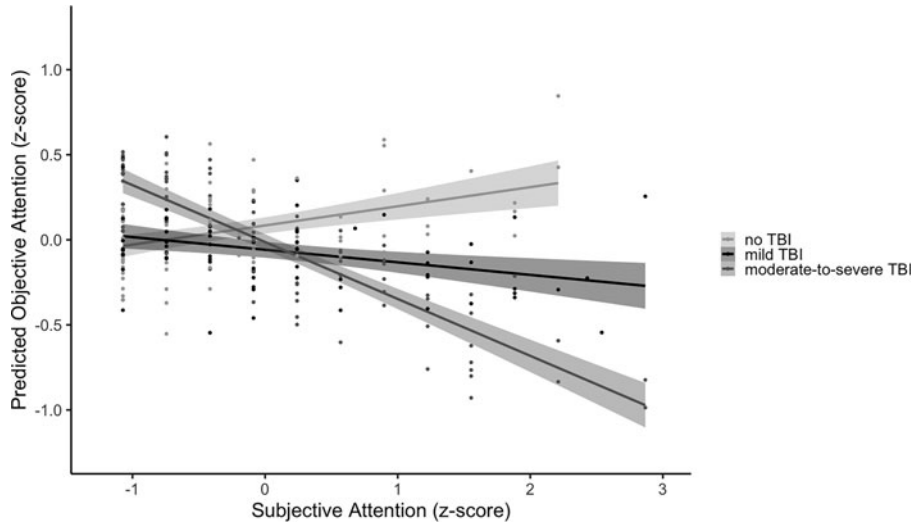

Figure 1. Associations of subjective attention and model-predicted objective attention by TBI status. Shaded area represents 95% confidence interval.

were included as covariates, both independently and together, and the pattern of results did not change.

DISCUSSION

Study findings show a stronger association between subjective and objective attention among veterans with a history of TBI, particularly a moderate-to-severe TBI, compared with those without a history of TBI. These findings are partially consistent with the hypothesis that both mild and moderate-to-severe TBI would moderate the association between subjective attention, though only the moderate-to-severe group reached statistical significance. History of TBI did not moderate the association between subjective and objective memory or language.

This work is in older, Vietnam-era veterans, which addresses a significant gap in our understanding since most studies include primarily younger veterans or service members. Compared with studies in younger samples, our results are somewhat consistent with a study of military personnel within 3 months of a mild-to-moderate TBI that showed self-reported executive functioning was associated with attention/processing speed performance, but not other domains of objective cognition.[2] However, another study of patients seeking compensation showed that self-reported attention predicted objective attention in the mild TBI group, while the moderate-to-severe TBI group showed an association between self-reported and objective learning and memory.[1] There are several study differences that could account for our results not showing that moderate-to-severe TBI moderated the association between objective and subjective memory including: the age of the participants, time since injury, veteran versus compensation-seeking status, proportion with PTSD, and differences in some measures of subjective and objective cognition, as well as the covariates included in analyses.

Subjective cognitive decline is associated with higher risk for progressing to dementia and is considered one of the earliest symptoms to emerge in preclinical AD.[7,10] However, criteria for subjective cognitive decline often exclude individuals with medical or psychiatric conditions,[7] which has resulted in a shortage of work examining subjective cognition in older veterans with a history of TBI and PTSD. The results showing no moderating effect of TBI history on subjective and objective memory and language, two domains impacted early in AD, suggest that self-report of memory or language decline for an older veteran with a TBI history has a similar association with memory and language performance on neuropsychological testing as an older veteran who has not had a TBI. These findings may support the practice of being more inclusive of participants with a history of TBI in AD studies on subjective cognitive decline, though additional work is needed to replicate these findings in older veterans and extend the results in nonveterans.

The reason for the moderating impact of TBI history on subjective and objective attention is unclear, though the measures of Trails A and B that were included in the attention composite may be particularly sensitive to changes due to both TBI (including mild TBI) *and* aging.[15,16] The main effect of subjective attention on objective attention across the whole sample was nonsignificant, so it is possible that in general, one's subjective rating of attention is influenced by real-world factors that may not contribute to how one performs in a controlled environment. However, in the context

of a moderate-to-severe TBI history, there may be more consistency between their real-world experience of attention difficulties and objective performance because, on average, the moderate-to-severe TBI itself caused more severe cognitive difficulties, including in attention,[17] that had a more prominent impact on their life, at least initially, and are therefore more aware. Alternatively, perhaps there are more noticeable changes in attention as someone with a history of moderate-to-severe TBI gets older due to chronic TBI-related structural[18] and functional connectivity[19] changes that could increase their vulnerability to age-related declines.

Notably, the varying association between subjective and objective attention across TBI history groups suggests that assessment of both subjective and objective cognition is important. It is possible that, in addition to TBI history and aging, PTSD symptoms also contribute to these associations given that there was a main effect of CAPS scores on objective attention performance and there was a high rate of PTSD in the sample (44.6%). More work is needed to disentangle these cognitive associations at the intersection of aging, TBI, and PTSD, particularly given that both TBI and PTSD are associated with increased risk of dementia.[6,20]

The current study has several strengths including the multiple domains of cognition that were evaluated as well as the follow-up examination of multiple covariates relevant to both aging/AD, including psychiatric symptoms. Multiple limitations include: (1) the sample primarily included White men, which significantly limits the generalizability of the results; (2) relying on self-report of TBI history to define TBI groups and being unable to separate moderate and severe TBI histories given the potential heterogeneity of the combined group; and (3) the neuropsychological battery did not include sensitive measures of visuospatial functioning or other aspects of attention not requiring speeded visual scanning or motor functioning and executive functioning such as planning or inhibition and performance validity was not assessed. While there is overlap between the some of the domain-specific ECog items and the neuropsychological measures (ie, "forgetting names of objects" on ECog language may be assessed on the BNT), all of the items are not perfectly aligned with the measures used in the neuropsychological domain score. Notably, the items on the ECog are potentially more ecologically valid in that they are capturing the participants' real-world experience and comparing their experience to how they functioned in the past, while the neuropsychological measures may be testing cognition in a standardized environment but that may not allow for compensatory strategies or capture the extent that it may be relevant to their daily life.[21]

While the association between subjective and objective attention was moderated by TBI history, associations between subjective and objective memory and language were not. Together, results highlight the potential importance of assessing domain-specific subjective *and* objective cognition, and attention in particular, in older veterans. More work is needed to better understand the intersection of TBI and aging in the context of additional commonly co-occurring conditions such as PTSD and vascular disease to inform how these intersecting factors may be used to guide individualized and nuanced assessment and treatment approaches for older veterans presenting to a clinic with subjective cognitive decline.

REFERENCES

1. Jamora CW, Young A, Ruff RM. Comparison of subjective cognitive complaints with neuropsychological tests in individuals with mild vs more severe traumatic brain injuries. *Brain Inj*. 2012;26(1):36–47. doi:10.3109/02699052.2011.635352
2. Schiehser DM, Delis DC, Filoteo JV, et al. Are self-reported symptoms of executive dysfunction associated with objective executive function performance following mild to moderate traumatic brain injury? *J Clin Exp Neuropsychol*. 2011;33(6):704–714. doi:10.1080/13803395.2011.553587
3. Merritt VC, Jurick SM, Crocker LD, et al. Evaluation of objective and subjective clinical outcomes in combat veterans with and without mild TBI and PTSD: a four-group design. *J Clin Exp Neuropsychol*. 2019;41(7):665–679. doi:10.1080/13803395.2019.1610161
4. Vos L, Williams MW, Poritz JMP, Ngan E, Leon-Novelo L, Sherer M. The discrepancy between cognitive complaints and neuropsychological test findings in persons with traumatic brain injury. *J Head Trauma Rehabil*. 2020;35(4):E382. doi:10.1097/HTR.0000000000000557
5. Donnelly K, Donnelly JP, Warner GC, Kittleson CJ, King PR. Longitudinal study of objective and subjective cognitive performance and psychological distress in OEF/OIF veterans with and without traumatic brain injury. *Clin Neuropsychol*. 2018;32(3):436–455. doi:10.1080/13854046.2017.1390163
6. Barnes DE, Kaup A, Kirby KA, Byers AL, Diaz-Arrastia R, Yaffe K. Traumatic brain injury and risk of dementia in older veterans. *Neurology*. 2014;83(4):312–319. doi:10.1212/WNL.0000000000000616
7. Jessen F, Amariglio RE, van Boxtel M, et al. A conceptual framework for research on subjective cognitive decline in preclinical Alzheimer's disease. *Alzheimers Dement*. 2014;10(6):844–852. doi:10.1016/j.jalz.2014.01.001
8. Petersen RC. Mild cognitive impairment as a diagnostic entity. *J Intern Med*. 2004;256(3):183–194. doi:10.1111/j.1365-2796.2004.01388.x
9. Zlatar ZZ, Muniz MC, Espinoza SG, et al. Subjective cognitive decline, objective cognition, and depression in older hispanics screened for memory impairment. *J Alzheimers Dis*. 2018;63(3):949–956. doi:10.3233/JAD-170865
10. Rabin LA, Smart CM, Amariglio RE. Subjective cognitive decline in preclinical Alzheimer's disease. *Ann Rev Clin Psychol*. 2017;13(1):369–396. doi:10.1146/annurev-clinpsy-032816-045136

11. Weigand AJ, Thomas KR, Bangen KJ, et al. APOE interacts with tau PET to influence memory independently of amyloid PET in older adults without dementia. *Alzheimers Dement*. 2021;17(1):61–69. doi:10.1002/alz.12173
12. Farias ST, Mungas D, Reed BR, et al. The measurement of Everyday Cognition (ECog): scale development and psychometric properties. *Neuropsychology*. 2008;22(4):531–544. doi:10.1037/0894-4105.22.4.531
13. Department of Veterans Affairs and Department of Defense. Clinical Practice Guideline for the Management and Rehabilitation of Post-Acute Mild Traumatic Brain Injury. Published 2021. Accessed October 21, 2022. https://www.google.com/url?q=https://www.healthquality.va.gov/guidelines/rehab/mtbi/&sa=D&source=docs&ust=1666311803014387&usg=AOvVaw1IG7gP5RR14aoPJUfrntT7
14. Blake DD, Weathers FW, Nagy LM, et al. The development of a Clinician-Administered PTSD Scale. *J Trauma Stress*. 1995;8(1):75–90. doi:10.1007/BF02105408
15. Lange RT, Iverson GL, Zakrzewski MJ, Ethel-King PE, Franzen MD. Interpreting the trail making test following traumatic brain injury: comparison of traditional time scores and derived indices. *J Clin Exp Neuropsychol*. 2005;27(7):897–906. doi:10.1080/1380339049091290
16. Stuss DT, Stethem LL, Poirier CA. Comparison of three tests of attention and rapid information processing across six age groups. *Clin Neuropsychol*. 1987;1(2):139–152. doi:10.1080/13854048708520046
17. Cristofori I, Levin HS. Traumatic brain injury and cognition. In: J Grafman, AM Salazar, eds. *Handbook of Clinical Neurology*. Vol 128. Elsevier; 2015:579–611.
18. Cole JH, Jolly A, de Simoni S, et al. Spatial patterns of progressive brain volume loss after moderate-severe traumatic brain injury. *Brain*. 2018;141(3):822–836. doi:10.1093/brain/awx354
19. Venkatesan UM, Dennis NA, Hillary FG. Chronology and chronicity of altered resting-state functional connectivity after traumatic brain injury. *J Neurotrauma*. 2015;32(4):252–264. doi:10.1089/neu.2013.3318
20. Yaffe K, Vittinghoff E, Lindquist K, et al. Posttraumatic stress disorder and risk of dementia among US veterans. *Arch Gen Psychiatry*. 2010;67(6):608–613. doi:10.1001/archgenpsychiatry.2010.61
21. Chaytor N, Schmitter-Edgecombe M, Burr R. Improving the ecological validity of executive functioning assessment. *Arch Clin Neuropsychol*. 2006;21(3):217–227. doi:10.1016/j.acn.2005.12.002