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Investigating the Separate and Interactive Associations of Trauma and Depression on neurocognition in Urban Dwelling Adults

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Abstract

Background—Trauma and depression have each been associated with neurocognitive alterations, but their combined effect on neurocognition is unclear. We investigated the separate and interactive associations of trauma and depression on neurocognition in a sample of ethnically diverse urban dwellers, and explored the impact of age on these effects.

Methods—284 adults aged 30–89 were divided into groups based on their current depression and trauma history. Individuals meeting DSM-IV criteria for depression were considered Depressed (D+) and individuals rated through diagnostic interview as having trauma history were considered positive for Trauma (T+). Resulting Ns were 73 D+T+, 56 D+T–, 68 D–T+, and 87 D–T–. A principal component analysis of neuropsychological scores resulted in a 3-factor solution representing verbal learning/memory/recognition (VERBAL-LMR), visual learning/memory/recognition, and speeded attention/cognitive flexibility accounting for 70.21% of the variance.

Results—Multivariable linear regressions adjusting for age revealed that Trauma, regardless of Depression, is associated with worse VERBAL-LMR performance. This Trauma association was driven by verbal list and prose passages learning and memory, but not recognition memory. Age-stratified (<60 versus ≥60 years) regressions revealed the Trauma association was only significant for older adults. No main or interactive effects for Depression were observed.

Conclusions—Trauma, regardless of Depression, is associated with worse verbal learning and memory, but not recognition performance. These results suggest that trauma exposure may negatively impact neurocognition. Clinicians working with adults in urban settings should query

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for trauma in addition to depression when considering subjective and objective measures of neurocognitive functioning, particularly in older adults.

Keywords

trauma; depression; neurocognition; aging; learning; memory

Introduction

An estimated 89% of urban dwellers have experienced traumatic events (Breslau et al., 2004). Experiencing traumatic events such as exposure to actual or threatened death, serious injury or sexual violation puts one at risk for psychological disturbances including depressive disorders, regardless of genetic/familial factors that may contribute to mood disorders (Brown et al., 2014). Later life depression is a known risk factor for neurocognitive decline (Dotson et al., 2008) and dementia (Diniz et al., 2013). Though trauma is independently related to both depression and alterations in neurocognitive functioning (Hedges & Woon, 2010), the role of trauma in the depression-neurocognition association is rarely explored.

While neurocognitive alterations seen in depression include episodic memory/recognition, visuospatial and/or psychomotor deficits, reduced executive functioning and information processing are the most commonly occurring impairments (Elderkin-Thompson et al., 2011; Morimoto & Alexopoulos, 2013; Rock et al., 2013; Snyder, 2013); often persisting into remitted states (Hasselbalch et al., 2011). Depressed older adults are particularly vulnerable to alterations of memory, executive functioning and information processing given these deficits are more common (Sexton et al., 2012) and more pronounced (Dotson et al., 2008) in older compared to younger adults and are present in minor and major depression (Elderkin-Thompson et al., 2003). Furthermore, meta-analytic longitudinal findings suggest that the neurocognitive deficits seen in late life depression predict the development of dementia (Potter et al., 2013). This may be due, in part, to the fact that many of the neurocognitive deficits associated with depression, e.g., memory and executive dysfunction, are also early signs of dementia in older adults (Butters et al., 2008).

In some, but not all (Flaks et al., 2014; Leskin & White, 2007) studies, trauma history is also independently associated with neurocognitive dysfunction (Hedges & Woon, 2010), particularly in older adults (Petkus et al., 2012; Ritchie et al., 2012; Yehuda et al., 2005). For example, early-life traumas are associated with decline in verbal fluency, verbal learning, visual and verbal memory, and executive functioning in older adults (Ritchie et al., 2012). While the literature addressing the relationship between trauma and neurocognitive performance in adults regardless of age is almost exclusive to early-life trauma, studies of specific trauma (e.g. interpersonal violence in adulthood) provide insight into the impact of trauma experienced across the lifespan. For example, older adults with a history of multiple sexual assaults in adulthood, experienced executive dysfunction in later life (Petkus et al., 2012). In addition, individuals with trauma history experienced in adulthood exhibit worse performance on tasks of visuoconstruction and visual memory, sustained attention, and executive functioning as adults (Stein et al., 2002), as well as verbal learning as older adults

(Yehuda et al., 2005), than non-exposed control groups. Together, these findings suggest that trauma exposure across the lifespan is associated with neurocognitive alterations in older adults.

There is literature to suggest that depression and trauma history in combination are associated with poorer affective outcomes (Bernet et al., 1999), with recent literature extending these findings to include neurocognition. This may be due, in part to the fact that there are similarities in the long-term neurocognitive profiles associated with trauma history and those associated with depression on tasks of information processing and executive functioning (Petkus et al., 2012; Yehuda et al., 2004, Yehuda et al., 2005; Stein et al., 2002; Navalta et al., 2006; Majer et al., 2010; Gould et al., 2012). In fact, a recent study in adults with depression showed that processing speed worsens with increasing early-life trauma scores (Saleh et al., 2016). Additionally, compared to healthy controls, adults with depression and trauma history exhibited worse executive functioning, delayed recall, and recognition memory (Parlar et al., 2016). In considering these similarities, however, one must also consider that the literature investigating how depression and trauma individually contribute to neurocognition do not control for the presence of the other, i.e., depression studies do not control for trauma or vice versa. In fact, many early-life trauma studies fail to control for, or measure past and/or present mood disorders (Yehuda et al., 2004; Yehuda et al., 2005; Stein et al., 2002; Navalta et al., 2006; Gould et al., 2012). This is particularly important given the high rate of comorbidity between trauma and depression (Afzali et al., 2016). While a recent PTSD study attempted to address this statistically, reporting depressive symptoms mediated the relationship between PTSD and executive functioning (Olff et al., 2014), incorporating a trauma-exposed group free of formal psychiatric diagnoses including PTSD, and a depressed group free of trauma history would help to further elucidate how depression and trauma independently contribute to neurocognition in aging.

The current study examined the separate and interactive associations of trauma and depression on neurocognitive functioning in a diverse urban sample. We focused on an urban population given the high trauma exposure in metropolitan cities (Breslau et al., 2004). We hypothesized that depression alone would be negatively associated with information processing speed and executive functioning given that these domains are the most commonly and profoundly influenced in depression, regardless of remitted states (Rock et al., 2013; Snyder, 2013). We hypothesized that trauma alone would be negatively associated with information processing speed and executive functioning, as well as learning and memory. We further hypothesized that together, trauma and depression would exacerbate deficits in information processing speed, executive functioning, learning, and memory when compared to either one alone. Given that the aforementioned neurocognitive alterations associated with depression (Dotson et al., 2008) and trauma independently (Stein et al., 2002; Navalta et al., 2006; Majer et al., 2010) are worse in older adults (Yehuda et al., 2004, Yehuda et al., 2005; Petkus et al., 2012; Ritchie et al., 2012), we also explored the role of age on the associations between trauma/depression and neurocognition.

Methods

This study leveraged cross-sectional data from investigations of depression and diabetes conducted in a diverse urban population at the Department of Psychiatry, University of Illinois at Chicago (UIC). Participants include 319 adults >30 years old recruited through community outreach, fliers, and research registries. The study was approved by the UIC Institutional Review Board and conducted in accordance with the Declaration of Helsinki.

All participants underwent a preliminary telephone screen. Exclusion criteria consisted of current or past history of an Axis I disorder other than major depression or anxiety (i.e. manic episodes, psychotic disorders, PTSD), current substance abuse/dependence, neurological disorders (e.g. stroke, dementia, seizure, etc.), prior head injury with or without loss of consciousness, and/or current psychotropic medication use including anti-depressants. Thus, all study participants, including those diagnosed with major depression were free of anti-depressant medication for at least two weeks in order to study depressed mood during an untreated state. Participants were not excluded for chronic medical conditions (e.g. hypertension) or a past history of substance abuse >5 years prior to study entry; a past history of substance dependence was an exclusion criterion.

After passing the telephone screen, participants were scheduled for a more detailed evaluation that included neurocognitive, the Mini Mental State Examination (MMSE; Folstein et al., 1975), and affective, the Structured Clinical Interview for the DSM-IV-TR Disorders (SCID; Spitzer et al., 1992), screens for final inclusion/exclusion determination. Screening measures were administered by a trained research assistant followed by an evaluation by a board certified (AK) or board eligible (OA) psychiatrist who completed the 17-item Hamilton Depression Rating Scale (HDRS; Hamilton, 1960). All raters were blind to telephone screen information.

Final inclusion criteria for adults with Depression included a current diagnosis of major depressive disorder based on the SCID and HDRS scores >15. The SCID also assessed for trauma history (Spitzer et al., 1992) as it is a valid assessment of trauma that exhibits high positive predictive power compared to the Stressful Life Event Questionnaire (Elhai et al., 2008). Individuals with Trauma had to meet both traumatic event Criterion A:1) the person experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to physical integrity of self or others, and 2) the person's response involved intense fear, helplessness, or horror. Inclusion criteria for non-depressed participants included an absence of current and past history of any form of depression including depression, NOS or other psychiatric disorders based on the SCID and HDRS scores <8. All subjects, regardless of group, had MMSE scores >24 and were native English speakers.

The final sample included 284 participants, 49.6% female, 44.4% black, with an average age of 57 years. Participants were divided into the following groups: depressed with trauma history (D+T+; $n=73$), depressed with no trauma history (D+T-; $n=56$), non-depressed with trauma history (D-T+; $n=68$), and non-depressed with no trauma history (D-T-; $n=87$).

Diagnostic Characterization

Depression Status—Depression history including age of onset, episode duration, symptoms, and subtype were assessed with the SCID, along with presence, history, and symptomatology of anxiety disorders (Spitzer et al., 1992). The Center for Epidemiological Studies Depression Scale (CESD; Radloff, 1977) measured subjective symptom severity.

Trauma History—Trauma was further categorized using notes detailed in the SCID. Two raters identified whether the event(s) listed for each participant fell under one of the following categories: vehicular accident, assault/armed robbery, physical assault, sexual assault/rape, interpersonal violence, combat, natural disaster, hearing of the death/injury of a loved one, witness someone hurt, killed or dead, or an event outside of those categories (i.e., additional trauma). Raters determined whether participants experienced traumatic event(s) that was either a direct (i.e., happened to the participant) or indirect (i.e., witnessed/learned of) exposure to actual or threatened death, serious injury, or sexual violation (Table 1). Inter-rater reliability for all categories was high, ranging from κ 's=.77–1.0.

Neuropsychological Assessment

Principle component analysis with varimax rotation informed neurocognitive composite scores. The resulting 3-factor solution accounted for 70.21% of the variance (Table 2). Using the default standardized regression method in SPSS, three composite scores were derived using all weighted variables. Two licensed clinical neuropsychologists (ML,DJL) were consulted in labeling the following constructs: verbally-mediated learning/memory/recognition (VERBAL-LMR), visually-mediated learning/memory/recognition (VISUAL-LMR), and speeded attention/cognitive flexibility (attention/flexibility). Participants were given the Wechsler Test of Adult Reading (Wechsler, 2001) to establish premorbid verbal IQ (pVIQ).

Cardiovascular Risk Factor Assessment

Participants received an electrocardiogram and a non-fasting blood draw administered by a registered nurse and interpreted by a licensed physician (OA). A modified Framingham Stroke Risk Profile (modified-FSRP; age not included) was calculated using systolic blood pressure, hypertension medication, diabetes mellitus, current cigarette smoking, cardiovascular disease, atrial fibrillation, and left ventricular hypertrophy (Wolf et al., 1991).

Statistical Analyses

Group differences in sample characteristics were examined using a 2x2 factorial analysis of variance (ANOVA) for continuous and chi-square for categorical variables. To examine the separate and interactive associations between Trauma and Depression, a series of multivariable linear regression analyses were conducted. For each neurocognitive composite, we ran a model with Trauma and Depression controlling for age and additional variables shown to differ between-groups, followed by a model additionally including the TraumaDepression interaction term. We conducted follow-up regression analyses with appropriate adjustments on the individual variables that comprised significant neurocognitive composites to determine what was driving results. In order to explore the role

of age, we conducted a series of multivariable linear regressions as described above but stratified by age (i.e., younger<60 vs. older ≥60) choosing a cut-point consistent with the literature (Yehuda et al., 2004, Petkus et al., 2012) and appropriate to our cohort. Given we were testing pre-specified hypotheses, we did not correct for multiple comparisons in our main or follow-up analyses. Furthermore, correcting for multiple comparisons would have decreased our power to detect true associations and increase the false negative rate (Rothman, 1990). These analyses were conducted using SAS (version 9.4).

Results

Sample Characteristics

Table 3 shows sample characteristics for D+ (n=73 T+, n=56 T-) and D- (n=68 T+, n=87 T-). D+ individuals were younger than D- individuals, [$F(3, 279)=6.01, p=.02$]. Compared with T- individuals (0%), T+ individuals had a greater past history of substance abuse (3.5%), particularly cannabis [$\chi^2(2, 284)=5.16, p=.02$] and slightly lower, albeit non-significant, pVIQ scores [$F(3, 274)=3.51, p=.06, ns$] and years of education [$F(3, 279)=20.97, p=.08, ns$]. As expected, there was a main effect of depression on the CESD [$F(3, 274)=787.35, p<.001$]; in contrast, only 5 of 68 (7%) of D-T+ participants had CESD scores>16. Given diabetes was a focus of the larger program of research, we compared our groups on hemoglobin A1c (hA1c) and cumulative vascular risk, and found that D+ individuals had respectively higher and lower, albeit non-significant hA1c [$F(1, 274)=2.90, p=.09, ns$] and modified-FSRP scores [$F(1, 268)=3.21, p=.08, ns$]. There were no other significant differences as a function of Trauma or Depression.

To determine additional study covariates given our many non-significant albeit trending between-group differences, we assessed collinearity and frequencies. pVIQ, a proxy for educational quality in ethnically diverse samples, correlated with education ($r=.65, p<.001$); while hA1c significantly correlated with modified-FSRP ($r=.49, p<.01$). There was a low frequency of past substance abuse (3.5%), a low threshold to meet DSM-IV substance abuse criteria more generally (Hasin et al., 2013), and no participant met criteria for past substance dependence or current substance abuse/dependence. In contrast, there was a high prevalence of comorbid anxiety in our depression sample (38–48%). Thus, we adjusted for age and comorbid anxiety in initial regression models and added pVIQ and modified-FSRP in fully adjusted models to ensure these variables did not influence our results.

Separate Associations of Trauma and Depression on Neurocognitive Composites

Regardless of Depression status, T+ individuals performed worse than T- individuals on the VERBAL-LMR composite [$\beta=-.33, t(264)=-2.74, p=.007, d=.33$] after adjusting for age and comorbid anxiety; this became marginally significant in a fully adjusted model also including pVIQ and modified-FSRP [$\beta=-.22, t(252)=-1.90, p=.06, d=.22$]. Follow-up analyses revealed that T+ individuals performed worse than T- individuals on CVLT-II trials 1–5 [$\beta=-.15, t(274)=-2.88, p=.01, d=.30$] and CVLT-II delayed free recall [$\beta=-.15, t(274)=-2.52, p=.01, d=.32$] regardless of adjustments, and LMI [$\beta=-.13, t(274)=-2.21, p=.03, d=.26$] and LMII [$\beta=-.15, t(274)=-2.49, p=.01, d=.30$] but only when controlling for age and comorbid anxiety. Applying a $p<0.01$ multiple comparisons correction to the significant

results above leaves all but LMI significant. Trauma history was not associated with recognition memory on either the CVLT-II ($p=.41$) or LM ($p=.10$) regardless of adjustments. Trauma was not associated with either the VISUAL-LMR or attention/flexibility composites and Depression status was not associated with any of the composites adjusting for age and comorbid anxiety. Given these non-significant results, fully adjusted models including pVIQ and modified-FSRP were not conducted.

Interactive Associations of Trauma and Depression on Neurocognitive Composites

There were no significant interactive associations of Trauma and Depression on the VERBAL-LMR, VISUAL-LMR, or attention/flexibility composites (Table 4a, p -values $>.20$) in age and comorbid anxiety adjusted models. Given these non-significant results, fully adjusted models controlling for age, comorbid anxiety, pVIQ and modified-FSRP were not conducted.

Stratified Models

Prior to conducting stratified analyses, ANOVA's and chi-square analyses found that Trauma and Depression groups in both older ($n=135$) and younger ($n=149$) cohorts did not vary significantly by sample characteristics including pVIQ and modified-FSRP. Thus, stratified analyses adjusted for comorbid anxiety only. The association of Trauma and worse VERBAL-LMR performance was significant in older adults [$\beta=-.34$, $t(121)=-1.92$, $p=.05$, $d=.37$], but not in younger adults [$\beta=-.29$, $t(122)=-1.69$, $p=.09$, $d=.29$, ns ; Table 4b]. Similar to the pattern of results in the total sample, in older adults, Trauma was associated with worse performance on CVLT-II Trials 1-5 [$\beta=-.17$, $t(126)=-1.93$, $p=.05$, $d=.35$], and long delay free recall [$\beta=-.18$, $t(127)=-2.02$, $p=.05$, $d=.49$], but not with LMI [$\beta=-.16$, $t(125)=-1.68$, $p=.08$, $d=.30$, ns] or LMII [$\beta=-.15$, $t(125)=-1.70$, $p=.09$, $d=.30$, ns]. Given the truncated sample size, if we apply a $p<0.01$ multiple comparisons correction to these results none remain significant; however, the Cohen's d values range from small to medium, equivalent or larger than analyses for the entire sample. Adjusting for comorbid anxiety, there were no significant associations of Trauma on recognition memory for either verbal memory test in older adults (p -values >0.17); Trauma was not associated with either the VISUAL-LMR or attention/flexibility composites; and Depression was not associated with any of the composites in either age group. There were no interactive associations of Trauma and Depression on any composite in our stratified models adjusting for comorbid anxiety (Table 4b).

Discussion

The current study is the one of the first to examine the separate and interactive associations of Trauma and Depression on neurocognition. Trauma was negatively associated with verbal learning and memory performance regardless of Depression. While consistent with the previous trauma findings, our results extend this work to account not only for current depression, but also by exclusion of depression history in our non-depressed group while simultaneously adjusting for several important confounding variables including anxiety. The current findings did not support a relationship between Depression and worse neurocognition. As previous studies of neurocognition in samples with depression rarely, if

ever, control for trauma history, future work may wish to consider the potential impact of trauma on neurocognition in cohorts that are at high risk for trauma exposure. In assessing for the presence/history of depression as well as the presence/history of trauma, we were able to identify an association between Trauma and neurocognition independent of Depression.

In addition to the negative association between Trauma and verbal memory performance in our ethnically diverse sample of urban dwellers, follow-up analyses further suggested the type of performance deficit contributing to this result. Specifically, the impairment on learning and delayed free recall in the presence of intact recognition memory is indicative of a retrieval-based deficit, not an encoding deficit (Butters et al., 1985; Delis et al., 1987; Lezak et al., 2012; Squire, 1982) that may be modifiable. For example, retrieval difficulties can be improved through interventions such as providing recognition cues or memory training shown to improve memory in healthy older adults and individuals with MCI (Reijnders et al., 2013). While the statistical significance of this work may not equate to clinical significance in the immediate, these results may not only represent harbingers of risk for and development of neurocognitive decline and/or dementia, but also potential remediation techniques in vulnerable individuals. Future longitudinal work is needed to determine whether this profile of impairment and aforementioned remediation strategies may be beneficial in individuals with trauma.

In identical models stratified by age, older adults with trauma showed a significant association with VERBAL-LMR performance, while younger adults exposed to trauma did not. Similar to the total sample, the verbal memory deficit appeared to be retrieval based as opposed to encoding, particularly as it related to the CVLT-II. Given that Logical Memory was not significantly associated with Trauma, particularly in our older adults, this may suggest that the context driven information in prose passage recall may have facilitated performance. This finding should be validated in future studies with larger cohorts given the inherent loss of power resulting from stratification, although we showed equivalent if not larger estimates of power in stratified vs. total group analyses. Future studies, including future longitudinal studies, may also provide evidence of accelerated aging in older individuals with trauma history.

Unlike our VERBAL-LMR results, there were no separate associations of Trauma or Depression on VISUAL-LMR or attention/flexibility composite scores; furthermore, there were no interactive associations of Trauma and Depression on any composite scores. This is not consistent with the literature, and may be due in part to characteristics of our sample. For example, our D-T+ group is, by definition (and psychiatric interview), psychologically resilient (Bonanno, 2004). In fact, only five individuals subjectively reported depressive symptomatology >16 on the CESD—a cut-point increasingly viewed as inadequate for use in the general population given its low positive likelihood ratio (Vilagut et al, 2016). Although psychological resilience did not fully protect against neurocognitive alterations as it relates to verbal learning and memory, it may have acted as a buffer against comprehensive neurocognitive impairment in individuals with trauma but no depression. In addition, our participants with depression may have had a more manageable form of depression as we recruited through fliers and community outreach as opposed to mental health clinics;

furthermore, none of our participants were on anti-depressant medications, another indication of the nature of the depression seen in our sample. Our urban sample often from underserved communities, still had an average of 3 years of college across all groups. This may have further countered the effects of trauma and/or depression given that advanced education is a form of cognitive reserve (Stern et al., 2002).

We should also note that our Depressed group was younger than our non-depressed group, which may have provided a counterweight to the role that depression is known to play on neurocognitive profiles. Additionally, while the SCID is a valid trauma screener with the benefit of assessing trauma through a clinical interview, our ability to study trauma was limited to a dichotomous variable and did not allow for a more comprehensive investigation, e.g., of timing and/or duration of trauma (Elhai et al., 2008). Further, we relied on the structured questions of the SCID and discretion of trained administrators to determine trauma history. This, along with findings in the trauma literature indicating the importance of using comprehensive interviews to capture number and type of traumas, potentially contributed to a lack of nuance in our Trauma sample (Gould et al., 2012; Ritchie et al., 2012; Stein et al., 2012).

Despite these considerations, our results provide initial evidence to suggest health care professionals, particularly those working in urban settings, may wish to screen for trauma exposure—particularly in older adults with subjective memory complaints—to ensure that all possible factors contributing to neurocognition are being considered. The prevalence of trauma in our study suggests that trauma exposure is quite common in urban community dwellers. This is consistent with the literature suggesting that urban dwelling adults are at high risk for experiencing trauma throughout the lifespan (Breslau et al., 2004). Not all individuals exposed to trauma, however, showed psychological ramifications of their experience, (e.g. current/past depressive history). As stated above, this may signal ‘psychological resilience,’ though, it did not afford complete ‘neurocognitive resilience,’ particularly in older adults. Nonetheless, it did result in a neurocognitive profile that may be amenable to intervention as described above. In addition to memory training to improve verbal retrieval, given that individuals with trauma history did not exhibit visual memory difficulties, using multiple modalities when attempting to encode information (e.g., using visual as well as auditory verbal stimuli) may facilitate later retrieval in this vulnerable population. Intervention studies incorporating these strategies should be explored in individuals with trauma history, particularly older adults with trauma exposure.

The literature surrounding chronic stress and the Hypothalamic-Pituitary-Adrenal axis (Heim et al., 2008) as it relates to trauma exposure may provide a possible mechanism for the current findings. Animal and human studies suggest that overproduction of cortisol facilitated by changes in the Hypothalamic-Pituitary-Adrenal axis feedback loop, is toxic to the hippocampus, a key structure involved in learning and memory (Squire, 1992). Overproduction of cortisol levels, long attributed to depression may be the result of trauma *not* depression (Heim et al., 2008). Thus, our results suggesting an association of trauma with learning and memory may be the downstream effects of excessive cortisol secondary to the chronic stress of trauma exposure negatively impacting hippocampal structure and function. Literature linking this neuroendocrine response to the hippocampus and associated

neurocognition has largely focused on early-life trauma (Heim et al., 2008); the present results may provide the basis for future investigations of cortisol, the Hypothalamic-Pituitary-Adrenal axis, hippocampal and prefrontal cortex brain/behavior associates in an older cohort.

If the present results are replicated and extended to include an examination of neuroendocrine functioning, they would suggest that learning and memory deficits associated with depression may be related to trauma history and that trauma history may predispose to elevated levels of cortisol that negatively impact brain-behavior relationships. Additional prospective, and longitudinal work in this area is needed for these conclusions to be drawn. Work studying the separate and interactive associations of trauma, depression, and age on neurocognition has clinical implications. Thus, this study provides support for increased work in this area and perhaps, increased screening for trauma in older adults with depression and/or subjective memory complaints as well as increased consideration of interventions to facilitate better retrieval in affected individuals.

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Table 1**Reported Traumatic Events in Participants Rated Positive for Trauma History**

Category	<i>n</i>	%
Direct threat	77	63
Vehicular accident	25	20
Assaulted/robbed with weapon	18	15
Physical assault	13	11
Sexual assault/rape	9	7
Interpersonal violence	9	7
Combat	8	7
Natural disaster	5	4
Indirect threat	74	60
Hear of loved one being hurt or killed	19	15
Witness someone hurt, killed or dead	33	27
Additional trauma	49	40
Not specified	18	13

Note. Categories are not mutually exclusive with the exception of Not Specified. Counts are not comprehensive, and only represent traumas endorsed by the participant and noted by the administrator during the SCID. Direct threat refers to direct exposure to threatened death, serious injury, or sexual violation, while indirect threat refers to witnessed/learned actual or threatened death, serious injury, or sexual violation. The superordinate direct/indirect threat descriptions are not limited to the categories listed, and may include additional trauma. Additional trauma included reported traumatic events that did not fall under the specified categories or lacked description needed to fall under a given category e.g. death of a loved one. 65% of individuals reporting additional trauma also reported events that belonged in the specified categories.

Table 2

Component Loadings for Neurocognitive Test Scores with Varimax Rotation

Test Score	VERBAL-LMR	VISUAL-LMR	Attention/Flexibility
CVLT-II Immediate Recall	0.78	0.33	0.23
CVLT-II Long Delay	0.80	0.32	0.12
CVLT-II Recognition Discriminability	0.72	0.26	0.05
Logical Memory Immediate Recall	0.82	0.13	0.19
Logical Memory Long Delay	0.85	0.15	0.20
Logical Memory Recognition	0.79	0.03	0.23
Visual Reproduction Immediate Recall	0.28	0.79	0.25
Visual Reproduction Long Delay	0.22	0.79	0.23
Visual Reproduction Recognition	0.22	0.78	0.27
Self-Ordered Pointing Task Total Errors	-0.29	-0.65	-0.18
Trail Making Test – Part-A	-0.09	-0.08	-0.84
Trail Making Test – Part-B	-0.16	-0.34	-0.75
Digit Symbol Coding	0.14	0.26	0.81
Stroop Color-Word Raw	0.27	0.30	0.65
Eigenvalue	3.54	2.88	2.70
Cronbach's Alpha	.90	.86	.83

Note. Numbers in boldface indicate loadings > 0.600. CVLT-II Recognition Discriminability, VR Recognition, TMTA, and TMTB were winsorized. VERBAL-LMR= verbally-mediated learning/memory/recognition; VISUAL-LMR=visually-mediated learning/memory/recognition and working memory; Attention/Flexibility= speeded attention and cognitive flexibility. DSC=Digit Symbol Coding; LM= Logical Memory; SOPT= Self-Ordered Pointing Task, TMT=Trail Making Test; VR=Visual Reproduction.

Table 3

Sample Characteristics Across Trauma/Depression Groups

Variable	Depressed		Non-Depressed	
	Trauma (n=73)	No Trauma (n=56)	Trauma (n=68)	No Trauma (n=87)
Demographic Variables				
Age, <i>M(SD)</i> , range ^a	53.08(11.50), 32–75	56.55(12.72), 32–89	59.13(14.18), 30–89	58.26(13.55), 30–84
Female, %	53.42	55.36	43.48	48.28
Race, %				
Black	27.8	18.3	22.2	31.7
White	20.2	22.7	24.4	32.8
Other	35.9	15.4	28.2	20.5
Years of Education, <i>M(SD)</i> , range ^{†bc}	14.58(2.56), 11–24	15.66(2.37), 11–21	15.47(2.95), 11–24	15.49(2.40), 11–23
pVIQ, <i>M(SD)</i> , range ^{†b}	100.69(12.90), 71–126	106.18(12.44), 76–124	104.03(14.24), 75–126	104.27(13.12), 74–126
MMSE, <i>M(SD)</i> , range	28.90(1.28), 24–30	28.95(1.35), 24–30	28.76(1.44), 25–30	28.83(1.29), 24–30
Psychological Variables				
CESD, <i>M(SD)</i> , range ^a	31.32(9.86), 10–57	31.94(9.07), 13–50	6.40(5.27), 6–21	6.35(4.77), 6–18
Number of Depressive Episodes, <i>M(SD)</i> , range ^a	4.90(7.69), 1–50	3.93(7.28), 1–42	0.00(0.00), 0	0.00(0.00), 0
Duration of Current Symptoms in months, <i>M(SD)</i> , range ^a	19.93(24.63), .5–168	21.14(27.70), .5–120	0.00(0.00), 0	0.00(0.00), 0
Comorbid Anxiety Disorder, % ^a	38.36	48.21	0.00	0.00
Hx of Alcohol Abuse, %	9.59	8.93	7.25	6.9
Hx of Illicit Substance Abuse, % ^b	2.74	0.00	4.41	0.00
Medical Variables				
modified-FSRP, <i>M(SD)</i> , range ^{†a}	6.75(3.86), 1–16	6.05(4.30), 0–21	6.98(4.75), 0–20	5.90(3.96), 0–20
Current Smoker, %	20.55	19.64	14.49	14.94
Diabetes, %	39.73	37.5	47.76	36.78
Hemoglobin A1c, <i>M(SD)</i> , range ^{†a}	6.49(1.50), 5.0–14.5	6.74(2.00), 4.5–13.9	6.27(1.11), 4.9–11.8	6.34(1.45), 4.8–12.9

Note. pVIQ = predicted verbal intelligence quotient from the Wechsler Test of Adult Reading. MMSE = Mini Mental Status Examination. CESD=Center for Epidemiological Studies Depression Scale. modified-FSRP=Modified Framingham Stroke Risk Profile not including age. Hx of Illicit substance use=any endorsement of past drug use that was less than 10 times per month. Number of depressive episodes, duration of current symptoms in months, comorbid anxiety disorder, history of alcohol or substance abuse, and history of illicit substance use were all taken from the SCID. There were no interactive associations of Trauma and Depression on participant characteristics. Hemoglobin A1c levels <5.7% are considered normal while 5.7–6.4% are considered in the increased risk range for diabetes (American Diabetes Association, 2016).

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^a $p < .10$,
* $p < .05$
^a Main effect of Depression
^b Main effect of Trauma
^c Interactive effect of Depression and Trauma

Table 4

Associations of Trauma and Depression on Neurocognitive Composites

a. for the Total Sample (N=284)						
Composite	Model 1: No interaction		Model 2: Interaction included			
	<u>Trauma Status</u>	<u>Depression Status</u>	<u>Trauma x Depression</u>			
	T+ vs. T- β (SE)	D+ vs. D- β (SE)	Adjusted R ²	β (SE)	Adjusted R ²	
VERBAL-LMR	-.33(.12) ^{**}	-.04(.16)	.02	-.09(.25)	.01	
VISUAL-LMR	-.05(.12)	.20(.14)	.03	-.07(.24)	.03	
Attention/Flexibility	-.05(.12)	-.09(.14)	.11	-.13(.23)	.11	
b. for the Sample Stratified by Age						
Composite	Model 1: No interaction		Model 2: Interaction included			
	<u>Trauma Status</u>	<u>Depression Status</u>	<u>Trauma x Depression</u>			
	T+ vs. T- β (SE)	D+ vs. D- β (SE)	Adjusted R ²	β (SE)	Adjusted R ²	
Younger Adults (<60 years old; n=149)						
VERBAL-LMR	-.29(.17) [*]	-.18(.20)	.01	.04(.34)	.002	
VISUAL-LMR	.08(.17)	.20(.20)	.01	.02(.34)	.02	
Attention/Flexibility	.14(.16)	-.06(.16)	.008	-.27(.32)	.01	
Older Adults (≥ 60 years old; n=135)						
VERBAL-LMR	-.34(.18) [*]	.13(.22)	.03	-.22(.37)	.02	
VISUAL-LMR	.02(.18)	.28(.22)	.01	-.17(.38)	.02	
Attention/Flexibility	-.22(.19)	.08(.23)	.005	.07(.39)	.01	

Note. Unstandardized betas are reported; LMR=learning/memory/recognition.

Results in this table reflect adjustment for age and comorbid anxiety disorder, but not the additional adjustment for premorbid verbal IQ and modified-Framingham Stroke Risk Profile scores given that these covariates did not alter our results.

^{*} $p < .10$.

Results in this table reflect adjustment for comorbid anxiety disorder, but not the additional adjustment for premorbid verbal IQ and modified-Framingham Stroke Risk Profile scores given that these covariates did not alter our results. Younger adults included ($n=149$) participants under 60 years of age; older adults include ($n=135$) participants 60 years of age and older.

 $^{\dagger}_{p<.10},$
$$*p<.05,$$

 $p < .01$