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Scoring the Life Events Checklist: Comparison of Three Scoring Methods

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Abstract

Objective: Prior trauma history is a reliable and robust risk predictor for PTSD development. Obtaining an accurate measurement of prior trauma history is critical in research of trauma-related outcomes. The Life Events Checklist (LEC) is a widely used self-report measure of trauma history that categorizes events by the proximity to trauma exposure; however, the field has published multiple scoring methods when assessing the LEC. Herein, we propose a novel scoring procedure in which total scores from the LEC are weighted according to the proximity of trauma exposure with "experienced" events weighted most and "learned about" events weighted least.

Method: The utility of this weighted score was assessed in two traumatically-injured civilian samples and compared against previously published scoring methods, including a non-weighted score including all events experienced, witnessed, and learned about, as well as a score consisting of only experienced events.

Results: Results indicated the standard total score was most reliable, followed by the weighted score. The experienced events score was least reliable, but the best predictor of future PTSD symptoms.

Conclusions: One method to balance the predictive strength of experienced events and the excellent reliability of a total LEC score, is to adopt the newly proposed weighted score. Future use of this weighted scoring method can provide a comprehensive estimate of lifetime trauma exposure while still emphasizing the direct proximity of experienced events compared to other degrees of exposure.

Keywords

prior trauma history; Life Events Checklist; PTSD; trauma outcomes

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Introduction

Trauma exposure is exceedingly prevalent; an estimated 70% of individuals will experience at least one traumatic event in their lives (Kessler et al., 2017; U.S. Department of Veterans Affairs, 2019). While most individuals are resilient in response to trauma, lifetime prevalence rates indicate a substantial subset (5-9%) go on to develop post-traumatic stress disorder (PTSD: American Psychiatric Association, 2013; Cloitre et al., 2019; Kessler et al., 2017; Kilpatrick et al., 2013; Thompson et al., 2018; Wisco et al., 2014; Wu et al., 2013). A vast body of literature has shown that repeated trauma exposure (Delahanty, 2006; Delahanty et al., 2003; Jakob et al., 2017; Karam et al., 2014; Kessler et al., 2018; Lee & Park, 2018; Milligan-Saville et al., 2018; Ozer et al., 2003; Shalev et al., 2019; Wu et al., 2013), and previous trauma history significantly increases risk of PTSD development (Jakob et al., 2017; R C Kessler et al., 2018; Reger et al., 2019; Shalev et al., 2019). Therefore, reliable and accurate measurement of prior trauma history is important in research of trauma-related outcomes in order to assess its specific contributions to PTSD vulnerability.

The Life Events Checklist (LEC) is a widely used self-report measure of prior trauma history that was designed to accompany the Clinician Administered PTSD Scale (CAPS) in aiding PTSD diagnosis (Gray et al., 2004; Weathers et al., 2013). The LEC consists of 17 questions about various traumatic events a person may have experienced, each asked in reference to the degree of (i.e., proximity to) exposure (i.e. experienced, witnessed, learned about). The LEC has demonstrated good test-retest reliability (item-level Kappa's > 0.50) and strong convergence of total scores with validated PTSD symptom severity measures (Pearson *r*'s ranging from 0.34-0.48) including the Traumatic Life Events Questionnaire (TLEQ; Kubany et al., 2000), PTSD Checklist (PCL; Blevins et al., 2015), and CAPS (Gray et al., 2004; Weathers et al., 2013). In non-clinical samples, the LEC also has moderate test-retest reliability, with events that were directly experienced being the most reliably reported (Pugach et al., 2020).

By sorting traumatic events according to proximity, the LEC is able to capture a myriad of traumatic experiences that may have differential impacts on an individual (Benfer et al., 2018; Irish et al., 2008; Kelley et al., 2009; Keshet et al., 2019). However, the scoring protocol instructs all endorsed items across all exposure types to be summed together to generate a total score (Gray et al., 2004). This method of scoring does not account for the notion that proximity of exposure may carry different risk conferral for PTSD than others (Sareen, 2014). For example, sexual assault has been shown to be more traumatizing (i.e. greater PTSD symptom severity) than the sudden death of a loved one (Benfer et al., 2018; Kelley et al., 2009; Keshet et al., 2019). Although researchers have published manuscripts utilizing this total scoring method (Belleau et al., 2020; Chung et al., 2014; Heir et al., 2019; Letica-Crepulja et al., 2020; Weis et al., 2018; White et al., 2015), others have attempted to capture the notion that proximity to the trauma is an important consideration (e.g. Møller et al., 2020; Reger et al., 2019). The LEC can also be scored to "count" only the endorsed experienced items (e.g. Møller et al., 2020; Reger et al., 2019), if those events really do carry the greatest risk, though this approach has not been validated (Milligan-Saville et al., 2018). Furthermore, only considering the events directly experienced by an individual does not capture the trauma load of other forms of exposure assessed in the LEC.

We have framed the proposed method in the context of evidence suggesting that all trauma types, even events that are learned about, are important when assessing cumulative life trauma (Baker et al., 2020; Conrad et al., 2017; Sacchi et al., 2020) as well as the substantial evidence that direct proximity to (i.e., "experienced") trauma bestows additional risk (Benfer et al., 2018; Kelley et al., 2009; Keshet et al., 2019; Milligan-Saville et al., 2018; Qi et al., 2016; Reger et al., 2019). Therefore, in order to harmoniously bridge these two conceptualizations and fully capture the utility of the LEC, the current report proposes an alternative scoring procedure for the LEC to measure prior trauma history. In two traumatically injured clinical samples, we evaluated whether a total weighted LEC score, according to proximity of trauma exposure, may better capture the relationship between previous trauma history and risk of PTSD compared to the unweighted total and experienced events only score.

Method

Participants

Both samples in the current study included participants recruited from the urban Level 1 Trauma Center in southeastern Wisconsin who were being treated for injuries. For sample characteristics see Table 1 and Supplemental Table 2.

Imaging Study on Trauma & Resilience (iSTAR).—The first sample was derived from a large longitudinal study designed to identify acute post-trauma risk factors of PTSD development using biospecimen, self-report measures, cognitive and behavioral assessments, and magnetic resonance imaging (MRI) to assess structural and functional brain data (study name: iSTAR). Individuals were eligible for the study if they had recently been discharged from the ED of a Level 1 Trauma Center, and were excluded for comorbid substance abuse, psychosis, and moderate to severe traumatic brain injury (TBI) (See Supplemental Table 1 for full inclusion/exclusion criteria). Enrolled participants were asked to complete seven study visits: two weeks after their injury on two consecutive days ("Day 1" and "Day 2"), and 3-, 6-, 12-, 18-, and 24-months post-injury. A majority of the injuries were caused by non-assaultive trauma (i.e. accidents) such as motor vehicle collisions (MVC), falls, and recreational injuries (78%), while the remaining 22% were injured due to assaultive trauma. Relevant to the current study, 215 participants completed self-report measures (see Measures) at Day 1, of which 191 were retained in the study and completed measures at 6-month follow up.

Study on Trauma & Resilience (STAR 1.0).—The second sample was from a separate longitudinal study also aimed at identifying post-trauma risk factors of PTSD development using biospecimens, genetics, and self-report measures (study name: STAR 1.0). Participants were asked to complete three study visits: in-hospital (baseline, BL), 3-months, and 6-months post-injury. Enrolled participants were admitted to the hospital for a single-incident traumatic injury and were excluded for active psychosis and moderate to severe TBI (See Supplemental Table 1 for full inclusion/exclusion criteria). Relevant to the current study, 278 participants completed self-report measures at BL, of which 172 were retained and

completed measures at 6-month follow up. A majority of the injuries were caused by non-assaultive trauma (67%) while the remaining 33% were injured due to assaultive trauma.

Measures

Life Events Checklist.—The LEC assesses occurrence of 17 major life events (e.g. natural disaster, assault, combat, life-threatening illness or injury) that a person may have experienced, witnessed, or learned about happening to someone close to them (Gray et al., 2004). In both samples, the LEC was collected at baseline visits, which was 2-weeks for iSTAR (average of 16 days since trauma), and within 1-week while in-hospital for STAR 1.0 (average of 2.5 days since trauma).

One way to score the LEC, commonly utilized in the literature (Belleau et al., 2020; Heir et al., 2019; Letica-Crepulja et al., 2020; Weis et al., 2018; White et al., 2015), is to sum all endorsed items from all exposure types to generate a total LEC score (min/max for each scale = 0-17, total score min/max = 0-51). In addition to this total score, we also totaled items endorsed as experienced only, as some researchers have chosen to do (Gray et al., 2004; Møller et al.,2020; Reger et al., 2019).

Finally, a weighted score was developed to highlight the theorized greater traumatization from experienced events as opposed to other forms of exposure while still including all forms of exposure. Items experienced directly were weighted by a factor of 3, items witnessed weighted with a factor of 2, and items learned about were weighted with a factor of 1. After weighting, all items were summed (maximum score = 102). Greater weighted scores would therefore indicate more events experienced with closer proximity to the individual.

Thus, three separate LEC scores were calculated: experienced events only, standard total score, and a weighted score. All three LEC scores were analyzed for both samples (iSTAR, STAR 1.0).

The Clinician-Administered PTSD Scale for DSM-5 (CAPS-5).—The CAPS-5 was used to assess chronic PTSD symptoms for both samples at 6-months post-injury (Weathers et al., 2013). The CAPS-5 is a clinical interview consisting of 18 questions corresponding to DSM-5 PTSD symptoms. Frequency and intensity of PTSD symptoms are assessed by the interviewer and a single severity rating is designated for each item. Total symptom severity is derived from the sum of severity ratings on all questions. The interview was audio-recorded for each participant and a random selection of interviews (~20%) were reevaluated to establish excellent reliability across interviewer administration within the study (interclass correlation coefficient (ICC)=0.96, with 95% confidence interval [0.93, 0.98]). According to the CAPS-5 at 6-months, in iSTAR, 42 of 191 participants (21%) met criteria for PTSD diagnosis, and in STAR 1.0, 50 of 172 met criteria (29%).

Statistical Analysis

To evaluate reliability of LEC measures, pairwise correlations were calculated between all three LEC scoring methods (experienced only, total, and weighted) within each sample. In addition, to assess internal reliability of the LEC in the current samples, Cronbach's

alpha (Cronbach, 1951) was calculated for all three LEC scoring methods using the "cronbach.alpha()" function in the "ltm" package in R (Rizopoulos, 2006).

Finally, correlations of LEC measures (BL) and CAPS-5 symptom severity (6-month) were calculated to evaluate the predictive utility of each of the LEC scoring methods. To compare the degree of correlation significance between LEC scoring methods with CAPS severity (overlapping correlations of dependent groups), Hotelling's *t* (Hotelling, 1940) was calculated between all pairwise combinations of the LEC scoring methods and the CAPS using the "cocor" package in R (Diedenhofen & Musch, 2015).

Results

For sample characteristics see Table 1 and Supplemental Tables 1 and 2. There were no significant gender differences in the three LEC scoring methods for either sample. There were no gender differences in total CAPS in the iSTAR sample ($p > 0.05$) though females in the STAR 1.0 sample had significantly greater CAPS symptom severity ($t(100) = -2.02$, $p = 0.04$). The sample from STAR 1.0 was significantly older than the sample in iSTAR, $t(308) = 6.34$, $p < 0.01$. While inclusion criteria were the same for both samples in terms of age (18-60), the STAR 1.0 sample tended to be older as there were sometimes competing health concerns resulting in their admittance to the hospital post-trauma. Age was not significantly related to CAPS symptom severity in the iSTAR sample, but in the STAR 1.0 sample, greater age was significantly related to greater CAPS symptom severity ($t(171) = -3.60$, $p < 0.01$).

There were no significant differences in the scores produced by the three LEC scoring methods between the two samples (Experienced: $t(450) = 1.06$, $p = 0.28$; Total: $t(434) = 0.89$, $p = 0.37$; Weighted: $t(438) = 0.99$, $p = 0.31$). In addition, both samples had comparable CAPS symptom severity scores at 6-months, $t(325) = -0.10$, $p = 0.91$.

First, LEC metrics were evaluated for reliability of measurement across both samples. Pairwise correlations demonstrated all three LEC measures were highly correlated with one another at baseline for both samples (all $p < 0.01$, Table 2).

Internal reliability results indicated experienced only scores demonstrated poor reliability for both samples ($\alpha < 0.67$), while total scores demonstrated excellent reliability in both samples ($\alpha > 0.87$), and weighted scores demonstrated good reliability in both samples ($\alpha > 0.83$; Table 3; Hair, 2010).

To characterize the relationship of the three LEC scores with PTSD symptoms, all three LEC scoring methods were correlated with total CAPS symptom severity at 6-months. In the iSTAR sample, all three LEC scoring measures were highly correlated with CAPS symptom severity at 6-months (all $p < 0.01$). In the STAR 1.0 sample, experienced only scores at baseline were highly related to CAPS severity at 6-months ($p < 0.01$; Table 4).

Finally, to compare degree of correlation significance between LEC measures with CAPS severity, Hotelling's *t* were calculated between all pairwise combinations of the LEC measures and the CAPS. In the iSTAR sample, there were no significant differences in

correlation significances for any pairwise comparisons of LEC correlations with CAPS (all $p > 0.50$). In the STAR 1.0 sample, total versus weighted scores yielded a significant difference in correlation significance ($p = 0.02$) such that weighted scores had a statistically more significant relationship with the CAPS than total scores. Even though the experienced LEC measure was the lone scoring method related to CAPS in the STAR 1.0 sample, the relative difference between total and weighted scores was greater than experienced versus total ($p = 0.09$) or experienced versus weighted scores ($p = 0.21$).

Discussion

While exposure to previous trauma has been shown as a significant risk factor in PTSD development (Jakob et al., 2017; Kessler et al., 2018; Reger et al., 2019; Shalev et al., 2019), different scoring methods have been utilized for the Life Event Checklist (LEC), a widely used trauma exposure instrument. Therefore, the current study evaluated the reliability and validity of various LEC scoring methods and proposed a new method wherein exposure to trauma was weighted by the proximity to exposure (i.e., experienced, witnessed, learned about). In two independent traumatically-injured civilian samples, we demonstrated good reliability and validity of a novel weighted scoring method and compared it to the total and experienced only scoring methods.

Unsurprisingly, results of the reliability analysis show the weighted score is significantly and highly correlated with the standard total score and the experienced only score. The weighted score also had very good internal reliability ($\alpha > 0.83$). In addition, the weighted score had better internal reliability than the experienced only score ($\alpha > 0.59$), though not as high of reliability as the standard total score ($\alpha > 0.87$). Of particular interest within the current study, was the validity of the weighted LEC score in predicting PTSD symptom severity. In both samples, the experienced events only score was significantly predictive of PTSD symptom severity assessed with CAPS-5 at follow-up. However, the weighted score only showed robust predictive utility with PTSD symptom severity in one sample (iSTAR). The difference in predictive utility may stem from the different natures of the samples (see limitations).

Although the experienced only scores were most predictive of PTSD symptom severity, experienced only events had the worst reliability of the three measures. While this result underscores the well-documented significance of experienced traumatic events in risk of PTSD (Benfer et al., 2018; Irish et al., 2008; Kelley et al., 2009; Keshet et al., 2019; Milligan-Saville et al., 2018; Qi et al., 2016; Reger et al., 2019), it may not be the most reliable measure of trauma history; however, poor reliability could simply be due to the fewer number of items in the experienced score compared to total and weighted scores (Cronbach, 1951). Weak internal reliability but strong correlation with PTSD symptoms may also suggest some of the experienced events in particular were stronger predictors of PTSD than other experienced events. However, the nature of this relationship cannot be further evaluated due to the lack of event context recorded by the LEC (see limitations).

Moreover, while the standard LEC total demonstrated the highest reliability, it does not capture the degree to which various trauma exposure types may confer PTSD risk (Benfer

et al., 2018; Irish et al., 2008; Kelley et al., 2009; Keshet et al., 2019). Therefore, we have suggested an alternative method to capture the importance of experienced events in a reliable way. The weighted score emphasizes experienced events while still including the other forms of trauma exposure, and in the current study had excellent reliability over experienced events only. Of note, the weighted score is supported by research indicating that proximity of the traumatic event is a factor that confers differential risk of PTSD. However, it is important to note that is not the only factor, or perhaps even most important factor, by which risk of PTSD is conferred. Subjective interpretations and perceptions of trauma vary by individuals and are important when assessing trauma outcomes (Brasel et al., 2010; Geiger et al., 2011; Keshet et al., 2019). The utilization of the standard total score is also based on an assumption, that all traumatic events, regardless of proximity, impact an individual in the same way or to the same degree. Choice of a score (weighted versus standard) should be considered within the context of LEC administration, whether as a direct predictor of PTSD or as a covariate in other analyses, and with the consideration of how the underlying assumptions behind each scoring method may apply to a particular sample or research question.

A notable aspect of the current study is the inclusion of racially diverse samples. In both the iSTAR and STAR 1.0 samples 67% and 54% of participants, respectively, identified as a race other than White. While previous work has shown trauma, PTSD, and culture intersect in complex ways (Alegría et al., 2013; Chemtob, 1996; Ungar, 2013), in the U.S., prevalence of PTSD is one of many health disparities that varies by racial and ethnic groups. More specifically, several studies have demonstrated higher rates and conditional risk for PTSD for Black and African Americans when compared to Hispanics, Latinx, Asians, and Whites (Alegría et al., 2013; Roberts et al., 2011). Despite this empirical evidence, reliability of PTSD risk assessments, like the LEC, have not been appropriately evaluated in a diverse sample (Gray et al., 2004; Weathers et al., 2013). Thus, the current study adds to the literature by presenting reliability indices of various scoring methods for the LEC while utilizing a more representative trauma sample and encourages future work to include cultural considerations in study designs.

Limitations

While the current study utilized two independent samples in evaluating the reliability and validity of LEC scoring methods, there is significant overlap in the sample characteristics. The samples were recruited from the same geographic region, hospital, and trauma center (albeit in completely independent time frames), and due to similar inclusion criteria (i.e. requiring medical attention for traumatic injuries). However, the iSTAR sample were discharged from the emergency department (and therefore less severely injured) and the STAR sample were those admitted to the hospital and therefore more severely injured, providing breadth related to injury severity in a trauma sample. Despite the overlap in sample characteristics, results of the current study show separable findings in the performance of the weighted LEC score. Still, further work needs to be done to replicate the current findings in other trauma exposed as well as nonclinical (i.e. not hospitalized) samples.

Another limitation lies within the construct of the LEC. The LEC is a checklist meant to provide a general overview of an individual's lifetime trauma history. The LEC was not originally designed to measure the frequency, severity, duration, or the recency of an endorsed item. Although the LEC is limited in its predictive validity, as it does not provide a comprehensive overview of a person's lived traumatic experiences, future studies may consider including additional measures to assess more specifically how traumatic events may have impacted the participant.

Conclusions

The current study demonstrated the reliability and validity of the LEC experienced only score, total score, and newly proposed weighted score. An individual's trauma history has been repeatedly shown to be a critical risk factor in PTSD development (Jakob et al., 2017; Kessler et al., 2018; Reger et al., 2019; Shalev et al., 2019). Though experienced events may carry greatest risk conferral of PTSD (Benfer et al., 2018; Kelley et al., 2009; Keshet et al., 2019), other forms of trauma exposure should not be discarded at the expense of statistical power as they carry significant weight in the theory that accumulating traumas increase risk of PTSD development (Karam et al., 2014). The current proposal of a weighted LEC scoring method provides a balance of predictive strength and history completeness when evaluating a person's prior trauma history and offers an alternative assumption of how proximity of trauma may confer risk of PTSD. Nonetheless further validation of this metric is warranted through application in other trauma samples from different geographic regions and backgrounds.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Clinical Impact Statement:

The Life Events Checklist (LEC) is a widely used self-report measure of trauma history that categorizes events by the proximity of trauma exposure; however, the field has published multiple scoring methods for the LEC. We proposed a novel scoring procedure in which total scores are weighted according to the proximity of trauma exposure with "experienced" events weighted most and "learned about" events weighted least. Results assessed in two traumatically injured civilian samples indicated the weighted score is reliable and valid. Future utilization of this scoring method will provide a comprehensive estimate of lifetime trauma while emphasizing proximity of trauma exposure.

Table 1.

Sample Characteristics

	iSTAR (n=215)	STAR 1.0 (n=278)
Gender (M/F)	103/112	201/77
Age (mean/SD)	32.89/10.68	39.86/15.64
Race (count/percent of sample)		
American Indian or Alaska Native		2 (<1%)
Asian	4 (1%)	
Black or African American	124 (57%)	124 (44%)
Hispanic or Latino		24 (8%)
White	58 (27%)	128 (46%)
More than one	15 (7%)	
Unknown or Not Reported	13 (6%)	
LEC (Baseline)		
Exp	4.96	5.22
Total	16.52	17.23
Weighted	30.99	32.47
CAPS-5 (6-months)	(n=191)	(n=172)
Total Severity (mean/SD)	13.69/12.05	13.54/15.20
Dx (+/−)	42/191	50/172

Note: **M,** male; **F,** female; **Exp,** experienced events only score; **Total**, standard total score, **Weighted,** weighted score**; LEC,** life events checklist; **CAPS-5,** Clinician Administered PTSD Scale for DSM-5; **SD,** standard deviation; **Dx,** PTSD diagnostic status.

Table 2.

R^2 Values Between Life Events Checklist Scores in iSTAR and STAR 1.0

	iSTAR (N = 215) Baseline (2-week)				**STAR 1.0 (N = 278) Baseline (In-hospital)**		
	Exp	**Total**	**Weighted**		**Exp**	**Total**	**Weighted**
Exp	--	**0.69** ***	**0.81** ***	Exp	--	**0.57** ***	**0.75** ***
Total		--	**0.97** ***	Total		--	**0.95** ***
Weighted			--	Weighted			--

Note: **Exp,** experienced events only score; **Total**, standard total score, **Weighted,** weighted score

*** ***p* < 0.001.**

Table 3.

Reliability of LEC Measures Across Samples (Cronbach's α)

	iSTAR	STAR 1.0
	α (95% CI)	**α (95% CI)**
Exp	0.67 (0.60, 0.73)	0.59 (0.51, 0.65)
Total	0.91 (0.89, 0.92)	0.87 (0.84, 0.89)
Weighted	0.87 (0.85, 0.89)	0.83 (0.80, 0.86)

Note: **CI,** confidence interval; **Exp,** experienced events only score; **Total**, standard total score, **Weighted,** weighted score.

Table 4.

R^2 Values of LEC Correlations with CAPS

		Baseline LEC		
		Exp	**Total**	**Weighted**
CAPS (6-months)	iSTAR (n=191)	**0.031** *	**0.034** **	**0.031** *
	STAR (n=172)	**0.03** *	0.01	0.02

Note: **Exp,** experienced events only score; **Total**, standard total score, **Weighted,** weighted score;

* ***p* < 0.05,**

** ***p* < 0.01.**