The Dutch 20 item Centrality of Event Scale

Factor Structure, Psychometric Properties, and Prospective Value

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Abstract

Event centrality is defined as the extent to which a memory of a traumatic event forms a reference point for people's identity and attribution of meaning to other experiences in their life. Event centrality is typically measured with the Centrality of Event Scale (CES; Berntsen & Rubin, 2006). The present study's first aim was to investigate the underlying factor structure and construct validity of the Dutch 20-item CES (CES-20) in undergraduates (N = 1091). The second aim was to test whether the CES-20 could prospectively predict posttraumatic stress disorder (PTSD) symptoms four months later. The data supported a one-factor structure of the CES with a high internal consistency (α = .95), which is not in line with the theoretical model of event centrality but aligns with previous empirical research. Furthermore, high construct validity was evidenced by positive and significant relations between the CES and PTSD symptoms, depressive symptoms, DSM-5 trauma A criterion, and the number of experienced negative life events. Event centrality was not a significant predictor of PTSD symptoms four months later when controlling for PTSD symptoms at time 1, which questions the prospective relation between event centrality and later PTSD symptoms for those events.

Keywords: Event centrality; factor analysis; psychometric properties; PTSD; depression

Introduction

The event centrality theory (Berntsen & Rubin, 2006, 2007) suggests that a memory of a traumatic event stays highly accessible due to the distinctiveness and emotional impact of the event and its memory. Subsequently, trauma memory may form a reference point for the organization of autobiographical memory and can have a continuous impact on the interpretation of the meaning of other, non-traumatic experiences in the present and the future (Berntsen & Rubin, 2006, 2007). Conceptually, the theory states that event centrality consists of three aspects: (1) the extent to which the memory is a reference point for everyday inferences (e.g., the individual overestimates the occurrence of similar traumatic events); (2) the extent to which the event is seen as a turning point in the individual's life-story (e.g., the individual feels that the traumatic event has permanently changed their life); and (3) the extent to which the memory of the event is integrated within components of one's identity (e.g., 'being a trauma victim' has become part of the individual's self) (Berntsen & Rubin, 2006; 2007).

Event centrality is typically measured by the Centrality of Event Scale (CES; Berntsen & Rubin, 2006). The CES exists in a 20-item (CES-20) and an abbreviated 7-item version. Both versions showed good reliability in student populations, with respective alpha coefficients of .94 and .92. The CES positively correlates with symptoms of posttraumatic stress disorder (PTSD; Boals, 2010; Brown et al., 2010; Robinaugh & McNally, 2011), depression (Boals, 2014), social anxiety (Matos et al., 2013), and prolonged grief (Boelen, 2009, 2012b). Several translations of the CES have been developed, and studies using these other language versions of the CES have reported similar results regarding construct validity as well as high reliability coefficients (Cunha et al., 2015; Gauer et al., 2013; Ionio et al., 2018; Vermeulen et al., 2020). Although previous research on the abbreviated Dutch CES showed good internal consistency with one underlying factor (Vermeulen et al., 2020), no

studies have yet systematically evaluated the psychometric properties of the Dutch CES-20. In addition, mixed results were found regarding the underlying factor structure of the different CES-20 translations.

Regarding the factor structure of the CES-20, of the eight reviewed studies, four studies found evidence for three underlying factors. Of these four, two reported evidence for a three-factor solution aligning with the event centrality theory (Ionio et al., 2018; Vagos et al., 2018), whereas two other studies found factors that were not in line with the theoretical constructs (Gauer et al., 2013; Robinaugh & McNally, 2011). In contrast, four studies found only one underlying factor of the CES (Berntsen & Rubin, 2006; Cunha et al., 2015; Galán et al., 2017; Matos et al., 2010). An overview of factors, languages, statistical methods, and used samples of the different studies can be found in Table 1.

Different methodological reasons can be identified for this discrepancy. First, the samples differed across studies (e.g., adolescents, students, community, and patient samples), which could have caused different factor solutions. Second, different statistical approaches were used (Galán et al., 2017). For example, Principal Component Analysis (PCA), Exploratory Factor Analysis (EFA), and related terms are often used interchangeably, confusing both researchers and readers (Beavers et al., 2013; Tabachnick & Fidell, 2001). Moreover, PCA is known to overestimate the number of underlying components (Park et al., 2002), which could result in an inaccurate number of reported factors. Also, CFA should be conducted (instead of EFA or PCA) when prior theories exist regarding the data structure (Henson & Roberts, 2006). Nevertheless, the studies using PCA did not use CFA to test the original one-factor model found by Berntsen and Rubin (2006), and Berntsen and Rubin (2006) did also not use CFA to test the three-factor event centrality model in their study. For these reasons, it is unclear what caused the differences in factorial solutions between the studies.

As no studies systematically evaluated the psychometric properties of the Dutch CES-20, the first aim of the present study was to validate the Dutch CES-20 by testing the factor structure and the scale's construct validity. Based on the mixed findings regarding the underlying factors, we first wanted to investigate the factor structure in a student sample. We examined the fit of the models shown in Table 1 using CFA. As three of the four studies using student samples found one underlying factor of the CES (Berntsen & Rubin, 2006; Galán et al., 2017; Matos et al., 2010), we expected no significant improvement in fit for a three-factor model in comparison to a one-factor model (Hypothesis 1). In order to test the construct validity of Dutch CES-20 we explored the relation between CES and trauma-related psychopathology markers. We predicted to replicate earlier findings with the abbreviated Dutch CES (Vermeulen et al., 2020) (Hypothesis 2). Specifically, we predicted that CES scores would be positively correlated with symptoms of PTSD, such that individuals with a possible PTSD diagnosis (based on PCL cutoff scores) would report higher CES scores than individuals below the cutoff, and that the CES would have a unique predictive value for symptoms of PTSD when controlling for depressive symptoms. We further predicted significant positive correlations between event centrality and depressive symptoms. However, event centrality would have no predictive value for depression when controlling for PTSD symptoms. We predicted that individuals with a history of potentially traumatic experiences, according to the DSM-5 trauma A-criterion, would report higher CES scores than individuals without a history of trauma. In addition, we expected that individuals who experienced multiple negative life events would report higher CES scores than individuals who experienced none or only one negative life event(s).

The second aim of this study was to examine whether event centrality prospectively predicts PTSD symptoms at four months follow-up. Several studies have shown that event centrality (measured with the abbreviated CES) at baseline predicts PTSD symptoms at a later

time (Blix et al., 2016; Boals & Ruggero, 2016; Boelen, 2012a, 2017). In this study, we aimed to replicate these results with the Dutch CES-20 (Hypothesis 3).

Method

Participants

Participants were Dutch-speaking first-year psychology students of the KU Leuven. Data were collected at the beginning of the academic year for three consecutive years, resulting in three independent samples. The first sample consisted of 382 participants (83.8% females) with an average age of 18 years (*SD* = 1.75; range: 17 - 35 years). Sample 2 consisted of 267 participants (84.6% females) with an average age of 18 years (*SD* = 1.45; range: 17 - 31 years). Sample 3 consisted of 422 participants (82.5% females) with an average age of 18 years (*SD* = 1.17; range 17- 26 years), of which 276 participants completed both measurement moments in sample 3. Overall, this resulted in a total sample of *N* = 1091 for the factor analyses.

Measures

The Dutch version of the 20-item Centrality of Event Scale (CES). The CES-20 (Berntsen & Rubin, 2006) measures the centrality of the memory of a specific negative life event in the life story of the participants. Sample items are: *"I feel that this event has become a central part of my life story"* and *"This event was a turning point in my life"*. The questionnaire consists of 20 self-report items rated on a 5-point Likert scale from 1 *(totally disagree*) to 5 *(totally agree*). Scores range between 20 and 100. The original English CES-20 has internal consistency coefficients ranging between α = .93 and .95 in American student samples (Berntsen & Rubin, 2006). The Dutch translation can be found in the supplementary material. Psychometric properties of the Dutch CES-20 translation are presented in the result section.

DSM-5 A criterion for trauma. Participants were asked one yes/no question on whether they were ever directly or indirectly exposed to actual or threatened death, serious injury, or sexual violence (APA, 2013, p. 271).

Post-traumatic Stress Disorder Check List-Civilian version (PCL-C). The Dutch version of the PCL-C (Weathers et al., 1993; Weathers & Ford, 1996) is a 17-item self-report questionnaire that assesses PTSD symptoms based on DSM-IV-TR (APA, 2000) criteria. Symptom severity is rated from 1 *(not at all)* to 5 *(extremely)*. Scores on the PCL-C range between 17 and 85. The PCL-C has an internal consistency of $\alpha = .94$ in a sample of trauma victims, and includes three subscales: avoidance ($\alpha = .82$), re-experiencing ($\alpha = .94$), and hyperarousal ($\alpha = .84$) (Blanchard et al., 1996). Following Blanchard et al. (1996), PCL-C scores above 44 were used as a cut-off to indicate a possible PTSD diagnosis. The internal consistencies for Samples 1, 2 and 3 were, respectively, $\alpha = .93$ (subscales: avoidance, $\alpha = .86$; re–experiencing, $\alpha = .85$; hyperarousal, $\alpha = .86$), $\alpha = .93$ (subscales: avoidance, $\alpha = .86$; re–experiencing, $\alpha = .88$; hyperarousal, $\alpha = .86$), and $\alpha = .94$ (subscales: avoidance, $\alpha = .86$; re–experiencing, $\alpha = .86$; hyperarousal, $\alpha = .89$).

Beck Depression Inventory-II (BDI-II). The Dutch version of the BDI-II (BDI-II; Beck et al., 1996; Van der Does, 2002) measures depressive symptomatology. The BDI-II consists of 20 items, rated on a scale from 0-3, with higher scores reflecting greater severity of depressive symptoms. Scores on the BDI-II range between 0 and 60. The Dutch translation has good internal consistency coefficients ranging between $\alpha = 0.88$ and 0.92 in different samples (Van der Does, 2002). The internal consistency coefficient in the current sample was $\alpha = 0.94$.

Life Event Scale (LES). The LES (Garnefski & Kraaij, 2001) was used to assess the self-reported history of negative life events. The LES consists of 28 negative non-traumatic or potentially traumatic life events (e.g., parents' divorce, sexual abuse). Participants were asked

to indicate whether they have experienced each event, and if so, when ('*No*', '*Yes, before my 16th birthday*', '*Yes, between my 16th birthday and a year ago*', and '*Yes, less than a year ago*'). Responses on the LES were used to determine whether the participants had experienced no, one, or more than one negative life event(s).

Procedure

Approval for this study was obtained from the Social and Societal Ethics Committee of KU Leuven (reference number G-201509344). For three successive years, all first-year psychology students were invited to participate in a routine collective testing session at the Faculty of Psychology and Educational Sciences. Students participated in exchange for course credits. In Sample 1, participants were seated in a computer lab with approximately 20 students simultaneously, one on every other computer (not directly next to each other). Participants were first asked to read and sign an informed consent form. Then, information about the study was given by the experimenter, both written and orally. Participants were asked to retrieve the memory of their most negative, stressful, or even traumatic experience and keep this memory in mind while completing the questionnaires. Participants completed, in this order, a demographic questionnaire (sex, age, nationality, course), CES, PCL-C, BDI-II, DSM-5 trauma A-criterion, and the LES. Participants were then asked to briefly describe the event they had kept in mind while completing the questionnaires. The LES and BDI-II were administered in Sample 1 only.

Data for Sample 2 was collected online. After retrieving the memory, participants completed, in this order, the CES, PCL-C, and DSM-5 trauma A-criterion.

The data of Sample 3 consisted of two waves. Wave 1 was collected in a computer lab, with a maximum of 50 to 90 participants per session. After retrieving the memory, the CES, PCL-C, and DSM-5 trauma A-criterion item were administered. Four months later, Wave 2 was collected online with the same questionnaires in the same order.

Statistical analysis

Hypothesis 1: The factor structure of the Dutch CES-20 was examined using a CFA using Mplus (Muthén & Muthén, 2017). Given the ordinal nature of the data, the CFA model was tested using a WLSMV estimation approach (e.g., Li, 2016a, 2016b). The model-to-data fit was evaluated using Chi-square test (χ^2), the Root Mean Square Error of Approximation (RMSEA), and the Comparative Fit Index (CFI), with small, insignificant χ^2 values, RMSEA values below .08, and CFI values above .95 pointing at adequate model fit (Hooper et al., 2008; Hu & Bentler, 1999). Structural and measurement invariance across the different samples were examined using the Lavaan package in R (Rosseel, 2012). Three levels of measurement invariance were sequentially tested: configural invariance (equal number of factors and items loading to the same factors), weak invariance (equal factor loadings across samples), and strong invariance (equal factor loadings and intercepts across groups). A ΔCFI value of $\leq .01$ was used as the cutoff criterion for model fit comparisons (Chen, 2007). Ordinal alpha coefficients were calculated to investigate the internal consistency of the CES using R psych package (R Core Team, 2017; Revelle, 2018).

Hypothesis 2*:* Correlations were calculated to test the relation between the CES and PCL-C subscales (avoidance, re-experiencing, and hyperarousal) and the BDI-II. Both Pearson's and Spearman's correlations were reported due to skewness of the BDI-II scores. Scale statistics per sample can be found in the supplementary material. Correlations were interpreted following Cohen's (1988) guidelines, where .10 is considered small, .30 moderate, and >.50 strong. Groups were compared on CES scores using one-way ANOVAs with CES as the dependent variable and grouping variables (possible PTSD diagnosis: yes/no; DSM trauma A-criterion: yes/no; LES groups: none, one, more than one) as between-subject factors. Linear regression analyses were used to determine the predictive value of the CES for the variance in PCL-C and BDI-II scores, controlling for the shared variance between PCL-C

and BDI-II. The independent variables were entered in two separate blocks. PCL-C scores were predicted by BDI-II and CES scores as independent variables. BDI-II scores were predicted by PCL-C and CES scores as independent variables.

Hypothesis 3: Regression analyses were conducted to determine the predictive value of T1 CES scores for T2 PCL-C scores: PCL-C T2 scores were predicted by PCL-C T1 scores and CES T1 scores. Post-hoc exploratory regression and path analyses were conducted to test for possible methodical limitations (see ESM - p2 for specific descriptions of these regression analyses). Path analysis was conducted using Mplus (Muthén & Muthén, 2017).

Due to differences in included questionnaires over the three samples, not all analyses could be conducted in all samples. Factor analyses were conducted on the merged sample consisting of Samples 1, 2, and 3. A multigroup factor analysis was conducted to test for structural and measurement invariance across the three samples. In addition, additional factor analyses were run in two subsamples: 1) DSM-5 trauma-A criterion, and 2) PCL cut-off score. Complete validity analyses were conducted in Sample 1; partial validity analyses were conducted in Samples 2 and 3; prospective analyses were conducted in Sample 3.

A probability of $\alpha = .05$ was used to determine statistical significance of all tests. Effect sizes for mean group differences were reported as Hedge's g (two groups) or partial eta-squared (> two groups). All correlations, regression analyses, and ANOVAs were calculated using SPSS 25 (IBM Corp., 2017) unless otherwise specified. No data was excluded prior to data analyses.

Results

Hypothesis 1: Factor analysis

We examined whether the three-factor models would result in a better fit than the one-factor model. The results are shown in Table 2. The fit indices indicated that the one-factor model had an acceptable to good fit. All three-factor models approached a similar fit. The

inter-factor correlations in the three-factor models were high (r > .88), indicating that it is difficult, if not impossible, to make an empirical differentiation between the factors. These high correlations suggest that the factors are either different reflections of the same process or parallel processes that cannot be measured separately with the CES. For those reasons, and because the three-factor models did not show a better fit to the one-factor model, the more parsimonious one-factor model was preferred. All items obtained a loading of >.65 on the underlying factor. An ordinal alpha coefficient of α = .95 was obtained with an average item correlation of r = .49. A multigroup confirmatory factor analysis was conducted to test for structural and measurement invariance across the three samples. A ΔCFI = .012 was found for comparing weak vs. configural invariance, and ΔCFI = .014 for strong vs. weak invariance, indicating only configural equivalence over the different samples (Chen, 2007; Hirschfeld & von Brachel, 2014). This means that similar, but not identical, latent constructs were measured over the samples (Widaman & Reise, 1997).

To exclude that the found results were due to specific sample characteristics, we reran all factor analyses in two subsamples: 1) participants who indicated having experienced an event meeting the DSM-5 trauma criterion (n = 302), and 2) participants with possible PTSD based on PCL cut-off score (n = 343). Results are shown in Table 1 and 2 in the supplementary materials. The results were similar to the results of the total sample: The one-factor model was not the best fit; yet, the inter-factor correlations in the three-factor models were high (r > .88), indicating that it is difficult, if not impossible, to make an empirical differentiation between the factors, thereby favoring the one-factor structure. Multigroup analysis could not be conducted, as the subsamples became too small to be able to obtain reliable and valid estimates of the parameters.

Hypothesis 2: Construct validity of the CES

Group distribution, mean scores, and standard deviations of the CES scores per group are shown in Table 4. In line with Hypothesis 2, correlations between the CES and PCL-C were significant and positive and moderate to strong, ranging between .44 and .58 (see Table 3). Results indicated that participants with possible PTSD reported higher CES scores than participants without PTSD in all samples: $F(1,380) = 80.53$, $p < .001$, $g = 1.00$ (Sample 1); $F(1,265) = 61.80$, $p < .001$, $g = 0.99$ (Sample 2); and $F(1,421) = 104.42$, $p < .001$, $g = 1.10$ (Sample 3). The regression analysis (Table 5) showed that CES scores explained a significant additional 8% of variance in PCL-C scores after controlling for depressive symptoms.

We predicted that event centrality would be positively correlated with depressive symptoms. Correlations between the CES and BDI-II were significantly positive and small to moderate, ranging between .38 and .39 (Table 3). The regression analysis (Table 5) showed that, as predicted, CES scores had no longer a significant predictive value for depressive symptomatology after controlling for PCL-C scores.

We predicted that individuals with a history of potentially traumatic experiences meeting the DSM-5 trauma A-criterion would report higher CES scores than individuals without a history of trauma. Results indicated that individuals who reported a traumatic event, showed higher CES scores than individuals without a history of trauma, in all three samples: $F(1, 380) = 8.83$, $p = .003$, $g = 0.34$ (Sample 1); $F(1, 265) = 25.97$, $p < .001$, $g = 0.66$ (Sample 2); and $F(1, 421) = 15.75$, $p < .001$, $g = 0.45$ (Sample 3).

We hypothesized that individuals who have experienced multiple negative life events would report higher CES scores than individuals who have experienced one or no negative life events. Overall, results indicated that higher CES scores were related to multiple negative life events, $F(1, 379) = 10.04$, $p < .001$, $\eta^2 = .05$. Pairwise comparisons showed no significant differences between no events vs. one event, $p = .19$, $g = 0.27$, and one event vs. multiple

events, $p = .10$, $g = 0.27$. Individuals who reported multiple events had significantly higher CES scores than individuals who reported no negative life event, $p < .001$, $g = 0.53$.

Hypothesis 3: Prospective value of CES

In contrast to Hypothesis 3, the regression analysis (Table 5) showed that CES T1 scores did not significantly predict PCL-C T2 scores when controlling for PCL-C T1 scores. To exclude different methodological possibilities of why our results were not in line with our expectations and the results of prior studies (Blix et al., 2016; Boals & Ruggero, 2016; Boelen, 2012a, 2017), we conducted several exploratory analyses. We tested (1) the reverse-path (PCL-C predicting CES), (2) the effects in the subsample of participants who reported the same event at the two timepoints, and (3) a path analysis to exclude the possibility that the difference in results was due to a different data analytical approach. See our supplementary material for figures, tables, and further argumentation of the rationale for these exploratory analyses. None of these post-hoc analyses showed a different pattern of results.

Discussion

The first aim of this study was to compare the fit of a theory-driven three-factor model with an empirically supported one-factor model for the Dutch 20-item Centrality of Event Scale (CES-20) (Hypothesis 1). A one-factor model, as well as different three-factor models, obtained a good fit in the full sample, as well as in both subsamples (DSM-5 trauma A-criterion; probable PTSD based on the PCL cut-off). However, because of the high inter-factor correlations and the parsimony criterion, the one-factor structure was preferred, in line with previous studies (Berntsen & Rubin, 2006; Cunha et al., 2015; Galán et al., 2017; Matos et al., 2010). The high inter-factor correlations in the three-factor models may indicate that the three theoretical principles of event centrality serve overlapping and mutually dependent functions in the cognitive network (Berntsen & Rubin, 2007). It could also indicate that event centrality does not contain three different principles but rather one type of cognition

(Vermeulen et al., 2020). Furthermore, only configural equivalence between samples could be met. Configural equivalence requires that in each group, the same items are associated with the same factor; however, the factor loadings may differ across groups. This level of invariance indicates that similar, but not identical, latent constructs were measured in our samples (Widaman & Reise, 1997), although the differences were small. This suggests a similar factor solution in each of our different samples, although theoretically, the meaning of the factor could be different in each sample. Thus, the results of the factor analyses do not provide strong support for empirical differentiation among the three constructs. Further, the results indicate that the theoretical meaning of the entire construct may differ depending on as yet unidentified sample characteristics. Moreover, additional factor analyses in a subsample of individuals meeting the DSM-5 trauma criterion A, and the sample of individuals with probable PTSD (based on PCL cut-off scores) indicated that the one-factor model was still the most pragmatic.

Taken together, similar to Galán et al. (2017), we recommend viewing the 20 CES-20 as measuring a single construct (one factor). Even more, as the alpha for the CES-20 seems to be consistently higher than .90 (which is a strong indication of item redundancy; Boyle, 1991; Clark & Watson, 1995), and as the reliability of the Dutch CES-20 was similar to the Dutch CES-6 (Vermeulen et al., 2020), the benefit of the CES-20 appears to lie fore mostly in the information individual items can provide. For a general assessment of event centrality in a Dutch student sample there is no clear indication that either version is to be preferred. Future research, however, is needed to clarify whether the three different aspects of event centrality can individually be measured, or whether the event centrality theory should be seen as a single construct.

The second aim was to investigate the construct validity of the CES-20 by examining the relation between event centrality and trauma-related psychopathology (Hypothesis 2). In

line with our expectations, we found positive and moderate to strong correlations between event centrality and symptoms of PTSD and higher event centrality levels in individuals with a possible PTSD diagnosis. In addition, event centrality was a significant predictor of PTSD symptoms after controlling for depressive symptoms. Our results are in line with the construct validity of the abbreviated CES (Vermeulen et al., 2020) and with a systematic review on the CES (Gehrt et al., 2018), in which moderate to strong correlations were found between event centrality and PTSD. These results build upon previous empirical research, suggesting a strong and reliable relation between event centrality and PTSD symptoms specifically (Berntsen & Rubin, 2006, 2007; Blix et al., 2014; Brown et al., 2010; Chung et al., 2017; Vermeulen et al., 2019). Positive weak to moderate correlations between event centrality and depressive symptoms we found, in line with the meta-analysis results of Gehrt et al. (2018). Furthermore, event centrality was not a significant predictor of depressive symptoms when controlling for PTSD symptoms. These results confirm our hypothesis and replicate the findings with the abbreviated Dutch CES (Vermeulen et al., 2020). It also adds to the growing body of research questioning the direct relation between event centrality and depression (Janssen et al., 2015; Newby & Moulds, 2011), suggesting that event centrality is more typically related to PTSD, or, at least, related to specific traumatic experiences (e.g., grief; Boelen, 2021). Our results showed that individuals who reported a DSM-5 trauma A-criterion event had higher levels of event centrality than individuals without a history of trauma, although only a small to medium effect size was found. These results are in line with previous research on the abbreviated Dutch CES (Vermeulen et al., 2020) and with the systematic review by Gehrt et al. (2018), where, in over 10.000 participants, small correlations were found between event centrality and the DSM trauma A-criterion. Moreover, we found that participants with multiple negative events reported higher levels of event centrality than participants who indicated no such events. No differences were found between having

experienced no event and one event, and between one event and multiple events. The finding that the experience of multiple negative events is related to higher levels of event centrality is in line with previous research (Karam et al., 2014; Kolassa et al., 2010; Vermeulen et al., 2020), in which it has been shown that higher trauma exposure was related to higher symptom severity and a higher prevalence of PTSD. In addition, research by Kaufman and colleagues (2018) showed that cumulative trauma exposure was related to several post-trauma appraisals. This finding could be clinically relevant as it suggests that negative appraisals, including those of event centrality (Vermeulen et al., 2019), could lead to a lower resilience in light of additional traumata. Longitudinal research and research in complex trauma patients are needed to examine the occurrence and maintenance of event centrality following cumulative trauma.

The final aim of this study was to examine the prospective value of the CES-20 on PTSD symptoms four months later (Hypothesis 3). Our results could not confirm our hypothesis: Event centrality was not a significant predictor for PTSD symptoms four months later when controlling for PTSD symptoms at baseline. This indicates that event centrality at baseline did not explain more variance in PTSD symptoms four months later, on top of the variance explained by PTSD symptoms at baseline. Event centrality at baseline, however, was significantly related to PTSD symptoms four months later. Our results are not in line with previous research finding that event centrality was predictive of prospective PTSD symptoms. There are several possible explanations for this. For example, three out of the four previous studies (Blix et al., 2016; Boelen, 2012a, 2017) contained a sample that experienced a severe adverse event in the recent past. These studies subsequently measured event centrality and PTSD symptoms related to that specific event. This was different from our study design, as we asked participants for their most stressful event in life. The difference in methods might have caused different results. Our method might have assessed the coherence of event

centrality and PTSD symptoms over time rather than the course of development of symptoms between two timepoints. However, the study of Boals and Ruggero (2016) had a similar study design to ours. The most important difference is the time between the measurement points, i.e., one month (Boals & Ruggero, 2016) vs. four months (this study). These differences in results, possibly due to differences in design, may suggest that event centrality is predictive of later PTSD symptomatology when related to very specific and (very) recent negative events. The CES-20 may only have a short-lived predictive value in healthy samples, as most individuals would recover naturally following stress. It may be that the predictive value would be higher in a clinical PTSD sample. Further research should be undertaken to investigate these suggestions.

Our study has several limitations. First, several earlier studies (e.g., Ionio et al., 2018; Vagos et al., 2018) included gender as a variable in their analysis, and one study found an effect of gender in their factor analysis (Vagos et al., 2018). However, as our sample contained very few men, it was not feasible to control for gender in our sample. Also, in the study on the abbreviated version of the Dutch CES in a similar sample as the current study (Vermeulen et al., 2020), gender was included as a covariate, but this did not significantly alter the results. Thus, although not controlling for gender is a limitation of the present study, this seems minimally problematic. Second, our sample included predominantly female psychology students, which is not representative of the general population or individuals who have experienced a traumatic event. Yet, in our paper we also tested the factor structure in a subsample of individuals who experienced a traumatic event (DSM-V trauma A-criterion/PTSD based on PCL) and found similar results to the factor analysis on our full sample. In addition, there were no theoretical grounds to expect a different factor structure for different samples, as event centrality is presented in the literature as a dimensional construct (Berntsen & Rubin, 2006; 2007). Thus, the generalizability of our results might be limited, yet

based on our findings in the subgroup with trauma and the theoretical foundation of event centrality we have no reason to expect huge differences. Future research is needed to show whether Dutch CES-20 yields similar results in different samples. Third, all measures were self-report, which could have led to higher between-variable correlations due to shared method variance. Future research should consider the possibility of examining the construct of event centrality in a mixed-method design or to counterbalance the order of the administered questionnaires (Podsakoff et al., 2003).

To conclude, this study demonstrated good psychometric properties of the Dutch CES-20 in a student sample. A one-factor model was supported, which does not reflect the three-component theoretical model of event centrality but is in line with previous empirical studies. Additionally, we found high internal consistency of the scale, and high construct validity was evidenced by the relationship between event centrality and PTSD symptoms. In line with earlier research, CES-20 did not predict depression when controlling for PTSD symptoms. Therefore, event centrality may not be as relevant to depression as it is to trauma. Event centrality was not a significant predictor of PTSD symptoms four months later. Comparing and analyzing methodological differences between our current study and earlier studies, we raise the possibility that event centrality is only especially relevant in predicting short-term PTSD symptoms, for specific events and/or only in clinical samples.

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Open Science

We report how we determined our sample size, all data exclusions (if any), all data inclusion/exclusion criteria, whether inclusion/exclusion criteria were established prior to data analysis, all measures in the study, and all analyses including all tested models. If we use inferential tests, we report exact p values, effect sizes, and 95% confidence or credible intervals.

Open Data: The information needed to reproduce all of the reported results are not openly accessible. The data is available on request from the authors.

Open Materials: The information needed to reproduce all of the reported methodology is not openly accessible. The material is available on request from the authors.

Preregistration of Studies and Analysis Plans: This study was not preregistered

Table 1:

Overview of the results of the different studies and factor solutions of the Centrality of Event Scale

Study	Statistical Method	Factors	Language	Sample	Cronbach's alpha			
					Total scale	Factor 1	Factor 2	Factor 3
Berntsen & Rubin (2006)	PFA	1	English	Students	.94	-	-	-
Matos et al. (2010)	PCA	1	Portuguese	Students + community	.96	-	-	-
Robinaugh & McNally (2011)	PCA	3	English	Trauma survivors	.94	-	-	-
Gauer et al. (2013)	PCA	3	Brazilian	Students	-	.89	.89	.81
Cunha et al. (2015)	CFA	1	Portuguese	Adolescents	.95	-	-	-
Galán et al. 2017	CFA	1	Spanish	Students	.93	-	-	-
Vagos et al. (2018)	CFA	3	Portuguese	Adoloscents	-	.87	.89	.85
Ionio et al. (2018)	CFA	3	Italian	Adolescents	-	.85	.82	.86

Note. PFA = Principal Factor Analyses; PCA = Principal Component Analysis; CFA = Confirmatory Factor Analysis;

Table 2:

Fit indices of the tested models (factor solutions of previous studies), and correlations between factors in our full sample

Item distribution of the tested models suggested by previous research		DF	χ^2	RMSEA	CFI	Factor correlations		
						F1 – F2	F1 – F3	F2 – F3
Berntsen & Rubin (2006)	F1: all items	170	2079.62	.102	.926	-	-	-
Berntsen & Rubin (2006) theoretical model	F1: 1, 2, 4, 9, 12, 13, 17, 20 F2: 3, 5, 6, 7, 8, 11, 19 F3: 10, 14, 15, 16, 18	167	1763.33	.094	.938	.92	.88	.91
Robinaugh & McNally (2011)	F1: 2, 4, 6, 7, 8, 9, 11, 14 F2: 3, 5, 10, 16, 18, 19 F3: 1, 12, 13, 15, 17, 20'	167	1967.95	.100	.930	.94	.95	.93
Gauer et al. (2013)	F1: 1, 2, 3, 4, 6, 7, 8, 9, 10, 12 F2: 5, 11, 14, 15, 16, 18, 19 F3: 13, 17, 20	167	1624.54	.090	.943	.89	.86	.87
Vagos et al. (2018)	F1: 1, 4, 9, 12, 13, 17, 20 F2: 10, 14, 15, 16, 18 F3: 3, 5, 6, 7, 8, 19 Excluded: 2, 11	132	1359.75	.093	.948	.89	.94	.94
Ionio et al. (2018)	F1: 1, 2, 4, 9, 12, 13, 17, 20 F2: 10, 14, 15, 16, 18 F3: 3, 5, 6, 7, 8, 19 Excluded: 11	149	1479.46	.091	.946	.88	.94	.94

Note. DF = Degrees of Freedom; RMSEA = Root Mean Square Error of Approximation; CFI = Confirmatory Fit Index; F = Factor

Table 3:

Pearson and Spearman correlations between the CES, PCL-C, and BDI-II

	Sample 1		Sample 2		Sample 3	
	Pearson	Spearman	Pearson	Spearman	Pearson	Spearman
PCL-C	.54	.53	.55	.54	.58	.58
PCL-C – reliving	.45	.43	.48	.47	.50	.49
PCL-C – avoidance	.51	.52	.50	.49	.55	.55
PCL-C – hyperarousal	.45	.44	.46	.45	.49	.49
BDI-II	.39	.38	-	-	-	-

Note. CES = centrality of event scale; PCL-C = Posttraumatic stress disorder Check List – Civilian Version; BDI-II = Beck depression index.

All correlations are significant at $p < .001$

Table 4:

Mean scores and standard deviations of the CES in the three samples.

		Possible PTSD (PCL-C ≥ 44)		DSM-5 trauma A-criterion		LES groups		
		No	Yes	No	yes	0	1	>1
Sample 1	*N*	68.50% (262)	31.40% (120)	72.30% (280)	27.70% (102)	29.3% (112)	24.1% (92)	46.6% (178)
	CES scores	53.87 (15.33) [52.10 – 55.64]	68.29 (12.24) [65.68 – 70.91]	56.91 (16.32) [55.03 – 58.78]	62.29 (14.60) [59.26 – 65.32]	53.49 (15.75) [50.58 – 56.40]	57.62 (14.93) [54.41 – 60.83]	61.89 (15.97) [59.59 – 64.20]
Sample 2	*N*	61.40% (164)	38.60% (103)	63.90% (176)	34.10% (91)			
	CES scores	55.94 (16.97) [53.50 - 58.38]	71.65 (14.02) [68.57 – 74.74]	58.22 (16.78) [55.72 – 60.72]	69.31 (16.98) [65.83 – 72.79]	-	-	-
Sample 3	*N*	71.69% (302)	28.40% (120)	75.20% (317)	24.80% (105)			
	CES scores	57.48 (15.93) [55.78 - 59.17]	74.02 (12.37) [71.32 – 76.71]	60.34 (16.36) [58.53 - 62.16]	67.70 (16.75) [64.54 – 70.85]	-	-	-

Note. CES = Centrality of Event Scale; PTSD = posttraumatic stress disorder; PCL-C = Posttraumatic stress disorder Check List – Civilian Version; LES = Life Event Scale. Numbers of participants and standard deviations are reported between brackets. Confidence intervals are reported between squares brackets.

Table 5:

CES scores predicting PCL-C and BDI-II scores while controlling for the shared variance, and CES T1 scores predicting PCL-C T2 scores while controlling for the shared variance.

	ΔR^2	F_{change}	*B*	*SE*	β	*t*
Prediction of PCL-C scores						
BDI-II	.50*	383.24*	.88	.05	.59	16.37*
CES	.08*	75.63*	.26	.03	.31	8.70*
Prediction of BDI-II scores						
PCL-C	.50*	383.24*	.47	.02	.71	19.58*
CES	.00	0.03	.00	.02	.01	0.16
Prediction of PCL-C T2 scores						
PCL-C T1	.31*	123.09*	.57	.05	.56	11.10*
CES T1	.08	3.40	.09	.05	.11	1.74

Note. CES = Centrality of Event Scale; PCL-C = Posttraumatic stress disorder Check List – Civilian Version; BDI-II = Beck Depression Inventory – second edition.

*$p < .001$

Supplementary material

Centrality of Event Scale – 20 items versie – NL

Translated by: Mirjam Vermeulen & Julie Krans, Klinische Psychologie, KU Leuven, 2015.

1. Deze gebeurtenis is een referentiepunt geworden voor de manier waarop ik over nieuwe ervaringen denk.
2. Ik zie automatisch verbanden en overeenkomsten tussen deze gebeurtenis en ervaringen in mijn huidige leven.
3. Ik heb het gevoel dat deze gebeurtenis deel is geworden van mijn identiteit.
4. Deze gebeurtenis kan gezien worden als symbool of kenmerk van belangrijke thema's in mijn leven.
5. Door deze gebeurtenis is mijn leven anders dan het leven van de meeste andere mensen.
6. Deze gebeurtenis is een referentiepunt geworden voor de manier waarop ik over mijzelf en de wereld denk.
7. Ik geloof dat mensen die een dergelijke gebeurtenis niet hebben meegemaakt anders denken dan ik.
8. Deze gebeurtenis zegt veel over wie ik ben.
9. Ik zie vaak verbanden en overeenkomsten tussen deze gebeurtenis en mijn huidige relaties met andere mensen.
10. Ik heb het gevoel dat deze gebeurtenis een centraal onderdeel van mijn persoonlijke verhaal is geworden.
11. Ik geloof dat mensen die een dergelijke gebeurtenis niet hebben meegemaakt op een andere manier naar zichzelf kijken dan ik.
12. Deze gebeurtenis heeft de gevoelens en gedachten die ik heb over andere ervaringen gekleurd.
13. Deze gebeurtenis is een referentiepunt geworden voor de manier waarop ik naar mijn toekomst kijk.
14. Als ik een tapijt zou weven van mijn leven, dan zou deze gebeurtenis in het midden staan met allemaal draden die zich uitspreiden naar vele andere ervaringen.
15. Mijn persoonlijke verhaal kan ingedeeld worden in twee belangrijke hoofdstukken: één voor en één na het meemaken van deze gebeurtenis.
16. Deze gebeurtenis heeft mijn leven voorgoed veranderd.
17. Ik denk vaak na over de effecten van deze gebeurtenis op mijn toekomst.
18. Deze gebeurtenis was een keerpunt in mijn leven.
19. Als deze gebeurtenis mij niet was overkomen zou ik vandaag de dag een ander mens zijn.
20. Als ik reflecteer over mijn toekomst denk ik vaak terug aan deze gebeurtenis.

Antwoordmogelijkheden:
1 – Helemaal niet mee eens, 2 – Niet mee eens, 3 – Niet mee eens/mee eens, 4 – Mee eens,
5 – Helemaal mee eens

Results of exploratory analyses

To explore whether the relation between event centrality and PTSD symptoms is bi-directional, a regression analysis was run with PCL-C T1 scores predicting CES T2 scores controlling for CES T1. PCL-C T1 scores were not a significant predictor of CES T2 scores when controlling for CES T1 (see ESM Table 4).

We hypothesized that the lack of an effect might have been caused by some participants completing the questionnaires in Wave 2 with a different stressful event in mind than during Wave 1. We reran the original regression analysis in two sub-samples: different events reported (n = 142) vs. same event reported (n = 134). We anticipated that the predicted effect might show up in the subsample with participants who reported the same event at both time points. The analyses, however, showed that the effect was absent in both sub-samples (see EMS Table 4).

To exclude the possibility that the difference in results between our study and the study by Boals and Ruggero (2016) was due to a different data analytical approach, we conducted an explorative pathway analysis (cf. Boals & Ruggero, 2016), which resulted in the same pattern of results. No significant pathways were found between CES T1 and PCL-C T2 and PCL-C T1 and CES T2 (see ESM figure 1).

ESM Table 1:

Fit indices of the tested models (factor solutions of previous studies), and correlations between factors in a subsample of individuals meeting DSM trauma A-criterion

Item distribution of the tested models suggested by previous research		DF	χ^2	RMSEA	CFI	Factor correlations		
						F1 – F2	F1 – F3	F2 – F3
Berntsen & Rubin (2006)	F1: all items	170	632.08	.095	.935	-	-	-
Berntsen & Rubin (2006) theoretical model	F1: 1, 2, 4, 9, 12, 13, 17, 20 F2: 3, 5, 6, 7, 8, 11, 19 F3: 10, 14, 15, 16, 18	167	603.07	.093	.939	.95	.91	.94
Robinaugh & McNally (2011)	F1: 2, 4, 6, 7, 8, 9, 11, 14 F2: 3, 5, 10, 16, 18, 19 F3: 1, 12, 13, 15, 17, 20'	167	612.50	.094	.938	.95	.95	.93
Gauer et al. (2013)	F1: 1, 2, 3, 4, 6, 7, 8, 9, 10, 12 F2: 5, 11, 14, 15, 16, 18, 19 F3: 13, 17, 20	167	518.25	.083	.951	.89	.83	.90
Vagos et al. (2018)	F1: 1, 4, 9, 12, 13, 17, 20 F2: 10, 14, 15, 16, 18 F3: 3, 5, 6, 7, 8, 19 Excluded: 2, 11	132	484.89	.097	.947	.93	.97	.96
Ionio et al. (2018)	F1: 1, 2, 4, 9, 12, 13, 17, 20 F2: 10, 14, 15, 16, 18 F3: 3, 5, 6, 7, 8, 19 Excluded: 11	149	524.52	.091	.945	.92	.96	.96

Note. DF = Degrees of Freedom; RMSEA = Root Mean Square Error of Approximation; CFI = Confirmatory Fit Index; F = Factor

ESM Table 2:

Fit indices of the tested models (factor solutions of previous studies), and correlations between factors in a subsample of individuals with probable PTSD based on PCL cut-off score

Item distribution of the tested models suggested by previous research		DF	χ^2	RMSEA	CFI	Factor correlations		
						F1 – F2	F1 – F3	F2 – F3
Berntsen & Rubin (2006)	F1: all items	170	762.90	.101	.886	-	-	-
Berntsen & Rubin (2006) theoretical model	F1: 1, 2, 4, 9, 12, 13, 17, 20 F2: 3, 5, 6, 7, 8, 11, 19 F3: 10, 14, 15, 16, 18	167	638.96	.091	.910	.83	.81	.83
Robinaugh & McNally (2011)	F1: 2, 4, 6, 7, 8, 9, 11, 14 F2: 3, 5, 10, 16, 18, 19 F3: 1, 12, 13, 15, 17, 20'	167	722.73	.098	.893	.94	.90	.84
Gauer et al. (2013)	F1: 1, 2, 3, 4, 6, 7, 8, 9, 10, 12 F2: 5, 11, 14, 15, 16, 18, 19 F3: 13, 17, 20	167	631.99	.090	.911	.86	.74	.73
Vagos et al. (2018)	F1: 1, 4, 9, 12, 13, 17, 20 F2: 10, 14, 15, 16, 18 F3: 3, 5, 6, 7, 8, 19 Excluded: 2, 11	132	495.55	.090	.922	.81	.86	.86
Ionio et al. (2018)	F1: 1, 2, 4, 9, 12, 13, 17, 20 F2: 10, 14, 15, 16, 18 F3: 3, 5, 6, 7, 8, 19 Excluded: 11	149	521.92	.085	.925	.88	.94	.94

Note. DF = Degrees of Freedom; RMSEA = Root Mean Square Error of Approximation; CFI = Confirmatory Fit Index; F = Factor

ESM Table 3:

Scale statistics of the different measures over the different samples.

		Mean *(SD)*	Skewness	Kurtosis
CES	Sample 1	58.40 (16.03)	-.34	-.30
	Sample 2	62.00 (17.62)	-.15	-.58
	Sample 3	62.17 (16.75)	-.24	-.32
PCL	Sample 1	37.07 (13.45)	.57	-.21
	Sample 2	39.46 (13.77)	.48	-.35
	Sample 3	36.26 (13.76)	.69	-.19
BDI	Sample 1	11.72 (9.01)	1.14	1.29

Note: CES = Centrality of Event Scale; PCL-C = Posttraumatic stress disorder Check List – Civilian Version; BDI-II = Beck Depression Inventory – second edition.

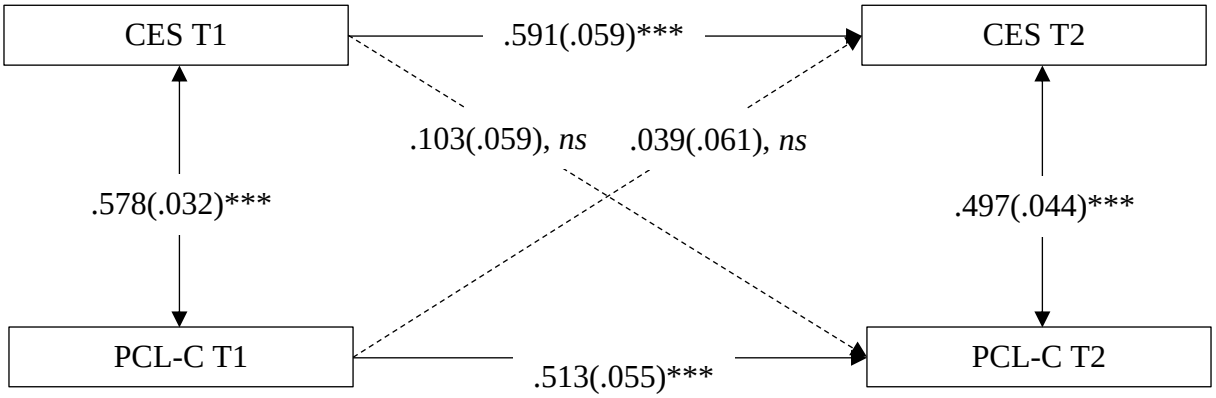
ESM Table 4:

PCL-C T1 scores predicting CES T2, and CES T1 scores predicting PCL-C T2 scores in the subsamples of participants reporting different or the same event at both assessments.

	ΔR^2	F_{change}	*B*	*SE*	β	*t*
Prediction of CES T2 scores						
CES T1	.37*	159.48*	.66	.05	.61	12.63*
PCL-C T1	.00	0.77	.07	.08	.05	0.88
Prediction of PCL-C T2 scores						
Different events (*n* = 142)						
PCL-C T1	.18*	31.29*	.44	.08	.43	5.59*
CES T1	.01	2.27	.12	.08	.14	1.51
Same events (*n* = 134)						
PCL-C T1	.49*	128.74*	.73	.06	.70	11.35*
CES T1	.00	0.99*	.06	.06	.07	0.99*

Note: CES = Centrality of Event Scale; PCL-C = Posttraumatic stress disorder Check List – Civilian Version

*$p < .001$



ESM Figure 1: Path analysis of CES scores and PCL-C scores on two measurement points. Dotted lines represent insignificant coefficients. Standard errors are noted between brackets.

*$p < .05$; **$p < .01$; ***$p < .001$.