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# Event centrality and posttraumatic stress symptoms after traumatic injury: A longitudinal investigation

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**Abstract**

The development of posttraumatic stress symptoms (PTSS) can occur following a traumatic injury, which may include an increase in negative cognitions. One cognitive construct shown to be associated with the development of PTSS is event centrality, or the degree to which an individual views a traumatic experience as central to their life story. Although cross-sectional work has demonstrated a robust connection between event centrality and PTSS, the directionality of this association remains unclear. Most previous work has investigated centrality as a predictor of PTSS, although one recent study suggests that PTSS may, in fact, predict event centrality. The current longitudinal study enrolled adult civilian participants ($N = 191$) from a Level 1 trauma center following a traumatic injury and assessed both event centrality and PTSS at three points posttrauma (3, 12, and 18 months). A time-constrained random intercept cross-lagged panel analysis showed that PTSS predicted event centrality over the 18-month follow-up period, $B = 0.16$, $p = .021$, but event centrality did not predict PTSS, $B = -0.27$, $p = .340$. These findings suggest that the development of PTSS following trauma exposure may lead to the perception of the traumatic event as central to an individual's story over time. Further longitudinal research is necessary to determine what variables may influence the connection between PTSS and event centrality.

In 2019 alone, over 26,000,000 individuals in the United States sustained a traumatic injury (Centers for Disease Control and Prevention, 2020). After exposure to a traumatic event, individuals may go on to develop posttraumatic stress symptoms (PTSS), and these rates are higher in traumatically injured populations (Hunt et al., 2017; Zatzick et al., 2008). PTSS can include reliving the traumatic event, experiencing negative thoughts and emotions related to the event, hyperarousal and increased hypervigilance to trauma-related stimuli, and an increased desire to avoid trauma reminders (American Psychiatric Association [APA], 2013). The development of PTSS can negatively impact recovery and quality of life postinjury (Zatzick et al., 2008). Although most individuals demonstrate resilience postinjury (deRoon-Cassini et al., 2010), a significant proportion experience lingering symptoms of distress and develop chronic posttraumatic stress disorder (PTSD).

One cognitive construct known as *event centrality* has been examined as a critical component of the development

  

and maintenance of PTSS (Gehrt et al., 2018). Event centrality refers to an individual's perception of an event—in this case, a traumatic injury—as a central component of their identity (Berntsen & Rubin, 2007). The event becomes central in a variety of ways, such as an individual's use of the event as a reference for evaluating current experiences (e.g., perceiving something as unsafe due to past trauma exposure). Likewise, the traumatic event can become central to one's perceived "life story" and the experience seen as a turning point in their life (Berntsen & Rubin, 2007). In these ways, the experience is accessed and used as information to shape one's worldview and day-to-day life. It is generally assumed that once an individual sees an event as more central to their identity, they are more likely to develop fearful and avoidant responses to that event, thus contributing to the development of PTSD (Boals et al., 2021). Previous research has shown cross-sectional correlations between PTSS and event centrality, with high ratings of event centrality associated with high levels of PTSS (Barton et al., 2013; Boelen, 2012; Groleau et al., 2013; Webermann, et al., 2020). Likewise, in a systematic review, positive correlations were observed between specific PTSD symptom clusters and event centrality across a host of populations (Gerht et al. 2018).

Although there is extensive literature supporting a strong cross-sectional association between event centrality and psychopathology following trauma exposure, recent work has only begun to explore the longitudinal association between the two constructs. In one such study, researchers assessed event centrality following bereavement and found that the centrality of participants' loss was a significant predictor of psychopathology 1-year postloss (Boelen, 2012). Although the study did not assess centrality following traumatic injury, this finding suggests that event centrality may impact long-term emotional recovery. In another study, researchers examined the prospective association between event centrality and PTSS in two samples over short periods (Boals & Ruggero, 2016). An undergraduate sample was asked to complete measures related to a prior stressful event and later critical event, with the results showing showed that the centrality of the two events was related, and centrality for the second event was the strongest predictor of PTSS after accounting for earlier centrality. In addition, changes in event centrality and PTSS over 1 month were examined in a second sample to test causal direction, with a cross-lagged panel design demonstrating that centrality as assessed at baseline predicted PTSS 1-month later. Grau et al. (2021) found that baseline event centrality, decreases in event centrality, and baseline PTSS were predictive of decreases in PTSS following a partial hospitalization program for PTSD treatment. Findings from these studies demonstrate a prospective association between earlier ratings of event centrality and later PTSS, whereas the reverse was not significant, indicating that event centrality influences the formation and maintenance of PTSS.

Additional studies have explored centrality and PTSS following traumatic events. Two studies have examined event centrality longitudinally following the 2011 Oslo bombing (Blix et al., 2015; Glad et al., 2020). Glad and colleagues (2020) assessed event centrality at 10- and 22-months posttrauma using a cross-lagged panel model (CLPM). The results demonstrated that PTSS severity and event centrality were positively related at both assessment points such that PTSS prospectively predicted event centrality, but event centrality did not predict PTSS. Distinct from previous findings, this suggests that PTSS plays a role in later event centrality as opposed to event centrality impacting PTSS. On the other hand, Blix and colleagues (2015) assessed individuals exposed to the bombing up to 3 years later and found that event centrality predicted PTSS concurrently as well as at later assessments. Longitudinal studies such as these help to illuminate the association between PTSS and event centrality. Continued understanding of the trajectory of this association, beginning in the acute posttraumatic period and across time, is critical.

One limitation present in previous longitudinal investigations is the use of CLPMs (Boals & Ruggero, 2016; Glad et al., 2020), which have received criticism for their inability to separate stable trait-like differences between individuals from within-person change when assessing associations between target variables (Hamaker et al., 2015). These stable, trait-like factors are time-invariant, and, therefore, it is important to control for them within longitudinal studies that aim to directly assess questions related to directionality. Hamaker and colleagues (2015) proposed an extension of the traditionally used CLPMs to include the creation of random intercepts to represent these stable factors and control for them in investigations of cross-lagged effects. This method is particularly useful in investigations of posttraumatic outcomes, where researchers are seeking to isolate within-person change over time following exposure to a traumatic event.

As such, the current study sought to examine the association between event centrality and PTSS following traumatic injury over time, beginning 3-months posttrauma. Given the paucity of longitudinal literature, we sought to further determine the nature and directionality of the association between event centrality and PTSS. Although event centrality has been shown to be both a correlate and predictor of PTSS, the few studies that have assessed the directionality of this association have produced contradictory findings (Blix et al., 2021; Boals & Ruggero, 2016; Glad et al., 2021); we aimed to extend this work by examining this association in a sample of adult civilians who were

recently traumatically injured. Additionally, we used the random intercept cross-lagged correlation model to examine more directly the influence that within-person change in event centrality and PTSS have on one another over the 18 months following traumatic injury. We hypothesized that PTSS and event centrality would be positively related at each assessment point. Additionally, we hypothesized that earlier ratings of event centrality would predict later PTSS severity but that earlier PTSS severity would not predict later event centrality.

## METHOD

### Participants

Participants were drawn from a larger longitudinal study examining risk and resilience markers for the development of PTSD after injury (Bird et al., 2021; Webb et al., 2021, 2022; Weis, et al., 2021; Weis, Huggins, et al., 2021; Weis, Webb, et al., 2022). Participants for the larger study were recruited from a Level 1 trauma center in a city in the midwestern United States following treatment and discharge from the emergency department (ED) after experiencing a traumatic injury. Eligible participants were adults 18 years of age or older seen in the ED within 1 week following exposure to a traumatic event as defined by PTSD Criterion A PTSD in the *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; APA, 2013). Exclusion criteria were a history of diagnosed PTSD, psychosis, or bipolar disorder; moderate-to-severe cognitive impairment; and evidence that the traumatic injury occurred using self-inflicted methods. Additional exclusion criteria for the parent study were pregnancy and the presence of ferrous artifacts in the body, as participants needed to be safe to enter a magnetic resonance imaging environment for the larger study.

For this secondary analysis, we included participants who had completed at least one assessment that involved a measure of event centrality (i.e., 3-, 12-, and/or 18-months posttrauma follow-ups). Of the 215 eligible and enrolled participants in the larger study, 191 completed data collection for at least one of these three study visits and, therefore, were included in the final analyses. At the 3-month assessment, data were found to be missing for 7.9% of the sample on the Centrality of Event Scale (CES; Berntsen & Rubin, 2006) and 7.3% on the PTSD Checklist for *DSM*-5 (PCL-5; Weathers et al., 2013). At the 12-month assessment, 29.8% of CES scores and 29.3% of PCL-5 scores were missing. At 18 months, 42.9% of the data were missing for the PCL-5 and CES. Attrition analyses revealed no significant differences in PTSS severity or the endorsement of event centrality in participants retained in the study compared with those not retained nor were there any differences in demographic characteristics, including age, gender, or racial and ethnic background. Characteristics for the final sample are detailed in Table 1.

**TABLE 1** Sample demographic characteristics

| Variable | *n* | % |
|---|---|---|
| Gender | | |
| Female | 101 | 52.9 |
| Male | 90 | 47.1 |
| Ethnicity | | |
| Not Hispanic or Latino | 171 | 89.5 |
| Hispanic or Latino | 20 | 10.5 |
| Race | | |
| White | 53 | 27.7 |
| Black or African American | 109 | 57.1 |
| Asian[a] | < 5 | |
| More than one race | 12 | 6.3 |
| Chose not to report | 14 | 7.3 |
| Mechanism of injury | | |
| Motor vehicle crash | 131 | 68.6 |
| Assault/domestic violence | 27 | 14.1 |
| Motorcycle crash | 7 | 3.7 |
| Pedestrian struck | 7 | 3.7 |
| Fall | 6 | 3.1 |
| Gunshot wound[a] | < 5 | |
| Other | 12 6.3 | |

*Note*: $N = 191$.

[a]Exact numbers and percentages are not reported to protect participant confidentiality.

### Procedure

All eligible participants were approached either in the hospital or contacted by phone within 1 week of their injury. Participants were screened, provided written consent, and were enrolled within 3 weeks of their injury, with subsequent data collected at follow-up assessments conducted 3-, 12-, and 18-months posttrauma. All participants completed their study tasks within 2–3 weeks of the targeted assessment point depending on the date of their discharge from the emergency department. At each study session, participants completed self-report measures assessing PTSD symptoms and event centrality and were compensated $50 (USD) for their time. All study activities were overseen and approved by the Institutional Review Board at the Medical College of Wisconsin–Froedtert Hospital in Milwaukee, Wisconsin.

## Measures

### Event centrality

The 20-item CES (Berntsen & Rubin, 2006) was used to assess how central the traumatic event had become to participants' life and identity. The scale is designed to address whether the respondent considers the traumatic event to be an anchor point for their personal narrative in terms of expectations for the future and assessing personal meaning, a central component of their identity, and a personal turning point. Items are rated on a 5-point Likert scale ranging from 1 (*totally disagree*) to 5 (*totally agree*), with scores summed (range: 20–100) and higher scores indicating higher levels of event centrality. In the present sample, reliability was excellent, with Cronbach's alpha values of .93 at 3 months, .95 at 12 months, and .95 at 18 months. Intraclass correlation (ICCs) estimates indicated high consistency across timepoints, with a coefficient of .85, 95% CI [.80, .90], $F(92,184) = 6.91$, $p < .001$.

### PTSD symptoms

The 20-item self-report PCL-5 (Weathers et al., 2013) was used to assess the presence and severity of the 20 symptoms of PTSD determined by the *DSM-5* (APA, 2013). Respondents are asked to endorse their current level of symptom severity on a 5-point Likert scale ranging from 0 (*not at all*) to 5 (*extremely*). Scores are totaled across all items, with potential severity scores ranging from a score of 0 to 80 and higher scores indicating more severe symptoms. Participants were asked to respond to items in reference to symptoms stemming from the traumatic injury that brought them into the ED prior to enrollment. Internal reliability was excellent, with Cronbach's alpha values of .95 at 3-months, .96 at 12-months, and .95 at 18-months posttrauma. ICC estimates indicated high consistency across time, with a coefficient of .87, 95% CI [.82, .91], $F(93, 186) = 7.87$, $p < .001$.

### Demographic characteristics

Gender, age, race and ethnicity, and mechanism of injury (MOI) were collected at recruitment and assessed as potential covariates in the analyses. Bivariate analyses were conducted using independent samples *t* tests to investigate the potential associations between both the CES and PCL-5 and gender; ethnicity (Hispanic vs. non-Hispanic); and MOI, which was dichotomized as assaultive and nonassaultive mechanisms to reflect much of the present research investigating MOI on posttrauma outcomes. Associations with age were assessed using bivariate correlations, and with race using one-way analyses of variance (ANOVAs). Results revealed that demographic characteristics were not significantly associated with scores on the CES or PCL-5 and, therefore, none were entered or adjusted for in the final model.

## Data analysis

Statistical analyses were conducted using R statistical software (Version 4.1.1; R Core Team, 2021). To assess the directionality of centrality and PTSS across time, we used a random intercept cross-lagged panel model (RI-CLPM). This model uses the addition of random intercepts to separate the contributions of stable, trait-like differences between individuals from state-like within-person differences. Traditional cross-lagged panel models do not separate these two, which can result in biased parameter estimates (Hamaker et al., 2015). Following the suggestions of Hamaker and colleagues (2015), two random intercepts were created representing the stable, trait-like effects captured by the CES and PCL-5, with factor loadings constrained to 1.0 to reflect the hypothesized consistency of these effects. We then modeled both autoregressive and cross-lagged regressive coefficients with variances of the coefficients set to 1.0. Error variances of both the observed PCL-5 and CES variables were constrained to 0 to ensure that all variance was captured by the trait- and state-like latent factor structure.

To assess the best model specification to maximize both simplicity and explanatory power, we assessed the fit of three models of varying complexity. In the first model, both autoregressive and cross-lagged effects were allowed to freely vary over the three time points (i.e., unconstrained). In the second model, cross-lagged paths were constrained to be the same across time, whereas autoregressive paths were allowed to freely vary (i.e., partially constrained). The third model fixed both autoregressive and cross-lagged paths to be the same across the 18-month period (i.e., fully constrained). In comparing models, the Bayesian information criterion (BIC) can be used, with the smallest BIC values indicating the best fitting model for the data (Lin et al., 2017). In assessing the three models, the fully constrained model with autoregressive and cross-lagged effects fixed to be the same across time had the lowest BIC, with a value of 6,282.05; the model with both unconstrained autoregressive and cross-lagged effects had the highest BIC value at 6,296.41; and the model with unconstrained autoregressive paths and constrained cross-lagged paths had a BIC that was only slightly lower at 6,290.24. As the fully constrained model yielded the lowest BIC and, therefore, demonstrated the best

**TABLE 2** Means, standard deviations, and correlations between Centrality of Event Scale (CES) and PTSD Checklist for DSM-5 (PCL-5) scores

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | *M* | *SD* |
|---|---|---|---|---|---|---|---|---|
| 1. 3-month PCL-5 | – | .73** | .64** | .70** | .67** | .57** | 25.05 | 17.42 |
| 2. 12-month PCL-5 | | – | .72** | .51** | .63** | .56** | 19.34 | 17.79 |
| 3. 18-month PCL-5 | | | – | .40** | .40** | .55** | 17.57 | 17.38 |
| 4. 3-month CES | | | | – | .67** | .65** | 16.92 | 8.82 |
| 5. 12-month CES | | | | | – | .64** | 16.12 | 9.65 |
| 6. 18-month CES | | | | | | – | 15.90 | 8.12 |

*Note*: $N = 191$. All p values are two-tailed. PTSD = posttraumatic stress disorder; *DSM-5* = *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.).
**$p < .01$.

fit for the data, this model was chosen to test our hypotheses.

Multiple traditional fit indices were used to assess the final constrained model, including the Tucker–Lewis Index (TLI), comparative fit index (CFI), and the root mean square error of approximations (RMSEA; Hu & Bentler, 1999). CFI and TLI fit indices compare a baseline model that assumes the variables have no covariance (i.e., "worst-fitting" model) to the specified user model. As a ratio between these two models, the CFI and TLI values typically range between 0 and 1.0. Values greater than .90 indicate a higher degree of difference between the user model and the baseline model, therefore indicating a good fit. The RMSEA index is used to compare the user model to the observed data such that an RMSEA value closer to 0 indicates a better fit, with previously established benchmarks proposing that values under .05 are considered to demonstrate reasonable fit and values under .08 are considered to demonstrate an acceptable fit (Browne et al., 1993). Maximum likelihood was used to estimate all parameters. As missing data were found to occur at random, full information maximum likelihood techniques were used to account for missing data. This was performed using the *lavaan* package in R as specified under the fit model structure commands prior to model estimation.

## RESULTS

Mean values, standard deviations, and correlations for CES and PCL-5 scores at all time points are given in Table 2. Correlations between all variables were significant at the .01 level. An RI-CLPM was fit to assess the directionality of event centrality and PTSD symptom severity over the 18-month posttrauma period. The results of the chi-square test assessing model fit indicated that this model was a good fit for the data, $\chi^2(4, N = 191) = 3.29$, $p = .495$. Additional model fit indices suggested the model was a good fit as well, CFI = 1.0, TLI = 1.01, RMSEA = .00. Figure 1 illustrates the model as a whole, with coefficients for the (a) cross-sectional paths, (b) autoregressive paths, (c) cross-lagged paths, and (d) correlations of random intercepts shown for both variables. The correlation between the trait-like CES and PCL-5 latent variables indicated a stable and moderately strong association between the event centrality and PTSS symptom severity latent variables, $r = 0.72$, $p < .001$. The autoregressive association between PCL-5 scores over time was significant, $B = 0.42$, $p = .021$; however, the autoregressive association between CES scores over time was not significant, $B = 0.03$, $p = .851$. This suggests a less-stable intrapersonal association in within-person change in event centrality over the 18-month posttrauma period.

Cross-lagged regression coefficients examining the pathway from CES to PCL-5 scores over time, $B = -0.27$, $p = .340$, were not significant; however, the pathway from PCL-5 to CES scores over time was significant, $B = 0.16$, $p = .021$. In other words, participants who scored higher on the PCL-5 at earlier assessments were more likely to score higher on the CES at later assessments, but scoring higher on CES at earlier assessments was not related to scoring higher on the PCL-5 later. Thus, during the 18-month posttraumatic period, PTSS significantly predicted event centrality, but event centrality did not predict PTSS.

## DISCUSSION

To our knowledge, this was the first study to examine changes in event centrality starting 3 months following a traumatic injury. In this unique sample of traumatically injured adults, we found that event centrality and PTSS severity were highly correlated across time. More specifically, on average, both event centrality and PTSS tended to decrease, and the cross-sectional correlation between centrality and PTSS decreased somewhat over time. Further, we found that PTSS predicted later event centrality but not vice versa.

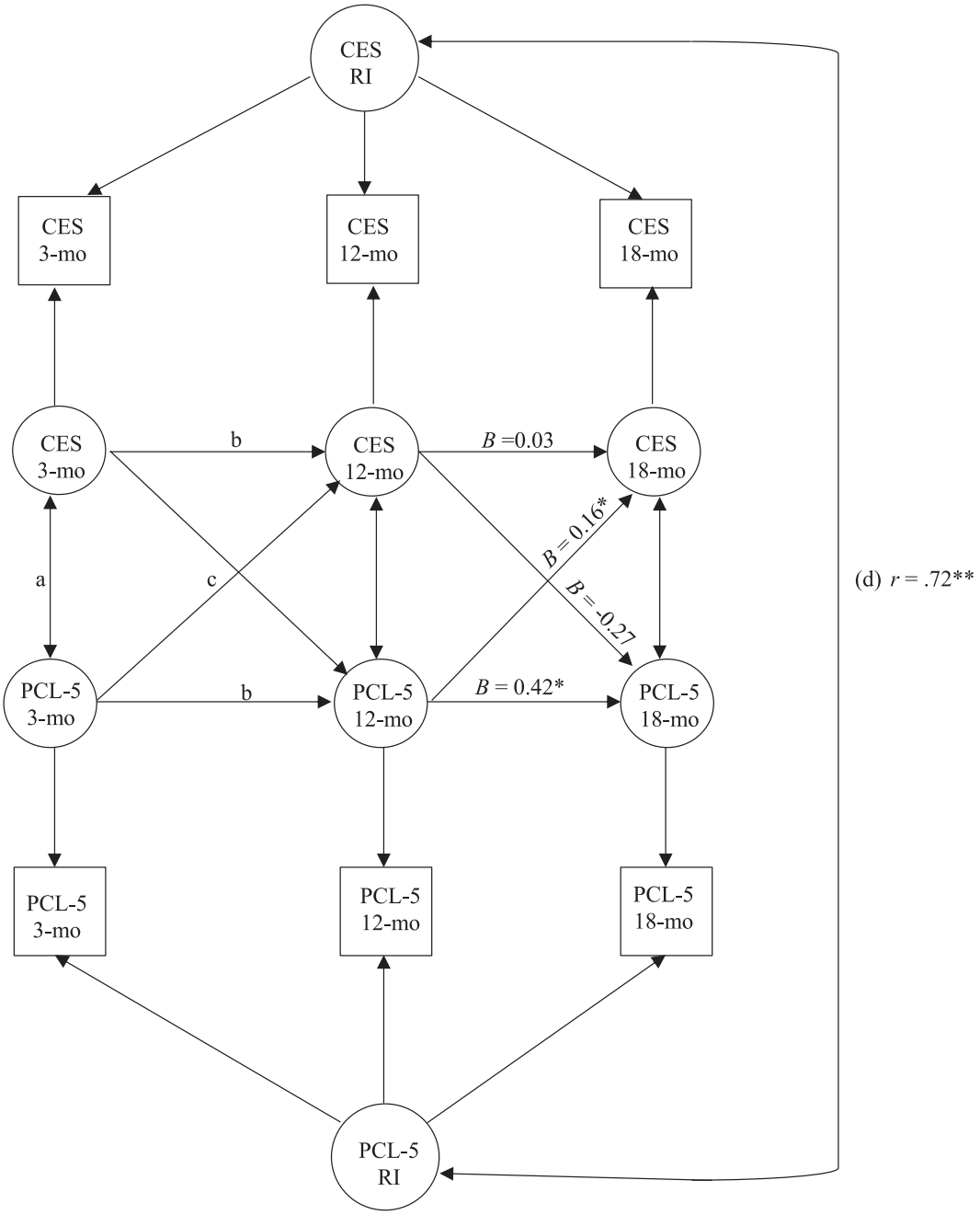


**FIGURE 1** Random intercept (RI) cross-lagged panel model assessing the direction of the longitudinal association between Centrality of Event Scale (CES) and PTSD Checklist for *DSM-5* scores over 18 months posttrauma

*Note*: Paths are denoted by (a) cross-sectional paths, (b) autoregressive paths, (c) cross-lagged paths, and (d) correlations between stable traits of event centrality and posttraumatic stress disorder (PTSD) symptoms at the between-person level. Squares represent observed variables; circles represent latent variables. Unstandardized beta coefficients are noted in the latent variable paths and are constrained by time, representing change over the entire 18-month follow-up period. Mo = month. *$p < .05$. **$p < .01$.

Past research has generally presumed that events perceived as more central to an individual's life are more likely to lead to PTSS rather than the opposite directionally (i.e., PTSS leading to perceptions of centrality). As longitudinal and intervention studies have emerged, the findings have been mixed. For instance, several longitudinal studies have demonstrated that centrality can lead to later PTSS (e.g., Boelen, 2012; Blix et al., 2016; Boals & Ruggero, 2016; Grau et al., 2021), but others have found the opposite (Glad et al., 2020) or have reported unclear directionality (Johanβen et al., 2021). Based on the hypothesis that centrality predicts PTSD, several studies have

also been designed to directly manipulate event centrality to decrease PTSD symptom severity. The results of these intervention studies directly targeting centrality have also been mixed, with one finding that decreasing centrality leads to corresponding decreases in PTSS (Boals & Murrell, 2016) and others finding that decreasing centrality did not lead to a decrease in PTSS (Boals et al., 2015; Vermeulen et al., 2018).

There are several possible explanations for why we observed that PTSS predicted centrality in the present sample even though early literature suggests the opposite. One possibility raised by Glad et al. (2020) is that different studies have examined the association between PTSD and event centrality during different timeframes, which can affect longitudinal findings. In addition, the current study was the first to examine this association longitudinally in the acute period following traumatic injury. Although the PCL-5 can measure fluctuations in PTSS severity over time, it may take longer for perceptions of event centrality to be consolidated and change a person's view of themselves and their lives. Establishing the trajectory of how event centrality develops in the acute posttrauma period is an area in need of further research, as understanding its progression could aid in clarifying the contradictory literature assessing directionality. It is also possible that the timing matters in a different way: Berntsen and Rubin (2007) originally argued that events can become central to a person's life when the memories are highly distinctive and emotional. This, in turn, leads to higher integration into one's sense of self, which may cause more maladaptive cognitions, higher perception of other future threats, and avoidance of such threats and events that are perceived as related to the event. Within this framework, higher centrality leads to later symptoms. It is possible that in the early posttrauma period, the directionality is the opposite such that symptoms themselves, whether nonclinical symptoms of acute stress disorder or early symptoms of PTSD, can signal to a survivor that an event is, in fact, more important than they may have initially assessed (i.e., higher symptom levels lead to later perceptions of centrality).

It is also possible that the association between centrality and PTSS varies by event type (or types for individuals exposed to multiple traumatic events). For instance, in the case of a terrorist bombing (Blix et al., 2016), people may assume that this event will be influential on their lives, and, indeed, traumas involving a human perpetrator are generally more predictive of PTSD (Kessler at al., 2017). In the present sample, motor vehicle crash was the most common MOI, a relatively more common event from which people may assume they will recover quickly. With this form of trauma exposure, it is possible that when individuals find themselves having early symptoms (e.g., nightmares, hypervigilance), they may be surprised and dismayed to discover that they are not "just moving on" and, thus, start to interpret an event as more central. Over time, as centrality and PTSD both stabilize, it is possible the association becomes more bidirectional or that ongoing interpretations of centrality influence changes in chronic PTSD. Future research conducted in the early posttrauma period following different types of events can help illuminate whether the findings in this sample generalize to other trauma types or populations. Future work is also needed to better understand centrality and any possible clinical implications related to its association with PTSS. As noted by Webermann et al. (2020), if centrality does lead to PTSD, then centrality itself is an important intervention target; however, if centrality is merely a byproduct of PTSD, interventions focused on centrality itself may not be clinically helpful. Johanβen et al. (2021) found bidirectional associations between centrality and PTSD that were partially mediated by negative cognitions and reasoned that it may be more helpful to intervene by shifting the valence of a central event rather than reducing centrality per se. That is, rather than aiming to reduce the importance of the event, it may be helpful to shift thinking (e.g., from "This event means I am weak" to "This event points to danger but made me realize I can overcome adversity"). Given that some studies have found associations between centrality and both PTSD and posttraumatic growth (Schuettler & Boals, 2011; Groleau et al., 2013; Steinberg et al., 2021), it may be worth understanding how centrality can be transformed (Johanβen et al., 2021) and related to different kinds of outcomes, both positive and negative. This is also consistent with recent calls for future work to explore interventions targeting cognitions about one's self and traumatic experiences via strategies from Acceptance and Commitment Therapy (Boals et al., 2021).

There are some limits to the generalizability of these findings. The sample was relatively homogenous regarding injury type, with most injuries resulting from motor vehicle crashes. Although investigations of the influence of event type on subsequent event centrality have produced mixed findings (Chung et al., 2018; Wamser-Nanney et al., 2017; Wamser-Nanney, 2019), the homogeneity of the present sample may limit broader conclusions. Likewise, the level of PTSS severity was relatively low and, indeed, not all participants were diagnosed with PTSD nor had clinically relevant levels of trauma-related symptoms. It is important to note, however, that individuals who experience subthreshold PTSS have still been shown to be at risk for difficulties in posttraumatic functioning, suicidal ideation, and psychiatric comorbidities (Brancu et al., 2016). Another notable limitation is the lack of variability in terms of how much event centrality and PTSS changed over time in the present sample. In particular,

centrality changed very little from 3-months to 18-months posttrauma. It may be that there was not enough variation in event centrality over the 18-month period to assess its ability to predict PTSS over time in this sample. Additionally, we assessed PTSS using self-report measures rather than a standardized clinical interview, which is the gold standard for assessing PTSD symptoms following trauma exposure. Although to date, the present study includes the longest posttraumatic period within the existing literature, the first assessment was conducted 3-months posttrauma. The acute period following traumatic injury is key to the formation of negative cognitions and trauma-related symptoms; future research assessing change in these variables in the days and weeks postinjury may yield a clearer picture of how event centrality and PTSS influence one another. Finally, to fully understand the association between event centrality and PTSS, it will be important to include other potentially relevant variables, such as the valence of the centrality or prior trauma exposure (Groleau et al. 2013).

This study highlights the need to understand event centrality following traumatic injury. Existing research has identified that event centrality plays an important role in posttraumatic distress and recovery, yet recent longitudinal and intervention studies have shown a mixed picture in terms of what exactly that association may be. The current study shows that PTSS tend to decrease over time after an initial injury and that this decrease predicts later decreases in event centrality. More research is needed to assess acute and long-term interactions between these constructs to better understand how to facilitate recovery.

## OPEN PRACTICES STATEMENT

The study reported in this article was not formally preregistered. Neither the data nor the materials have been made available on a permanent third-party archive; requests for the data or materials should be sent via email to the lead author at damianos@uci.edu.

## AUTHOR NOTE

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## REFERENCES

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Author.

Barton, S., Boals, A., & Knowles, L. (2013). Thinking about trauma: The unique contributions of event centrality and posttraumatic cognitions in predicting PTSD and posttraumatic growth. *Journal of Traumatic Stress*, *26*(6), 718–726. https://doi.org/10.1002/jts.21863

Berntsen, D., & Rubin, D. C. (2007). When a trauma becomes a key to identity: Enhanced integration of trauma memories predicts posttraumatic stress disorder symptoms. *Applied Cognitive Psychology*, *21*(4), 417–431. https://doi.org/10.1002/acp.1290

Bird, C. M., Webb, E. K., Schramm, A. T., Torres, L., Larson, C., & deRoon-Cassini, T. A. (2021). Racial discrimination is associated with acute posttraumatic stress symptoms and predicts future posttraumatic stress disorder symptom severity in trauma-exposed Black adults in the United States. *Journal of Traumatic Stress*, *34*(5), 995–1004. https://doi.org/10.1002/jts.22670

Blix, I., Birkeland, M. S., Hanse, M. B., & Heir, T. (2015). Posttraumatic growth and centrality of event: A longitudinal study in the aftermath of the 2011 Oslo bombing. *Psychological Trauma*, *7*(1), 18–23. https://doi.org/10.1037/tra0000006

Boals, A., & Murrell, A. R. (2016). I am >trauma: Experimentally reducing event centrality and PTSD symptoms in a clinical trial. *Journal of Loss and Trauma*, *21*(6), 471–483. https://doi.org/10.1080/15325024.2015.1117930

Boals, A., & Ruggero, C. (2016). Event centrality prospectively predicts PTSD symptoms. *Anxiety, Stress & Coping: An International Journal*, *29*(5), 533–541. https://doi.org/10.1080/10615806.2015.1080822

Boals, A., Griffith, E., & Southard-Dobbs, S. (2021). A call for intervention research to reduce event centrality in trauma-exposed individuals. *Journal of Loss and Trauma*, *26*(1), 1–15. https://doi.org/10.1080/15325024.2020.1734744

Boelen, P. A. (2012). A prospective examination of the association between the centrality of a loss and post-loss psychopathology. *Journal of Affective Disorders*, *137*(1–3), 117–124. https://doi.org/10.1016/j.jad.2011.12.004

Brancu, M., Mann-Wrobel, M., Beckham, J. C., Wagner, H. R., Elliott, A., Robbins, A. T., Wong, M., Berchuck, A. E., & Runnals, J. J. (2016). Subthreshold posttraumatic stress disorder: A meta-analytic review of *DSM–IV* prevalence and a proposed *DSM–5* approach to measurement. *Psychological Trauma: Theory, Research, Practice, and Policy*, *8*(2), 222–232. https://doi.org/10.1037/tra0000078

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). SAGE.

Chung, M. C., Shakra, M., AlQuarni, N., AlMazrouei, M., Al Mazrouei, S., & Al Hashimi, S. (2018). Posttraumatic stress among Syrian refugees: Trauma exposure characteristics, trauma centrality, and emotional suppression. *Psychiatry*, *81*(1), 54–70. https://doi.org/10.1080/00332747.2017.1354620

deRoon-Cassini, T. A., Mancini, A. D., Rusch, M. D., & Bonanno, G. A. (2010). Psychopathology and resilience following traumatic injury: A latent growth mixture model analysis. *Rehabilitation Psychology*, *55*(1), 1–11. https://doi.org/10.1037/a0018601

Grau, P. P., Larsen, S. E., Lancaster, S. L., Garnier-Villarreal, M., & Wetterneck, C. T. (2021). Change in event centrality and posttraumatic stress disorder symptoms during intensive treatment. *Journal of Traumatic Stress*, *34*(1), 116–123. https://doi.org/10.1002/jts.22541

Gehrt, T. B., Berntsen, D., Hoyle, R. H., & Rubin, D. C. (2018). Psychological and clinical correlates of the Centrality of Event Scale: A systematic review. *Clinical Psychology Review*, *65*, 57–80. https://doi.org/10.1016/j.cpr.2018.07.006

Glad, K. A., Czajkowski, N. O., Dyb, G., & Hafstad, G. S. (2020). Cross-lagged association between symptoms of posttraumatic stress disorder and perceived centrality of a terrorist attack. *Clinical Psychological Science*, *8*(2), 295–305. https://doi.org/10.1177/2167702619873590

Groleau, J. M., Calhoun, L. G., Cann, A., & Tedeschi, R. G. (2013). The role of centrality of events in posttraumatic distress and posttraumatic growth. *Psychological Trauma: Theory, Research, Practice, and Policy*, *5*(5), 477–483. https://doi.org/10.1037/a0028809

Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods*, *20*(1), 102–116. https://doi.org/10.1037/a0038889

Hunt, J. C., Sapp, M., Walker, C., Warren, A. M., Brasel, K., & deRoon-Cassini, T. A. (2017). Utility of the Injured Trauma Survivor Screen to predict PTSD and depression during hospital admission. *Journal of trauma and acute care surgery*, *82*(1), 93–101. https://doi.org/10.1097/TA.0000000000001306

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1–55. https://doi.org/10.1080/10705519909540118

Johanßen, H., Schoofs, N., Kliegl, R., Bermpohl, F., Ülsmann, D., Schulte-Herbrüggen, O., & Priebe, K. (2021). Negative posttraumatic cognitions color the pathway from event centrality to posttraumatic stress disorder symptoms. *Cognitive Therapy and Research*, *46*(2), 333–342. https://doi.org/10.1007/s10608-021-10266-w

Kessler, R. C., Aguilar-Gaxiola, S., Alonso, J., Benjet, C., Bromet, E. J., Cardoso, G., Degenhardt, L., de Girolamo, G., Dinolova, R. V., Ferry, F., Florescu, S., Gureje, O., Haro, J. M., Huang, Y., Karam, E. G., Kawakami, N., Lee, S., Lepine, J. -P., Levinson, D., & Koenen, K. C. (2017). Trauma and PTSD in the WHO World Mental Health Surveys. *European Journal of Psychotraumatology*, *8*(supp5), 1353383. https://doi.org/10.1080/20008198.2017.1353383

Lin, L., Huang, P., & Weng, L. (2017). Selecting path models in SEM: A comparison of model selection criteria. *Structural Equation Modeling: A Multidisciplinary Journal*, *24*(6), 855–869. https://doi.org/10.1080/10705511.2017.1363652

R Core Team. (2021). *R: A language and environment for statistical computing* [Software program]. R Foundation for Statistical Computing. https://www.R-project.org/

Schuettler, D., & Boals, A. (2011). The path to posttraumatic growth versus posttraumatic stress disorder: Contributions of event centrality and coping. *Journal of Loss and Trauma*, *16*(2), 180–194. https://doi.org/10.1080/15325024.2010.519273

Steinberg, M. H., Bellet, B. W., McNally, R. J., & Boals, A. (2022). Resolving the paradox of posttraumatic growth and event centrality in trauma survivors. *Journal of Traumatic Stress*, *35*(2), 434–445. https://doi.org/10.1002/jts.22754

Vermeulen, M., Brown, A. D., Raes, F., & Krans, J. (2019). Decreasing event centrality in undergraduates using cognitive bias modification of appraisals. *Cognitive Therapy and Research*, *43*(1), 214–225. https://doi.org/10.1007/s10608-018-9936-3

Wamser-Nanney, R., Howell, K. H., Schwartz, L. E., & Hasselle, A. J. (2017). The moderating role of trauma type on the relationship between event centrality of the traumatic experience and mental health outcomes. *Psychological Trauma: Theory, Research, Practice, and Policy*, *10*(5), 499–507. http://doi.org/10.1037/tra0000344

Wamser-Nanney, R. (2019). Event centrality: Factor structure and links to posttraumatic stress disorder symptom clusters. *Journal of Traumatic Stress*, *32*(4), 516–525. https://doi.org/10.1002/jts.22413

Weathers, F. W., Litz, B. T., Keane, T. M., Palmier, P. A., Marx, B. P., & Schnurr, P. P. (2013). *The PTSD checklist for DSM-5 (PCL-5)*. https://www.ptsd.va.gov/professional/assessment/adult-sr/ptsd-checklist.asp

Webb, E. K., Weis, C. N., Huggins, A. A., Fitzgerald, J. M., Bennett, K., Bird, C. M., Parisi, E. A., Kallenbach, M., Miskovich, T., Krukowski, J., deRoon-Cassini, T., & Larson, C. L. (2021). Neural impact of neighborhood socioeconomic disadvantage in traumatically injured adults. *Neurobiology of Stress*, *15*, 100385. https://doi.org/10.1016/j.ynstr.2021.100385

Webb, E. K., Weis, C. N., Huggins, A. A., Parisi, E. A., Bennett, K. P., Miskovich, T., Krukowski, J., deRoon-Cassini, T. A., & Larson, C. L. (2021). Neighborhood disadvantage is associated with stable deficits in neurocognitive functioning in traumatically-injured adults. *Health & place*, *67*, 102493. https://doi.org/10.1016/j.healthplace.2020.102493

Webb, E. K., Bird, C. M., deRoon-Cassini, T. A., Weis, C. N., Huggins, A. A., Fitzgerald, J. M., Miskovich, T., Bennett, K., Krukowski, J., Torres, L., & Larson, C. L. (2022). Racial discrimination and resting-state functional connectivity of salience network nodes in trauma-exposed Black Adults in the United States. *JAMA Network Open*, *5*(1), e2144759. https://doi.org/10.1001/jamanetworkopen.2021.44759

Webermann, A. R., Maldonado, A., Singh, R., Torres, S., Bushee, S., & Murphy, C. M. (2020). Centrality of traumatic events and men's intimate partner violence perpetration. *Psychological Trauma: Theory, Research, Practice, And Policy*, *12*(2), 200–206. https://doi.org/10.1037/tra0000497

Weis, C. N., Huggins, A. A., Miskovich, T. A., Fitzgerald, J. M., Bennett, K. P., Krukowski, J. L., Webb, E. K., deRoon-Cassini, T. A., & Larson, C. L. (2021). Acute white matter integrity post-trauma and prospective posttraumatic stress disorder symptoms. *Frontiers in Human Neuroscience*, *15*, 742198. https://doi.org/10.3389/fnhum.2021.742198

Weis, C. N., Webb, E. K., Stevens, S. K., Larson, C. L., & deRoon-Cassini, T. A. (2021). Scoring the Life Events Checklist:

Comparison of three scoring methods. *Psychological Trauma: Theory, Research, Practice, and Policy*, *4*(4), 714–720. https://doi.org/10.1037/tra0001049

Wolfe, T., & Ray, S. (2015). The role of event centrality, coping and social support in resilience and posttraumatic growth among women and men. *International Journal of Mental Health Promotion*, *17*(2), 78–96. https://doi.org/10.1080/13642529.2015.1008799

Zatzick, D., Jurkovich, G. J., Rivara, F. P., Wang, J., Fan, M. Y., Joesch, J., & Mackenzie, E. (2008). A national U.S. study of posttraumatic stress disorder, depression, and work and functional outcomes after hospitalization for traumatic injury. *Annals of Surgery*, *248*(3), 429–437. https://doi.org/10.1097/SLA.0b013e318185a6b

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