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The memory-experience gap for PTSD symptoms: The correspondence between experience sampling and past month retrospective reports of traumatic stress symptoms

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ABSTRACT

Posttraumatic stress disorder assessments typically require individuals to provide an aggregate report on the frequency or severity of symptoms they have experienced over a particular time period. Yet retrospective aggregate assessments are susceptible to memory recall and retrieval difficulties. This study examined the correspondence between a month of real-time experience sampling methodology (ESM) reports of traumatic stress symptoms and a retrospective assessment of past-month traumatic stress symptoms for that same period. Participants were a convenience community sample (*n*=96) from Southern and Central Israel exposed to rocket fire during the Israel-Gaza July-Aug 2014 conflict. Participants provided ESM reports on traumatic stress symptoms twice a day for 30 days via smartphone. Average ESM scores, rather than peak or most recent reports, were most highly correlated with retrospective assessments. For individual symptoms, concentration difficulties had the highest correspondence between ESM and retrospective reports, while amnesia had the lowest correspondence. Regression analysis found that average ESM scores and younger age significantly predicted past-month retrospective assessments of PTSD symptoms. Additionally, previously experiencing more types of trauma predicted PTSD symptoms, but did not moderate the relationship between ESM and retrospective assessments. These findings have implications for assessment.

Introduction

A diagnosis of posttraumatic stress disorder (PTSD) requires that symptoms should last for at least several weeks (ICD-11; World Health Organization, 2018) or one month (DSM-5; APA, 2013). In line with these criteria, standard assessment tools typically require individuals to provide an aggregate report on the frequency or severity of the symptoms they have experienced recently. Yet studies across a variety of disorders have found that retrospective reports of symptoms and experiences do not always reliably reflect participants' real-time reports of their symptoms (Ben-Zeev et al., 2009; De Beurs et al., 1992; Stone et al., 2005). The lack of consistency between experiences and their subsequent recall, or recall bias, has been termed the 'memory-experience gap' (Miron-Shatz et al., 2009). Trauma-related symptoms, including PTSD, may be especially susceptible to memory recall and retrieval difficulties (Harvey and Bryant, 2000; Nahleen et al., 2019). This raises the question whether asking individuals to recall symptoms over the past month is a reliable way to assess for PTSD in the first place.

Several factors contribute to the memory-experience gap related to the recall of symptoms and other experiences. First, individuals employ heuristic strategies to construct their responses, which can inadvertently bias their self-report (Bradburn et al., 1987; Shiffman et al., 2008). These include a tendency to recall the worst experiences of the period (i.e., severity bias), or their most recent experiences (i.e., recency bias; Schneider and Stone, 2016; Shiffman et al., 2008). Second, recall of psychological symptoms as well as content can be related to that

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individual's current mood (Levine et al., 2009; Nahleen et al., 2019), consistent with the mood-congruency theory (Bower, 1981). Finally, mental symptoms, including PTSD symptoms can be variable from one day to the next (Naragon-Gainey et al., 2012; Black et al. 2018), which could increase severity and recency effects.

Difficulties with retrospective recall of symptoms may be especially relevant for PTSD symptoms (Westermeyer et al., 2015). Memory processes are involved in the acquisition and/or maintenance of PTSD symptoms (Brewin and Holmes, 2003; Foa and Kozak, 1986), and several theories support PTSD's characterization as a disorder of memory (Halligan et al., 2002). For instance, cognitive theories of PTSD suggest that difficulties with perceptual cognitive processing may lead to disorganized trauma memories, which prevents integration and contextualization of these memories (Ehlers and Clark, 2000; Halligan et al., 2002). Key memory-related features of PTSD include deliberate avoidance of memories related to the trauma, and an inability to recall key features of the traumatic event (APA, 2013). Furthermore, individuals with higher levels of PTSD symptoms may have difficulty remembering symptoms and reactions related to their traumatic experience (Harvey and Bryant, 2000).

Trauma exposure itself might contribute to the memory-experience gap. There is evidence that exposure to multiple traumas has a greater post-trauma impact both on symptoms (Contractor et al., 2018a) and on difficulties recalling specific details of new traumatic experiences and related symptoms (Ono et al., 2016; Williams et al., 2007). Therefore, it is important to examine whether having experienced more trauma types moderates the memory-experience gap between ESM reports and retrospective assessments.

Experience sampling and PTSD

The last decade has seen a rising interest in studies utilizing real-time daily life reports, often referred to as experience sampling methodology (ESM) or ecological momentary assessment (EMA). In such studies, reports of symptoms and experiences are made by participants in their daily lives (Csikszentmihalyi and Larson, 2014; Schwarz, 2012). Examining the correspondence of real-time daily life reports of PTSD symptoms with a retrospective aggregate report provided at the end of that same time period could clarify the extent to which individuals accurately report their past month symptoms.

Only a few studies have examined the memory-experience gap for PTSD symptoms via an assessment of the correspondence of daily life ESM PTSD symptom reports over a particular time period with a retrospective summary assessment for that same time period (Carlson et al., 2016; Decker et al. 2021;Naragon-Gainey et al., 2012; Schuler et al., 2019; Westermeyer et al., 2015). Naragon-Gainey et al. (2012) used the 17-item PTSD Checklist (PCL) for DSM-IV for both the daily and retrospective assessment among their participants (*n*=132), finding high correspondence between retrospective assessments and mean daily reports, both for total scores and for the three individual DSM-IV symptom clusters. In a smaller study (n=17), Westermeyer et al. (2015) found a high correlation between the overall mean of daily assessments of PTSD symptoms over a one-month period (via a measure of 3 PTSD symptoms) and a retrospective assessment (17-item PCL for DSM-IV), with slightly weaker correlations for both the most severe daily report and more recent reports. Carlson et al. (2016) found a very high correspondence between participants' daily-life reports (n=62) made four times a day over a seven-day period, and retrospective assessment of the DSM-IV based 17-item Screen for Posttraumatic Stress Symptoms (SPTSS), although they did not examine whether there were severity or recency effects.

Only Schuler et al. (2019) and Decker et al. (2021) investigated DSM-5 rather than DSM-IV PTSD symptoms. Schuler et al. (2019), queried participants (*n*=202) three times a day over seven days. In contrast to Westermeyer et al., they found the highest level of congruence for peak (most severe) scores during the assessment period and

retrospective reports, rather than the overall mean of daily reports. It should be noted, however, that while this study used the 20-item PCL for DSM-5 (Weathers et al., 2013) for the retrospective report, they only examined eight symptoms in the EMA questionnaires. Decker et al. (2021) assessed participants (n=35) three times a day for 28 days using a modified version of the PCL-5 comprising all 20 items for the daily assessments, and then used the PCL-5 to assess past month symptoms, finding that peak scores were most highly correlated with retrospective scores.

The mixed findings from these studies regarding whether average ESM levels, peak scores, or most recent reports are the best predictors of retrospective assessments, may be due to differences across studies, such as the measures used for ESM and retrospective assessments, number of overall and daily ESM assessment points, sample size (i.e., sampling variability), and nature of sample. In addition, only one of these studies used the 20-item PCL-5 for the daily assessments, which limits the ability to judge the reliability of DSM-5 PTSD symptom recall, as well as preventing a symptom-specific examination of recall accuracy, which crucially requires a match between ESM and retrospective assessments.

The current study aimed to build on the existing literature, first by replicating the comparison of the daily life and retrospective approaches, and then expanding on this by taking a symptom-specific approach to examine the question of which PTSD symptoms are better recalled; a research question that has not yet been examined, as well as examining the role of prior trauma exposure as a potential moderator. Specifically the study examined, during a one-month period of trauma exposure: 1) whether past-month ESM reports, most severe 'peak' reports, or most recent 'last-day' reports were most highly correlated with retrospective assessments; 2) whether there were individual PTSD symptoms that were better or worse recalled, with no a priori hypotheses; and 3) whether previously experiencing more trauma types moderated the association between ESM and retrospective reports of PTSD symptoms.

Methods

Procedure

This study formed part of a larger prospective longitudinal study that used multiple bursts of ESM data collection during and after the 2014 Israel-Gaza Conflict (Gelkopf et al., 2017; Greene 2018; Greene et al., 2020; Greene et al., 2017). The conflict lasted 50 days, and participants entered the study between days 8-24. On entry to the study, they completed a questionnaire. Starting the next day, they completed ESM questionnaires via smartphones for 30 days (twice daily - morning and evening at predetermined times), using the online Qualtrics platform (www.qualtrics.com), and could respond within two hours. Each questionnaire assessed symptoms and experiences that had taken place since the previous questionnaire. The day after completing the ESM phase, participants completed a questionnaire that asked participants to report their symptom levels over the previous month. Participants were remunerated $150 for their participation. The study was approved by the University of Haifa Ethics Committee.

Participants

The participants comprised a community sample from Southern and Central Israel who lived in areas exposed to rocket fire during the Israel-Gaza July-Aug 2014 conflict. They were recruited during the conflict itself through advertisements posted on community, organizational and social networking websites and local noticeboards. Potential participants were invited to contact the research team via telephone; research personnel provided an explanation of the study and obtained informed consent from participants (n=114). Participants entered the study gradually, and began providing ESM reports on days 8 to 24 of the conflict. For demographic details of the participants, see Table 1.

Table 1

Demographic and main study variables (N=96)

		N (%)	M (SD)
Gender	Man	28 (29.2)	
	Woman	68 (70.8)	
Marital status	Single	29 (30.2)	
	In a relationship	67 (69.8)	
Children	Yes	40 (41.7)	
	No	56 (58.3)	
Religion	Jewish	94 (97.9)	
	Other	2 (2.1)	
Financial status	Below average	37 (38.5)	
	Average	45 (46.9)	
	Above average	14 (14.6)	
Education (years)			14.24 (2.67)
Age			30.07 (9.03)
Count of trauma types			2.02 (1.41)
Probable PTSD	Yes	7 (7.3)	
	No	89 (92.7)	

Measures

Pre-ESM Phase

Demographics. Participants reported their gender, age, relationship status, years of education, and financial status (operationalised by asking how participants rated their financial status in relation to those around them; see Table 1).

Trauma Exposure History. Participants completed a Hebrew version of the Trauma History Screen, a brief measure in which participants report their exposure to different types of traumatic events (Carlson et al., 2011). The measure was translated into Hebrew, and then back-translated into English. Trauma exposure history was operationalised by a count of the number of different trauma types previously experienced.

ESM Phase

Real-time Traumatic Stress Symptoms. We assessed traumatic stress symptoms using a modified Hebrew version (Greene et al., 2018) of the self-report PTSD 20-item Checklist for DSM-5 (PCL-5) (Weathers et al., 2013). The original tool was successfully translated and back-translated, and the timeframe for experiencing each symptom was changed from "in the past month" to "since the last time you replied" (minimum 8 hours). The Likert scale was changed from 5 to 4 points (0 = "not at all", to 3 = "a great deal") to be consistent with the response options to other ESM items in order to reduce participant burden (Greene et al., 2018). Total PCL-5 scores were computed as the sum of all item scores.

Past month retrospective assessment (the day after the ESM phase)

PTSD Symptoms. We assessed PTSD symptoms using the modified Hebrew version (Greene et al., 2018) of the self-report PTSD 20-item Checklist for DSM-5 (PCL-5) (Weathers et al., 2013), as described above, but with the time frame as in the original version ("in the past month"). Total PCL-5 scores were computed as the sum of all item scores. This assessment was completed the day after the final ESM questionnaire. To identify those meeting criteria for PTSD, we used scores of 2="moderately" and 3 "a great deal' to indicate endorsement of an item (equivalent to the original scale cutoffs of 2='moderately" or higher), and followed the DSM-5 diagnostic algorithm of endorsement of at least 1 item from each of the intrusions and avoidance clusters, and 2 items from each of the negative mood and cognitions cluster, and the alterations in arousal and reactivity cluster.

Data Analyses

For the current study, we used data from the pre-ESM, ESM, and the post-ESM questionnaires. Data were analysed using R 3.5.3. For means and standard deviations of ESM and retrospective PTSD symptoms, see supplementary table 1. For the correspondence between the ESM and retrospective reports, we report Spearman correlations due to the ordinal nature of the items. To examine whether count of trauma types moderated the relationship between ESM and retrospective scores, we conducted a regression analysis with an interaction term, after mean-centering the variables and controlling for gender and age, using the jtools package in R. A total of 114 participants were recruited, of them 112 (98.2%) completed at least one ESM assessment. We included data from participants completing 20 or more assessments (1/3 of potential assessments). In total, 84.2% participants (n=96) met this inclusion criteria, with 4723 questionnaires in total. All of these 96 participants also completed the retrospective PCL-5 assessment with no missing data.

Results

We conducted Spearman correlation analyses to examine associations between the past-month retrospective score for each individual PCL-5 item and: 1) mean ESM score for each individual PCL-5 item; 2) the last-day ESM score for each individual PCL-5 item; and 3) the peak ESM score for each individual PCL-5 item (see Table 2). The correlations were significant for all analyses.

To examine whether trauma history count moderated the relationship between ESM reports and retrospective assessments we conducted a regression analysis, controlling for gender and age (Table 3). The model explained 68% of the variance in past month PCL-5 total scores. This showed that the overall mean ESM PCL-5 total score was a significant predictor of past-month PCL-5 total score, together with age, and trauma history (count of prior trauma exposure types). However, the interaction

Table 2

Spearman correlations of ESM scores with past month retrospective PCL-5

	Retrospective symptom scores with mean ESM symptom	Retrospective symptom with last-day ESM symptom scores	Retrospective symptom with peak ESM symptom
ESM PCL-5 total score	.80**	.63**	.70**
Memories	.68**	.28*	.54**
Nightmares	.74**	.33**	.64**
Flashbacks	.62**	.36**	.53**
Emotional cues	.68**	.37**	.57**
Physical reactions	.67**	.41**	.53**
Avoidance thoughts	.63**	.38**	.41**
Avoidance reminders	.63**	.35**	.48**
Amnesia	.58**	.44**	.40**
Negative cognitions	.72**	.43**	.57**
Blame	.61**	.45**	.59**
Negative emotions	.68**	.33**	.56**
Loss of interest	.75**	.47**	.57**
Feeling detached	.73**	.47**	.51**
Anhedonia	.71**	.45**	.54**
Anger	.69**	.40**	.51**
Risky behaviours	.62**	.49**	.57**
Hypervigilance	.65**	.34**	.51**
Startle	.71**	.37**	.59**
Concentration	.78**	.56**	.55**
Sleeping	.74**	.39**	.56**

Table 2 note: * refers to p≤ 0.01, ** refers to p≤ 0.001

Table 3

Regression analysis for past-month retrospective PCL-5 assessment

	B	95% Confidence Intervals	Std. error	Beta	t-value	p-value
Sex	0.13	-0.022, 0.286	0.08	0.11	1.71	0.09
Age	-0.01	-0.018, -0.003	0.00	-0.17	-2.84	0.01
ESM total PCL-5 score	1.02	0.833, 1.209	0.09	0.71	10.81	0.00
Trauma History	0.06	0.011, 0.111	0.03	0.15	2.41	0.02
ESM total PCL-5 score * Trauma type count	-0.04	-0.158, 0.073	0.06	-0.04	-0.73	0.46
Model Fit	F(5, 90) = 37.95, p=0.00, R²=0.68					

Note 1: ESM is Experience Sampling Methodology; PCL-5 is PTSD Checklist for DSM-5

Note 2: Gender: 0=Male, 1=Female

Note 3: All independent variables were mean-centered

term of trauma history with ESM reports, was not significant (see Table 3).

Discussion

This study uniquely examined the memory-experience gap between 30 days of twice-daily reports of PTSD symptoms during a period of trauma exposure compared with a past-month retrospective aggregate assessment of the same period. The study examined whether average ESM scores, peak ESM scores, or last ESM scores were most highly correlated with retrospective assessments, finding the strongest correlations between the average ESM reports and the past-month retrospective assessment. Of these average reports, it was found that amnesia had the lowest correspondence between ESM and retrospective reports, whereas concentration difficulties had the highest correspondence. Average ESM scores and younger age significantly predicted the past-month retrospective assessment of PTSD symptoms. Additionally, it was found that count of previous trauma exposure types was a predictor of past-month retrospective PTSD symptoms, but not a moderator of the association between ESM reports and retrospective reports of PTSD symptoms.

Regarding our first research question, the high correlation between ESM reports and retrospective assessments was broadly in line with previous studies that have taken similar approaches to traumatic stress symptoms (Carlson et al., 2016; Decker et al., 2021; Naragon-Gainey et al., 2012; Schuler et al., 2019; Westermeyer et al., 2015). This is particularly important, given the current study's examination of the 20 DSM-5 PTSD symptoms in both the ESM and the retrospective assessment. However, the current finding that mean reports were more highly correlated with retrospective assessments than either highest or last-day reports replicated the findings of Westermeyer et al. (2015), but not Schuler et al. (2019) or Decker et al. (2021), both of which found that peak scores were most highly correlated. More research is needed to understand the factors that influence the accuracy of recall.

For our second research questions, we took a more fine-grained approach than previous studies by focusing on the correspondence between ESM and retrospective reports for individual PTSD symptoms. Our findings indicated the lowest level of agreement between ESM and retrospective reports for amnesia. It is perhaps unsurprising that a symptom of memory disturbance is more poorly recalled than other symptoms. In contrast, the symptom with the highest agreement between ESM and retrospective reports was concentration difficulties. This symptom is considered a more generalised symptom not specific to PTSD, common to depression and other distress disorders (Contractor et al., 2018b), and does not involve content of the traumatic experience.

For our third question, we did not find that the count of trauma types previously experienced by the participants significantly moderated the

relationship between ESM and past-month retrospective reports, although it was a significant predictor of past-month PTSD. This may indicate that despite contributing to PTSD levels, experiencing more trauma types does not impact on the memory-experience gap for PTSD symptoms. However, it could also be that other aspects of prior trauma exposure are more important, such as frequency or intensity of prior trauma exposure, which we did not examine in the current study. Furthermore, it may be that difficulties in encoding and recall are more marked when people think about traumatic events, rather than recall their own trauma reactions/symptoms, a question that could be examined in future studies.

Limitations

There are some limitations to this study. While one of the strengths of this study is that it was conducted during the peritraumatic phase, thereby enabling a comparison of the early reactions reported during the first month with the retrospective assessment of that month, it may not be applicable to posttraumatic contexts. Furthermore, although some participants reported moderate to severe symptoms, the study was not conducted with a clinical population of diagnosed patients, and it may be that the associations between daily and retrospective reports of symptoms are different among those with clinical levels of PTSD. Another limitation is that the PCL-5 response scale was amended from a 5-point to a 4-point scale, and although this is not a barrier to investigating the correlation between ESM and retrospective reports, it may prevent comparisons to other studies. Additionally, the sample was predominantly female, which limits generalizability of the findings. Finally, due to sample size limitations, we did not investigate whether different kinds of trauma events differentially predicted the level of correspondence between ESM and retrospective assessments among participants; future studies could examine this question.

Clinical implications

Study findings have notable clinical implications. While the correlations were not perfect, the very high degree of agreement between the average ESM reports and the retrospective assessments indicates asking individuals to recall the extent to which they have experienced or been bothered by a symptom over the past month or few weeks is likely a reliable approach for diagnosis. Furthermore, the findings suggest that retrospective assessments of PTSD symptoms will generally not be affected by severity or recency bias. It is important to highlight that we should not assume that accurate recall is necessarily a positive thing; it has been proposed that forgetting or underreporting the severity of previously experienced symptoms may be an adaptive adjustment mechanism that comes as part of a recovery process (Levine et al., 2009; Nahleen et al., 2019), something that could be examined in future studies.

Conclusion

Using ESM approaches to investigate PTSD symptoms can give insights into the daily life experiences of individuals following trauma exposure that are not captured by traditional retrospective assessments. While the memory-experience gap for PTSD symptoms was reasonably small in the current study, future research focusing on factors relating to the discrepancies between ESM and retrospective reports could be beneficial in distinguishing daily life experiences of PTSD symptoms from the degree to which participants perceive themselves to have experienced or bothered by symptoms over a period of time.

CRediT author statement

Talya Greene: Conceptualisation, methodology, Investigation, formal analysis, writing – original draft, supervision, funding acquisition

Conflicts of interest

None

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Supplementary materials

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