Residual symptoms following prolonged exposure and present-centered therapy for PTSD in female veterans and soldiers

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Background: Despite the effectiveness of evidence-based treatments for posttraumatic stress disorder (PTSD), some symptoms, such as sleep disturbance, can be difficult to treat regardless of treatment type.

Methods: We examined residual PTSD symptoms in 235 female veterans and soldiers who were randomized to receive 10 weekly sessions of either Prolonged Exposure (PE) or Present-Centered Therapy (PCT). PTSD symptoms were assessed using the Clinician-Administered PTSD Scale. Analyses examined the effects of PE and the effects of clinically significant improvement (loss of diagnosis, operationalized as meaningful symptom reduction and no longer meeting diagnostic criteria).

Results: Both treatments resulted in reductions in PTSD symptoms. PE had lower conditional probabilities than PCT of retaining intrusive memories, avoidance of people/places, detachment/estrangement, and restricted range of affect. Loss of diagnosis had lower conditional probabilities of almost all symptoms, although hyperarousal symptoms—especially irritability/anger (60.7%) and sleep difficulties (50.9%)—were the most likely to remain.

Conclusions: Results are consistent with previous findings on sleep difficulties being difficult to treat, but also show that hyperarousal symptoms overall may not be resolved even after substantial improvement. Additional strategies may be needed to treat the full range of PTSD symptoms in some patients.

KEYWORDS
Cognitive-behavioral therapy, PTSD, veterans, women

1 | INTRODUCTION

There are a number of effective treatments for posttraumatic stress disorder (PTSD). For example, the practice guideline recently published by the Department of Veterans Affairs and Department of Defense (2017) recommends trauma-focused psychotherapies such as Prolonged Exposure (PE), Cognitive Processing Therapy (CPT), and Eye-Movement Desensitization and Reprocessing, and selected medications (sertraline, paroxetine, fluoxetine, and venlafaxine). The guideline also suggests (a weaker recommendation) several manualized nontrauma-focused psychotherapies (present-centered therapy [PCT], interpersonal therapy, and stress inoculation training) and additional medications (nefazodone, imipramine, and phenelzine).

But despite these effective treatments, some symptoms persist in some patients. Most research has focused on the persistence of sleep problems following psychotherapy (e.g., Belleville, Guay, & Marchand, 2011; Gutner, Casement, Gilbert, & Resick, 2013; Pruiksma et al., 2016; Woodward et al., 2017; Zayfert & DeViva, 2004). Although treatment improves sleep problems and nightmares, these symptoms remain to some degree. One of the earliest studies (Zayfert & DeViva, 2004) found that 48% of patients who no longer met PTSD diagnostic criteria and had substantial reductions in PTSD symptoms after cognitive-behavioral therapy (CBT) reported difficulty falling or staying asleep. The average item severity at posttreatment for sleep problems (M = 3.6 on a 0–8 scale) was significantly higher than severity for all other symptoms except anger (M = 2.5) and startle (M = 1.5).

In a more recent study, 44% of patients who had undergone cognitive
therapy (that was shown to be highly effective) had difficulty falling or staying asleep after treatment (Woodward et al., 2017).

Other studies have identified additional residual symptoms. In Zayfert and DeViva’s (2004) study of treatment responders, 52% of the sample retained anger. A recent study examined the prevalence of all 17 DSM-IV symptoms of PTSD before and after treatment in complete responders of either PE or CPT (Larsen, Fleming, & Resick, 2018). Prevalences at posttreatment were highest for distress related to reminders, inability to recall the trauma, hypervigilance, startle, and sleep difficulty (31%-40%). Among the subsample of treatment responders, prevalences were in this range for inability to recall and sleep difficulty. The conditional probability of retaining a symptom at long-term (5-10 year) follow-up exceeded 30% in PE for inability to recall, sleep difficulty, and hypervigilance and in CPT for distress related to reminders, inability to recall, startle, and reactivity.

It is possible that sleep and other symptoms may persist simply because current PTSD treatments are not effective enough, or because PTSD is especially difficult to treat. However, evidence does not support these explanations. Effect sizes of treatments for PTSD (e.g., Lee et al., 2016; Watts et al., 2013) are comparable with effect sizes of treatments for other mental disorders (e.g., Bandelow et al., 2015; Carpenter et al., 2018; Cuijpers et al., 2013). Furthermore, the occurrence of residual symptoms is not unique to PTSD. For example, in a sample of depressed patients who met criteria for remission following treatment with duloxetine, almost 60% retained core depression symptoms, just over 50% retained insomnia symptoms, and almost 70% retained anxiety symptoms (Romera et al., 2014). The literature on residual symptoms in mood disorders highlights several types of symptoms, but, as in the PTSD literature, consistently emphasizes the persistence of sleep problems (e.g., Conradi, Ormel, & de Jonge, 2011; Culpepper, Muskin, & Stahl, 2015; Geoffroy et al., 2015; Romera et al., 2014; Zajecka, 2013).

Research on the topic of residual symptoms in PTSD is still emerging. The literature suggests that residual symptoms are common, as in depression, but few studies (Larsen et al., 2018; Zayfert & DeViva, 2004) have examined all PTSD symptoms. Most studies have focused only on sleep. Because of this focus, there is incomplete knowledge about which symptoms persist following specific treatments and treatment in general. There is also variability in how residual symptoms are defined, with most studies reporting the percentage of people who had a symptom after treatment, regardless of whether the symptom was present before treatment. Therefore, we conducted secondary analyses of a trial of PE, a trauma-focused CBT, in female veterans and soldiers (Schnurr et al., 2007). Prior studies of residual symptoms in PTSD had focused on female civilians (e.g., Gutner et al., 2013; Larsen et al., 2018), mixed samples of civilians (e.g., Belleville et al., 2011; Woodward et al., 2017; Zayfert & DeViva, 2004), and largely male samples of veterans or military personnel (e.g., Pruiksma et al., 2016).

The initial trial had found that PE was more effective than Present-Centered Therapy (PCT) for reducing PTSD severity and leading to clinically significant outcomes (loss of diagnosis and remission). Subsequent analysis of individual symptoms and symptom clusters found that averages of almost all clinician-rated symptoms improved following both treatments (Schnurr & Lunney, 2015). For clinician-rated PTSD, PE had greater benefit than PCT on the avoidance and numbing clusters, most individual symptoms in these clusters, and distress related to reminders. Such information is useful for understanding the specific effects of PE, but because the analyses focused on averages, is not informative about symptom retention—which should be determined at the level of an individual, and account for symptom presence before treatment.

We first examined the effects of treatment on residual symptoms by comparing PE and PCT and then examined the effects of clinically significant improvement, defined as loss of diagnosis. We chose this measure because prior analyses had shown it to be robustly associated with clinically significant improvements in functioning and quality of life (Schnurr & Lunney, 2012, 2016; Schnurr et al., 2009). Given the limited evidence, it was difficult to make predictions for most symptoms, but we expected that sleep difficulties and anger would be especially likely to remain even following PE and loss of diagnosis. The primary outcome in both sets of analysis was the conditional probability of retaining a symptom at posttreatment.

2 | MATERIALS AND METHODS

Details about the original study have been published previously (Schnurr et al., 2005, 2007). An institutional review board at each site approved the research protocol. Participants provided written informed consent after they had been given a complete description of the study. Data were collected between August 2002 and October 2005.

2.1 | Participants

Participants were 232 female veterans and three Army soldiers drawn from a randomized clinical trial of PTSD treatment (Schnurr et al., 2007). Participants were recruited from nine VA hospitals, two VA community Vet Centers, and one Army hospital. Inclusion criteria were current PTSD according to the “1/2” rule and minimum severity ≥ 45 on the Clinician-Administered PTSD Scale (CAPS; Weathers, Keane, & Davidson, 2001); 3 or more months since experiencing trauma; a clear memory of the trauma that caused PTSD; agreement to not receive other psychotherapy for PTSD during study treatment; and, for those on psychoactive medication, a stable regimen for the prior 2 months. Exclusion criteria were current psychotic symptoms, mania, or bipolar disorder; current substance dependence; prominent current suicidal or homicidal ideation; cognitive impairment; current involvement in a violent relationship; and self-mutilation within the past 6 months.

The 235 women were selected from the 284 enrolled in the trial because they participated in outcome measurement at posttreatment. The 235 did not differ from the 49 excluded women on PTSD symptom severity or any of the quality-of-life measures at pretreatment, nor on race, marital status, work status, or VA PTSD disability status.

2.2 | Measures

We assessed PTSD using the CAPS (Weathers et al., 2001), a structured interview in which the frequency and intensity of the 17
TABLE 1  Pretreatment demographic and clinical characteristics by treatment type and loss of diagnosis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (N = 235)</th>
<th>PE (n = 111)</th>
<th>PCT (n = 124)</th>
<th>Lost PTSD diagnosis (n = 68)</th>
<th>Retained PTSD diagnosis (n = 167)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M/%  SD/n</td>
<td>M/%  SD/n</td>
<td>M/%  SD/n</td>
<td>M/%  SD/n</td>
<td>M/%  SD/n</td>
</tr>
<tr>
<td>Age (M)</td>
<td>45.0  9.4</td>
<td>44.6  9.4</td>
<td>45.4  9.4</td>
<td>44.6  9.5</td>
<td>45.2  9.4</td>
</tr>
<tr>
<td>Post-high-school educationa</td>
<td>87.2  205</td>
<td>89.2  99</td>
<td>85.5  106</td>
<td>94.1  64</td>
<td>84.4  141</td>
</tr>
<tr>
<td>Non-white race</td>
<td>45.5  107</td>
<td>43.2  48</td>
<td>47.6  59</td>
<td>45.6  31</td>
<td>45.5  76</td>
</tr>
<tr>
<td>Married/living as married</td>
<td>29.8  70</td>
<td>30.6  34</td>
<td>29.0  36</td>
<td>33.8  23</td>
<td>28.1  47</td>
</tr>
<tr>
<td>Working full- or part-time</td>
<td>39.6  93</td>
<td>36.0  40</td>
<td>42.7  53</td>
<td>38.2  26</td>
<td>40.1  67</td>
</tr>
<tr>
<td>VA PTSD service-connected disability</td>
<td>21.6  50</td>
<td>19.8  22</td>
<td>23.1  28</td>
<td>22.7  15</td>
<td>21.1  35</td>
</tr>
<tr>
<td>Current comorbid psychiatric disorder</td>
<td>77.5  182</td>
<td>75.7  84</td>
<td>79.0  98</td>
<td>69.1  47</td>
<td>80.8  135</td>
</tr>
<tr>
<td>Lifetime comorbid psychiatric disorder</td>
<td>97.9  230</td>
<td>97.3  108</td>
<td>98.4  122</td>
<td>95.6  65</td>
<td>98.8  165</td>
</tr>
<tr>
<td>CAPS PTSD symptom severity (M)²</td>
<td>77.5  16.6</td>
<td>78.0  17.1</td>
<td>77.1  16.4</td>
<td>69.4  14.8</td>
<td>80.8  16.1</td>
</tr>
</tbody>
</table>

Note. N = 235. PE: Prolonged Exposure; PCT: Present-Centered Therapy; PTSD: posttraumatic stress disorder; CAPS: Clinician-Administered PTSD Scale. There were no significant differences between the two treatment types on any of the variables listed in the table.

aParticipants who lost their PTSD diagnosis were more likely to have post-high-school education than those who retained their PTSD diagnosis (P < 0.05).
bParticipants who lost their PTSD diagnosis had lower pretreatment PTSD symptom severity than those who retained their PTSD diagnosis (P < 0.001).

2.3 Procedure

Referring clinicians provided information about potential participants to study staff, who then met with the referrals to explain the study and obtain informed consent. A master’s- or doctoral-level clinician who was blind to participants’ treatment assignment performed all assessments. Posttreatment assessments were performed at least 1 week following the end of treatment. Eligible women were randomized to receive 10 weekly sessions of PE (Foa, Hembree, & Rothbaum, 2007) or PCT (Schnurr et al., 2005). Therapists were 52 female master’s or doctoral-level clinicians who were randomized to deliver one of the two treatments. All received specialized training in their assigned treatment, consisting of a training workshop followed by 1–2 practice cases. Sessions were videotaped and reviewed by an expert supervisor, who provided individual weekly or biweekly telephone supervision. Therapist adherence (4.2–4.7) and competence (4.3–4.5), rated on a 5-point scale ranging from 1 = poor to 5 = excellent) by an independent fidelity monitor, were excellent and equivalent across treatments (Schnurr et al., 2007).

2.4 Statistical analysis

We operationalized symptom retention as the conditional probability of retaining a symptom at posttreatment among individuals who had that symptom before treatment, using logistic regression to examine the effects of PE (vs. PCT), and the effects of loss of diagnosis (vs. retaining diagnosis). Additional analyses including loss of diagnosis, treatment type, and the treatment type by loss-of-diagnosis interaction were conducted but are not presented here, as the substantive findings remained the same.

3 Results

Table 1 contains descriptive information about the sample by treatment type and loss of diagnosis. On average, participants were in their mid-40s and ranged in age from 22 to 78 years. Most had more than a high school education, and almost one third were married or living as married. Just under half were non-white. Sexual trauma was the type of trauma most commonly identified as the index event to address in treatment (68.5%, n = 161), followed by physical assault (14.9%, n = 35) and war-zone exposure (6.0%, n = 14). The index trauma occurred when participants were 21.18 years of age (SD = 10.19, range = 3 to 54 years). Women randomized to PE and PCT did not differ at baseline in demographic, exposure, or clinical characteristics (Schnurr et al., 2007).

Figure 1 displays information about symptom presence before and after treatment for PE and PCT. The three most prevalent symptoms before treatment were detachment/estrangement (C5), distress...
FIGURE 1 Symptom presence for each posttraumatic stress disorder symptom before and after treatment by treatment type. PE: Prolonged Exposure; PCT: Present-Centered Therapy

TABLE 2 Percentage of participants retaining each posttraumatic stress disorder symptom after treatment by treatment type

<table>
<thead>
<tr>
<th>Symptom</th>
<th>PE</th>
<th>PCT</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1. Intrusive memories*</td>
<td>58.4</td>
<td>74.2</td>
<td>0.49 (0.26–0.91)</td>
</tr>
<tr>
<td>B2. Recurrent/distressing dreams</td>
<td>62.0</td>
<td>72.9</td>
<td>0.61 (0.31–1.19)</td>
</tr>
<tr>
<td>B3. Dissociative reactions</td>
<td>48.2</td>
<td>52.9</td>
<td>0.83 (0.39–1.77)</td>
</tr>
<tr>
<td>B4. Distress about reminders</td>
<td>67.6</td>
<td>77.8</td>
<td>0.60 (0.33–1.09)</td>
</tr>
<tr>
<td>B5. Physiological reactivity</td>
<td>71.4</td>
<td>73.5</td>
<td>0.90 (0.49–1.66)</td>
</tr>
<tr>
<td>C1. Avoidance of thoughts/feelings</td>
<td>56.2</td>
<td>66.4</td>
<td>0.65 (0.38–1.13)</td>
</tr>
<tr>
<td>C2. Avoidance of people/places*</td>
<td>47.7</td>
<td>64.3</td>
<td>0.51 (0.28–0.91)</td>
</tr>
<tr>
<td>C3. Psychogenic amnesia</td>
<td>52.0</td>
<td>67.7</td>
<td>0.52 (0.24–1.11)</td>
</tr>
<tr>
<td>C4. Diminished interest in activities</td>
<td>42.9</td>
<td>53.5</td>
<td>0.65 (0.37–1.16)</td>
</tr>
<tr>
<td>C5. Detachment/estrangement**</td>
<td>63.5</td>
<td>81.0</td>
<td>0.41 (0.22–0.75)</td>
</tr>
<tr>
<td>C6. Restricted range of affect**</td>
<td>60.2</td>
<td>78.4</td>
<td>0.42 (0.23–0.77)</td>
</tr>
<tr>
<td>C7. Foreshortened future</td>
<td>53.3</td>
<td>51.0</td>
<td>1.10 (0.49–2.47)</td>
</tr>
<tr>
<td>D1. Difficulty falling asleep</td>
<td>80.2</td>
<td>81.6</td>
<td>0.92 (0.46–1.83)</td>
</tr>
<tr>
<td>D2. Irritability/anger</td>
<td>79.8</td>
<td>79.0</td>
<td>1.05 (0.53–2.07)</td>
</tr>
<tr>
<td>D3. Difficulty concentrating</td>
<td>70.7</td>
<td>78.8</td>
<td>0.65 (0.34–1.32)</td>
</tr>
<tr>
<td>D4. Hypervigilance</td>
<td>71.7</td>
<td>77.6</td>
<td>0.73 (0.39–1.38)</td>
</tr>
<tr>
<td>D5. Exaggerated startle</td>
<td>72.8</td>
<td>66.0</td>
<td>1.38 (0.72–2.65)</td>
</tr>
</tbody>
</table>

Note. Symptoms were measured using the Clinician-Administered PTSD Scale. PE: Prolonged Exposure; PCT: Present-Centered Therapy; *P < 0.05; **P < 0.01.

At reminders (B4), and avoidance of thoughts and feelings (C1). Before treatment, fewer than half of participants experienced psychogenic amnesia (C3), dissociative reminders (B3), or foreshortened future (C7). After treatment, difficulty falling asleep (D1), anger/irritability (D2), and difficulty concentrating (D3) were the most prevalent symptoms, experienced by about three fourths of participants. Psychogenic amnesia (C3), dissociative reminders (B3), and foreshortened future (C7) remained the least common symptoms after treatment.

Table 2 presents the conditional probability of retaining each symptom following treatment. Probabilities were lower in PE than PCT for four symptoms: intrusive recollections (B1), avoidance of places, people, or activities (C2), detachment/estrangement (C5), and restricted range of affect (C6). In PE, conditional probabilities of symptom retention were highest for all hyperarousal symptoms, ranging from 70.7% to 80.2%, and physiological reactivity (B5; 71.4%). In PCT, conditional probabilities were highest for the first four hyperarousal symptoms (difficulty falling asleep, anger/irritability, difficulty concentrating, and hypervigilance), ranging from 77.6% to 81.6%, the two avoidance symptoms (C1, 81.0% and C2, 78.4%), and distress about reminders (B4, 77.8%).

After treatment, 28.9% of participants (n = 68) no longer met diagnostic criteria, 38.8% (n = 43) who received PE and 20.2% (n = 25) who received PCT. Their decrease in CAPS scores ranged from 10 to 83 points (M = −44.5, SD = 16.4) and they retained an average of 4.3 (SD = 2.2) symptoms. In contrast, change in CAPS scores ranged from a decrease of 59 points to an increase of 34 points (M = −59.0, SD = 16.6) among participants who still met diagnostic criteria, and they retained an average of 12.3 (SD = 2.8) symptoms. Figure 2 shows descriptive information about symptom presence before and after treatment as a function of loss of diagnosis.

Table 3 presents information about the conditional probability of retaining each symptom as a function of loss of diagnosis. For all symptoms, participants who no longer met diagnostic criteria had much lower conditional probabilities of symptom retention. However, probabilities were high for all hyperarousal symptoms among these participants, with difficulty falling asleep (D1) and anger/irritability (D2) having the highest probabilities, 50.9% and 60.7%, respectively. Symptom retention was also relatively higher for distress about reminders (B4; 41.0%) and physiological reactivity (B5; 37.3%).
DISCUSSION

We examined residual symptoms among female veterans and soldiers following treatment for PTSD and found that the probability of symptom retention was high for most symptoms unless improvement resulted in loss of diagnosis. PE improved symptom severity relative to PCT, but the conditional probability of retaining symptoms in PE was high, especially for physiological reactivity and all hyperarousal symptoms. Women who no longer met diagnostic criteria following treatment had substantially lower conditional probabilities of all symptoms relative to those women who still had PTSD. Yet even among women who no longer met diagnostic criteria, hyperarousal symptoms—especially irritability/anger and sleep difficulties—were the most likely to remain.

In the analyses comparing treatment types, PE was associated with lower conditional probabilities than PCT of retaining several symptoms—intrusive memories, avoidance of people/places, detachment/estrangement, and restricted range of affect. These findings are generally consistent with analyses that examined average symptom improvement (Schnurr & Lunney, 2015), although those analyses had identified the avoidance and numbing clusters and most symptoms in those clusters as improving more in PE. Using symptom retention, rather than improvement, as a criterion for examining treatment outcome resulted in a smaller number of symptoms for which PE had a unique effect.

Improvement in avoidance symptoms in PE is not surprising given that avoidance is a specific target of exposure-based therapies. In PE, exposure is used to activate dysfunctional perceptions and beliefs associated with the traumatic event in order to modify emotional processing of the traumatic event (e.g., Foa & Kozak, 1986; Foa et al., 2007). Reductions in intrusive recollections may be a result of reduced fear associated with aspects of the traumatic event. Theoretical conceptualizations (e.g., Foa, Zinbarg, & Rothbaum, 1992; Litz, 1992; Litz & Gray, 2002) and factor analytic evidence (e.g., Elhai & Palmieri, 2011; King, Leskin, King, & Weathers, 1998) suggest numbing and avoidance may result from different mechanisms, but because avoidance and numbing symptoms were grouped in a single cluster prior to DSM-5, few studies have compared the effects of different treatments on numbing separately from avoidance. If numbing results from depleted emotional resources as a consequence of traumatic reminders, treatments such as PE that reduce intrusive memories may in turn result in improvements in emotional numbing (Litz & Gray, 2002). Further study is needed to understand the effectiveness of different treatments in improving numbing symptoms, especially given the unique association between numbing and greater distress and poorer functioning and quality of life for veterans (e.g., Hassija, Jakupcak, & Gray, 2012; Schnurr et al., 2009; Sippel, Watkins, Pietrzak, Hoff, & Har Paz-Rotem, 2018).

The conditional probability of symptom retention in both PE and PCT was highest for difficulty falling asleep (81%), replicating the findings of investigations that have examined additional treatments (e.g., Belleville et al., 2011; Gutner et al., 2012; Larsen et al., 2018; Pruksma et al., 2016; Woodward et al., 2017; Zayfert & DeViva, 2004). The treatment-resistant nature of sleep symptoms may indicate that although PTSD may initiate these symptoms, that they may later develop into a primary sleep disorder that requires additional sleep-focused treatment to resolve (e.g., Spoormaker & Montgomery, 2008; Zayfert & DeViva, 2004). The residual nature of sleep symptoms may indicate that although PTSD may initiate these symptoms, that they may later develop into a primary sleep disorder that requires additional sleep-focused treatment to resolve (e.g., Spoormaker & Montgomery, 2008; Zayfert & DeViva, 2004). Our results are also consistent findings of residual sleep problems in studies of treatment for depression and bipolar disorder (e.g., Conradi et al., 2011; Culpepper et al., 2015; Geoffroy et al., 2015; Romera et al., 2014; Zajecka, 2013). Because it appears that residual sleep problems are not a phenomenon that occurs only in PTSD, but in the treatment of mental disorders more broadly, targeted interventions such as CBT for insomnia (e.g., Wu, Appleman, Salazar, & Ong, 2015) may be indicated across disorders in some patients.

In contrast to the circumscribed findings of the analyses of treatment type, analyses examining loss of diagnosis revealed broader and more substantial improvement. Although symptom reduction is necessary to define loss of diagnosis, all conditional probabilities were meaningfully reduced. However, hyperarousal symptoms, especially sleep difficulty and anger, had highest conditional probabilities of retention.
The finding on sleep is consistent with Larsen et al.’s (2018) findings that the prevalence of sleep problems remained high (over 30%) among treatment responders and the conditional probability of sleep problems was over 40% at long-term follow-up in PE. Larsen et al.’s (2018) long-term follow-up data also showed elevations of other hyperarousal symptoms—hypervigilance and startle—in PE. In addition, our finding on elevated residual anger is consistent with Zayfert and DeViva (2004) finding of residual anger in patients who no longer met diagnostic criteria for PTSD and had meaningful reductions in symptom severity. It is possible that the persistence of anger/irritability may be due to in part its relationship with sleep disturbances. Network analyses of PTSD symptoms show close connections between sleep and anger/irritability (e.g., Bryant et al., 2017; McNally et al., 2015; McNally, Heeren, & Robinaugh, 2017). Research is needed to determine the generalizability of our findings on sleep, anger, and other hyperarousal symptoms to other treatments and other disorders. Because scales exist to measure aspects of some of these symptoms more fully—for example, the Insomnia Severity Index (Morin, 1993) for sleep and the Dimensions of Anger Reactions for anger (Novaco, 1975)—it would be useful to include these measures in treatment studies when possible.

Instruments like the CAPS provide a standardized way to determine if a symptom is present, but it appears that there is no clear consensus on how to define a symptom as being residual. We suggest that the measure be computed at the level of the person, and not based on post-treatment group averages exceeding a specific threshold (e.g., Gutner et al., 2013). We also suggest that simply reporting what percentage of participants have a given symptom after treatment (e.g., Pruiksma et al., 2016) is not optimal because a participant may not have given a symptom before treatment. We recommend a measure that is person-specific and accounts for symptom presence before treatment, such as a conditional probability. We further recommend conditional probabilities calculated at posttreatment rather than follow-up as the best indicator of that symptom’s continued presence; conditional probabilities calculated at longer follow-ups (e.g., Larsen et al., 2018) are useful, but do not address the question of whether the symptom remained after treatment. Longer-term measures may need to account for symptom presence at posttreatment as well, for example, to determine if a symptom that remitted following treatment had returned.

When interpreting our findings, it is important to remember that our sample consisted of female veterans and active duty personnel who had severe and chronic PTSD with multiple comorbidities. Almost all had experienced sexual trauma, which was the index trauma for two thirds (Schnurr et al., 2007). The sample was large and ethnically diverse, but results may not generalize to men, non-veterans, and individuals who have experienced other types of traumatic events or are less clinically complex. The data were collected between 2002 and 2005 (Schnurr et al., 2007). It is also important to remember that we examined only two treatments, and that other treatments may lead to the identification of different residual symptoms. In addition, the PE manual used was based on an earlier version of the manual currently in use, and participants were diagnosed using DSM-IV criteria. Regarding the latter point, the VA/DoD PTSD guideline (2017) argues that the evidence based on DSM-IV should generalize to treating PTSD diagnosed according to DSM-5. However, the effects of PE or any treatment on the three new symptoms added to the diagnostic criteria are unknown. With regard to measurement, because this was a secondary analysis, symptoms were assessed using single items rather than more detailed measures. We also did not assess comorbid psychiatric diagnoses at posttreatment and therefore were unable to explore what extent comorbidity might account for the residual symptoms observed.

### 5 Conclusion

Our findings suggest that the cluster of hyperarousal symptoms is difficult to treat among PTSD patients, even among those who have a substantial clinical response. Although findings on sleep and anger are consistent with prior research, more investigation of residual
symptoms in PTSD is needed in order to optimally understand which symptoms are residual across treatments—specifically, studies of different treatments that use comparable definitions of symptom presence and examine the effects of both specific treatments (various medications and psychotherapies) and treatment success (loss of diagnosis, remission). Studies that examine which treatments are most effective for which symptoms are needed. Research should also examine whether residual comorbid disorders account for residual symptoms—e.g., depression might explain the residual sleep symptoms observed in this and other studies—and whether patient characteristics predict these symptoms. The ultimate goal is to learn what our treatments do—and do not do—so that we can enhance treatment effectiveness for individuals recovering from traumatic experiences.

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