Journal of
Experimental Psychopathology
JEP Volume 7 (2016), Issue 2, 246-260
ISSN 2043-8087 / DOI:10.5127/jep.051915

Tonic immobility and PTSD in a large community sample

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Abstract

People can be paralyzed when facing threat. Such paralysis, or peritraumatic “tonic immobility” (TI), is important as it seems associated with later PTSD development. However, the prevalence of TI is not known. This study investigated its prevalence in a large representative sample as well as its association with PTSD. 4781 participants from the general population completed measures of peritraumatic TI, peritraumatic fear, peritraumatic dissociation, trait anxiety, dissociative tendencies, behavioral inhibition, and PTSD symptoms. Extreme TI was rare in participants without PTSD (0.6% in those without trauma and 0.8% in those with trauma but without PTSD) but not in those with PTSD (7.6%). Moderate TI occurred more often (6.5%, 6.3% and 17.7% for participants without trauma, trauma without PTSD and trauma plus PTSD respectively). Extreme TI was more frequent in participants that experienced sexual violence, childhood emotional abuse, accidents and war-related traumas than in those that did not experience those traumas. In multivariate analyses TI, trait anxiety and dissociative tendencies predicted PTSD severity, with trait anxiety and TI being the most relevant predictors. These results stress the relevance of further exploration of TI responses.

Keywords: PTSD; tonic immobility; freezing; trait anxiety; dissociation; prevalence

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Received 19-Oct-2015; received in revised form 24-Feb-2016; accepted 24-Apr-2016

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Introduction

Although automatic action tendencies like fight and flight are functional and serve survival purposes, dysfunctional (exaggerated or generalized) action tendencies have been linked to the development of psychopathology (Brewin & Holmes, 2003). For example, increased avoidance or flight responses have been associated with the development and maintenance of anxiety disorders (Clark, 1999; Hofmann, Alpers & Pauli, 2009). In addition to fight or flight, organisms can also respond with immobility when facing threat. Two types of immobility behavior have been observed: freezing and tonic immobility (TI). Theoretical models slightly differ on when freezing takes place. That is, some put freezing at the beginning of the defense-cascade, in case of distant threat (Marx, Forsyth, Gallup, Fusé & Lexington, 2008) whereas others suggest that freezing often is a first response but then can be prolonged or shown intermittent with fight/flight even when threat is near, depending on the circumstances (e.g., escape options, individual differences) (Eilam, 2005; Hagenaars, Oitzl & Roelofs, 2014). However, all models propose freezing would be associated with heightened attention and serves action preparation. It is usually operationalized by immobility, a tense body posture, and heart rate deceleration (Hagenaars et al., 2014). On the other hand, TI may occur when freeze, fight, or flight is no option. In that case, the animal “plays dead”. This behavior occurs when threat is extremely close and freezing, fight or flight behavior is unsuccessful or when there is physical contact with the predator (Hagenaars et al., 2014; Marx et al., 2008). TI is normally evoked in case of (the perception of) entrapment and intense fear (Marx et al., 2008; Ratner, 1967), which is why research on human TI has focused on sexual violence mainly. Physical markers of TI are unexplored or even contradictory, although some key features have been observed in animals: a catatonic-like motionless posture, Parkinsonian-like tremors, suppressed vocal behavior, and analgesia (Gallup, 1974; Gallup & Rager, 1996). As such, it has been suggested to be related to dissociation in humans. However, several findings suggest TI and dissociation are related but distinctive constructs (Lima et al., 2010; Abrams, Hons, Carleton, Taylor & Asmundson, 2009). TI has been documented in many different species; insects, birds, fish, reptiles, and mammals (e.g., Gallup, 1974; Watsky & Gruber, 1990). In humans, interest in TI responses has grown in the past decade. As TI in animals occurs under acute threat, the most obvious analogue for human TI would be under conditions of extreme threat, i.e., trauma. Indeed, research on human TI has focused mainly on posttraumatic stress disorder (PTSD; Marx et al., 2008). In humans, TI is mostly assessed using the Tonic Immobility Scale (TIS), a self-report measure that was developed to reflect physiological and behavioral features that are associated with TI in animals, as well as general fear responding (Fusé, Forsyth, Marx, Gallup & Weaver, 2007; Heidt, Marx & Forsyth, 2005).

Peritraumatic TI responses have indeed been reported in humans as well. Unfortunately, the prevalence of TI in the general population is not clear, and numbers differ greatly across studies, due to the use of different terminology (freezing versus TI), different instruments for assessing TI (e.g., TIS, one-item scale for inability to move, experimental immobility induction), different settings (experimental threat versus trauma), and different populations that are included. For clarity reasons, the present study will therefore use TI when the construct of TI is measured (for example with the TIS), whereas "immobility" is used when the exact type of immobility response is not clear. For example, after CO_2 inhalation in an experimental setting, 13% of the healthy participants reported immobility (Schmidt, Richey, Zvolensky, & Maner, 2008). Percentages are higher in specific groups; within a group of rape victims 37% reported TI (Galliano, Noble, Travis, & Puelch, 1993), and within a group of traumatized inpatients 72.5% reported TI (Heidt et al., 2005). Therefore, the first aim of the present study is to determine the prevalence of TI in a large, representative community sample.

Secondly, this study aims to examine consequences of TI in terms of PTSD development. Several studies report negative consequences of TI: peritraumatic TI was related to depression, anxiety, peritraumatic dissociation, PTSD, intrusive images, reduced help-seeking, and poorer treatment outcome (Abrams et al., 2009; Bovin, Dodson, Smith, Gregor, Marx, Pineles, 2014; Bovin, Jager-Hymann, Gold, Marx & Sloan, 2008; Fiszman et al., 2008; Galliano et al., 1993; Hagenaars & Putman, 2011; Heidt et al., 2005; Kalaf et al., 2015). Moreover, two experimental studies have examined the role of induced peritraumatic immobility using the trauma-film paradigm. Participants that had watched the film in an immobile state developed more intrusive images of the film than those that were free to move during the film (Hagenaars, Van Minnen, Holmes, Brewin & Hoogduin, 2008). This may suggest altered encoding and consolidation processes during peritraumatic immobility. This was further confirmed by the fact that immobility during analogue trauma was associated with intrusive images rather than thoughts, while "free-to-move" participants showed similar frequencies of intrusive images and thoughts (Hagenaars, Brewin, Van Minnen, Holmes & Hoogduin, 2010). However, contradictory findings have also been reported. Abrams, Carleton, and Asmundson (2012) found that TI (a composite score of TI and dissociation) did not predict PTSD severity after controlling for peritraumatic dissociation and trait anxiety.

In addition, all studies described above included specific populations (i.e., university students), or specific traumas (i.e., sexual assault), or relatively small samples. Only one study included a large sample, but that sample consisted of traumatized individuals only, and confounding factors were not controlled for (Kalaf et al., 2015). It is highly relevant to control for state and trait TI-related factors in order to determine the true and independent role of TI (Zoellner, 2008). First, being a threat-related behavior, TI might simply be an indicator of event severity or fear. Therefore, research on TI should preferably control for fear during the event, as well as fear/anxiety proneness, especially because both have been associated with PTSD development (Lin et al., 2015; Ozer, Best, Lipsey & Weiss, 2003). Second, there is a conceptual overlap with dissociation, which has also been suggested to be involved in the development of PTSD (Hagenaars & Krans, 2011; Ozer et al., 2003). Thus, dissociation is another factor that should be controlled for when investigating TI (Zoellner, 2008). Finally, immobility responses may also be predictive as a symptom of behavioral inhibition, a general tendency to respond with withdrawal (Kalin & Shelton, 1989), that has indeed been linked to the development of (social) anxiety disorders (Barker, Reeb-Sutherland & Fox, 2014).

The present study therefore examines the association between peritraumatic TI and PTSD in a large representative sample while controlling for possible confounding factors: Trait anxiety, behavioral inhibition, dissociation, and peritraumatic fear and dissociation (Hagenaars et al., 2014).

Material and methods

Participants

In this paper use is made of the data of LISS (Longitudinal Internet Studies for the Social Sciences) panel administered by CentERdata (Tilburg University, The Netherlands). The LISS panel is a representative sample of Dutch individuals who participate in a monthly internet survey of about 15 to 30 minutes. The panel is based on a true probability sample of households drawn from the population register. Households that would not have been able

to participate were provided with a computer and internet connection to ensure representativeness (see www.LISSdata.nl for more information).

6778 panel members were approached for participation. Non-response was 1945 (28.7%) and the data of 52 participants was incomplete, leaving a total sample of 4781 participants. Age ranged from 16 to 93 (M = 50.48, SD = 17.32) and 2198 were male (46.0%). Educational level was low for 1734 participants (36.3%), middle for 1585 participants (33.2%), and high for 1462 participants (30.6%). All participants gave written informed consent after complete description of the study.

Measures

Peritraumatic responses.

Peritraumatic TI, fear and dissociation were assessed with the Tonic Immobility Scale (TIS; Forsyth, Marx, Fusé, Heidt & Gallup, 2000; De Kleine, Van Minnen & Hagenaars, 2009). The TIS was originally designed to assess presence and severity of TI in victims of sexual assault. The instructions were therefore adjusted in the present study so that the items referred to any trauma. More specifically, participants were asked to report about experiences that occurred at the time of their (main) trauma or (in case there was no trauma) most frightening event. The 10 self-report items of the TIS are scored on a 7-point Likert scale, ranging from 0 (not at all) to 6 (extremely/very much). Exploratory and confirmatory factor analyses showed that the TIS comprises two subscales (Fusé et al., 2007): Fear (TIS-Fear; 3 items) and Tonic Immobility (TIS-TI; 7 items). Example items of TIS-TI are “Rate the degree to which you were unable to move even though not restrained” and “Rate the degree to which you were unable to call out or scream during the event”. Reliability of TIS-TI was .86 in a previous study (Fusé et al., 2007) and .78 in the present sample. The TIS-Fear subscale is less consistent both theoretically as in psychometric properties. Originally, the 3 TIS-Fear items loaded on 1 factor and the subscale was moderately reliable (.65; Fusé et al., 2007). Items on this scale address trembling/shaking, feelings of fear/panic, and dissociation (derealisation). The dissociation item seems out of place theoretically, and indeed later findings with a similar TI-questionnaire yielded a 3 factor solution comprising Physical immobility, Fear and Dissociation subscales (Abrams et al., 2009). Moreover, reliability for the original 3-item TIS-Fear subscale was low in the present sample (.45). A closer inspection of the scale showed that this was caused by the one dissociation item that did not load on the Fear factor (factor loading = .02). Furthermore, reliability of the TIS-Fear greatly increased when this item was removed (.63). Therefore, in the present study a 2-item TIS-Fear was used. The dissociation item was used separately as an index of peritraumatic dissociation (TIS-Diss).

Trait anxiety.

Trait anxiety was assessed with the Spielberger State-Trait Anxiety Inventory (STAI-T; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983; Van der Ploeg, Defares & Spielberger, 1980), a 20-item self-report questionnaire on which participants report how anxious they feel in general using a scale ranging from 0 to 4. The internal consistency of the STAI is high (α = .90), and test-retest reliability (r = .70 - .76) and concurrent validity are good (Spielberger et al., 1983).

Dissociative tendencies.

Dissociative tendencies were measured with the Dissociative Experiences Scale (DES; Bernstein & Putnam, 1986; Carlson & Putnam, 1993; Draijer & Boon, 1993), a 28-item self-rating scale that measures the tendency to experience dissociation in daily life. For each item the respondent states how often a specific dissociative symptom occurs. Compared to other instruments gauging dissociation, the convergent validity of the DES was shown to be very good and its reliability good (Cohen’s d = 1.82, mean α reliability = .93; Van IJzendoorn & Schuengel, 1996).

Behavioral inhibition.

Behavioral inhibition was assessed with the BIS subscale of the BIS/BAS (Carver & White, 1994; Franken, Muris & Rassin, 2005), a 24-item self-rating scale that measures individual differences in the sensitivity of the behavioural

approach system (BAS) and behavioural avoidance or inhibition system (BIS). Higher scores on the BIS scale indicate predisposition to anxiety rather than experience of anxiety. The BIS scale has good reliability (Crohnbach's α = .76; Jorm, Christensen, Henderson, Jacomb, Korten, & Rodgers, 1999).

Posttraumatic Stress Symptoms.

The Posttraumatic Stress Symptom Scale, Self-Report (PSS-SR) is a 17-item self-report questionnaire that measures the frequency of PTSD symptoms (Engelhard, Arntz & van den Hout, 2007; Foa, Riggs, Dancu, & Rothbaum, 1993). Each item corresponds to one of the DSM-IV criteria for PTSD, and has three subscales: reexperiencing symptoms, avoidance symptoms and arousal symptoms. Each item has to be answered on a 4-point Likert scale. Analyses showed a high internal consistency (α = .91), and a good test-retest reliability of overall PTSD severity (*r* = .74) (Foa et al., 1993).

Trauma experiences.

Trauma experiences were assessed by an adjusted version of the Negative Life Experiences and Trauma Questionnaire (NLETQ; Engelhard, Van den Hout, Kindt, Arntz & Schouten, 2003). The original NLETQ consists of 24 items describing various events and one open-ended item ("other, namely") for unlisted events (Morgan & Janoff-Bulman, 1994). Participants have to indicate whether they experienced the event. The original NLETQ also includes several life events (e.g., divorce of parents, death of a friend, illness of someone close to you, going bankrupt). These were removed for the present study. For clarity reasons, some of the other items were combined in the analyses (e.g., "physical violence as an adult by a known person" and "physical violence as an adult by an unknown person" were combined: "Physical violence (adult)"), resulting in a list of 10 trauma types.

Procedure

LISS panel members completed the NLETQ in wave 1, and all other questionnaires in wave 2 (order: STAI, BIS, DES, TIS, PSS-SR).

Analyses

Bivariate correlations were used to test which of the variables would be associated with PTSD when looking at univariate relationships. Then, hierarchical linear regression analyses were used to test whether peritraumatic fear and TI (state predictors, entered in block 2) would predict PTSD severity over the effect of general variables (age, gender, education, entered in block 1), and whether this effect would hold when controlling for well-known trait predictors (trait anxiety, dissociation, and behavioural inhibition, entered in block 3). Multicolinearity was checked as several predictors could be related. All tests are two-tailed. Because of the large sample size, significance levels were set at α = .01. For the same reason, in addition to significance levels, β weights are inspected as an indicator of the magnitude and relevance of the effect. Betas smaller than .10 were considered too small to count as important predictors.

Results

Prevalence PTSD and tonic immobility

Descriptives are listed in Table 1. 1574 (32.9%) of the participants reported having experienced a traumatic event. Of these victims, 446 (28.3%) suffered from PTSD (scoring > 14 on the PSS; Wohlfarth, Van den Brink, Winkel, & Ter Smitten, 2003), which is 9.3% of the total sample. PTSD symptoms were severe in those with PTSD (PSS: *M* = 23.52, *SD* = 7.67). Trauma/PTSD and Trauma/NoPTSD participants were younger than NoTrauma/NoPTSD participants ($F(2, 4778) = 7.11$, $p = .001$, $\eta_p^2 = .82$; both $ps_{posthoc} < .01$). There were no age differences between Trauma/PTSD and Trauma/NoPTSD participants ($p_{posthoc} = .22$). Trauma/PTSD participants were female more often than Trauma/NoPTSD and NoTrauma/NoPTSD participants ($\chi^2(N = 1574) = 29.74$, $p < .001$ and $\chi^2(N = 3653) = 19.33$, $p < .001$ respectively). There were no gender differences between Trauma/NoPTSD and NoTrauma/NoPTSD participants ($\chi^2(N = 4335) = 5.78$, $p = .02$). Trauma/NoPTSD participants were highly educated more often than

Trauma/PTSD and NoTrauma/NoPTSD participants ($\chi^2(N = 1574) = 25.90$, $p < .001$ and $\chi^2(N = 1574) = 54.82$, $p < .001$ respectively). There were no education differences between Trauma/PTSD and NoTrauma/NoPTSD participants ($\chi^2(N = 3653) = 3.61$, $p = .16$). In sum, NoTrauma/NoPTSD participants were older, Trauma/NoPTSD participants were more highly educated and Trauma/PTSD victims were female more often than the other groups.

Table 1: Descriptives and prevalence of tonic immobility and PTSD in trauma participants with and without PTSD and no-trauma participants (N = 4781)

Variable	**No trauma, no PTSD (*n* = 3207)**	**Trauma, no PTSD (*n* = 1128)**	**Trauma and PTSD (*n* = 446)**
	M [SD]	*M* [SD]	*M* [SD]
Age*	51.11 [17.57]	49.54 [16.52]	48.36 [17.22]
Gender (% males)**	45.9%	50.2%	35.0%
Educational level**			
Low	39.0%	27.9%	37.7%
Middle	32.5%	33.7%	36.8%
High	28.5%	38.4%	25.6%
PSS-SR	N/A	7.53 [3.05]	23.56 [7.70]
TIS-TI*	7.47 [6.80]	8.50 [6.79]	15.02 [8.38]
Low	93.0%	92.9%	74.7%
Moderate	6.5%	6.3%	17.7%
Extreme	.6%	.8%	7.6%

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

Note: Clustering of peritraumatic tonic immobility (TIS-TI) scores: low: total score = 0-20, moderate: total score = 21-27, extreme: total score ≥ 28. PSS-SR = Posttraumatic Symptom Scale-Self Report; TIS-TI = Tonic Immobility Scale-TI subscale.

Mean TIS-TI across groups was low ($M = 8.41$, $SD = 7.29$). Groups differed significantly on TI scores, though. Trauma/PTSD participants reported higher levels of TI than Trauma/NoPTSD and NoTrauma/NoPTSD participants ($F(2, 4778) = 230.25$, $p < .001$, $\eta_p^2 = .09$; both $ps_{posthoc} < .001$). Trauma/No-PTSD participants also experienced more TI than and No-Trauma/No-PTSD participants ($p_{posthoc} < .001$). In order to be able to compare the prevalence of TI across studies, TIS-TI scores were categorized in three clusters: low (total score of 0 to 20), moderate (total score of 21-27) and extreme (total score of 28 or higher; Heidt et al., 2005). Trauma/PTSD participants experienced extreme TI more often than Trauma/No-PTSD and No-Trauma/No-PTSD participants ($\chi^2(N = 1574) = 110.36$, $p < .001$ and $\chi^2(N = 3653) = 21123$, $p < .001$ respectively). Note that Trauma/No-PTSD participants did not differ from No-Trauma/No-PTSD ($\chi^2(N = 4335) = .58$, $p = .75$).

TI and trauma type

Traumas were categorized in order to explore TI responses in different trauma types (see Table 2). Percentages extreme TI indeed differed per trauma. Moreover, some traumas were associated with increased TI (more TI in those that experienced that trauma versus those who did not) whereas other were not (no difference in TI between those who did and did not experience that trauma). More specifically, extreme TI was indeed more present in those with sexual violence (childhood or adulthood), childhood emotional abuse, serious accidents, and war-related trauma (all χ^2s > 11.97, all ps < .004), versus those without such trauma. For the other trauma types, differences in TI between participants with and without that trauma did not reach significance.

TI and PTSD severity

PTSD was not relevant for no-trauma participants and therefore correlation and regression analyses were done for those with trauma (N = 1574). Bivariate correlations revealed significant associations between PTSD severity and all other variables (see Table 3). Thus, without controlling for other variables, PTSD was related to peritraumatic fear, peritraumatic TI, trait anxiety, dissociative tendencies and behavioral inhibition.

Table 2: Trauma types and tonic immobility scores per trauma type (N = 1574)

Trauma type	N (%)	Mean TI M (SD)	TI category		
			Low	Moderate	Extreme
Childhood sexual abuse**	122 (2.6%)	13.14 (9.58)	79.3%	11.7%	9.0%
Childhood physical abuse	110 (2.4%)	10.61 (8.17)	86.0%	10.8%	3.2%
Childhood emotional abuse**	254 (5.5%)	11.39 (8.15)	84.2%	12.3%	3.5%
Sexual violence (adult)**	152 (3.28%)	13.44 (9.62)	74.8%	16.5%	8.7%
Physical violence (adult)	234 (5.06%)	10.96 (7.81)	87.4%	10.1%	2.5%
Serious accident*	286 (6.2%)	8.84 (7.54)	90.8%	5.6%	3.6%
Disaster or fire	66 (1.4%)	7.88 (6.16)	94.9%	5.1%	0.0%
Life threatening illness	417 (9%)	8.30 (7.66)	91.3%	6.6%	2.0%
War-related trauma**	436 (9.4%)	6.29 (6.14)	96.7%	3.1%	0.2%
Other[a]	273 (5.9%)	10.31 (7.74)	87.2%	9.9%	2.9%

*p < .01; **p < .001

[a]For example: armed robbery, death threat, witness of an airplane crash.

*Table 3: Univariate correlations in those who experienced a traumatic event (N = 1574)**

	Correlation coefficient (*r*)									
variable	1	2	3	4	5	6	7	8	9	1
1 TIS-Fear	-									
2 TIS-Diss	.04	-								
3 TIS-TI	.24	.64	-							
4 STAI-t	.20	.28	.35	-						
5 DES	.23	.40	.37	.35	-					
6 BIS	.17	.15	.30	.57	.18	-				
7 PTSD-Reexperiences	.21	.40	.42	.52	.40	.231	-			
8 PTSD-Avoidance	.18	.35	.39	.60	.38	.32	.77	-		
9 PTSD-Arousal	.21	.30	.38	.60	.41	.40	.62	.69	-	
10 PTSD-Total	.22	.39	.45	.64	.44	.38	.90	.93	.84	

*all *p*s < .001 except for the correlation between TIS-Fear and TIS-Diss (p > .01).

Note: TIS-Fear = Tonic Immobility Scale-Fear subscale; TIS-Diss = Tonic Immobility Scale-Dissociation subscale; TIS-TI = Tonic Immobility Scale-TI subscale; STAI-t = State Trait Anxiety Inventory-trait; DES = Dissociative experiences Scale; BIS = Behavioral Inhibition Scale

Hierarchical linear regression analyses showed a somewhat different picture though (see Table 4). In block 1, female gender and lower education predicted PTSD severity, age did not. Together, the general variables significantly predicted PTSD, although the explained variance was low (4%). Peritraumatic fear, dissociation and TI (entered in block 2) improved the model substantially, accounting for another 22% of the variance (R^2 = .26, p < .001). Peritraumatic TI was the highest predictor, but peritraumatic dissociation, peritraumatic fear and education also predicted PTSD severity. Gender and age did not predict PTSD. Peritraumatic TI was still a robust predictor in block 3 after adding trait variables. Other significant predictors were trait anxiety and dissociative tendencies. Gender,

education, peritraumatic fear, peritraumatic dissociation, and behavioral inhibition did not predict PTSD severity. Age reached significance but with β = .06 this is not considered a relevant predictor. The trait variables again explained a substantial amount of variance, with the total model being highly significant and explaining much variance (R^2 = .51, p < .001).

Because the predictors we included are likely to be related, we checked for multicollinearity. Tolerance was > .53 and VIF < 1.86 for all variables indication there was no multicollinearity problem (which may be present when tolerance < .20 and VIF > 5).

Table 4: Tonic immobility, control variables and confounding variables as predictors of posttraumatic stress symptoms (N = 1574)

Predictor	*B*	β	*p*	95% CI	ΔR^2
Model 1					.04
Age	-.04	-.06	.02	[-.06, .00]	
Gender	2.07	.12	< .001	[1.13, 3.02]	
Education	-1.14	-.13	< .001	[-1.61, -.67]	
Model 2					.22
Age	.01	.02	.54	[-.02, .03]	
Gender	.68	.04	.12	[-.17, 1.53]	
Education	-.90	-.10	< .001	[-1.32, -.49]	
TIS-Fear	.23	.09	< .001	[.11, .36]	
TIS-Diss	.89	.15	< .001	[.53, 1.25]	
TIS-TI*	.41	.37	< .001	[.37, .46]	
Model 3					.26
Age	.03	.06	< .01	[.01, .05]	
Gender	.37	.02	.32	[-.35, 1.08]	
Education	-.29	-.03	.10	[-.63, .06]	
TIS-Fear	.08	.03	.11	[-.02, .18]	
TIS-Diss	.24	.04	.12	[-.07, .53]	
TIS-TI	.23	.20	< .001	[.17, .29]	
STAI-Trait	.43	.49	< .001	[.39, .48]	
DES	.04	.19	< .001	[.03, .05]	
BIS	-.02	-.01	.68	[-.14, .09]	

Note: all models reached significance (p < .001 for all ΔR^2). TIS-Fear = Tonic Immobility Scale-Fear subscale; TIS-Diss = Tonic Immobility Scale-Dissociation subscale; TIS-TI = Tonic Immobility Scale-TI subscale; STAI-t = State Trait Anxiety Inventory-trait; DES = Dissociative experiences Scale; BIS = Behavioral Inhibition Scale

Discussion

The present study aimed to investigate the prevalence of TI responses as well as their association with PTSD. Previous studies used selective and relatively small samples, and often did not control for well-known PTSD predictors (such as trait anxiety) or TI-related variables (such as dissociation). Here, prevalence rates for TI are presented for the first time in a large community sample. Furthermore, the link between TI and PTSD was indeed present after controlling for several confounding factors.

Extreme TI responses were quite rare. Especially participants with PTSD had responded with TI, but even in this group, TI occurred in 25.3% and only 7.6% experienced extreme TI. This is somewhat lower than reported in other studies using traumatized groups, where 37% up to 72% report TI. Possibly, TI is a more frequent response in specific trauma types (such as rape) or in specific populations (for example persons with a vulnerability to develop psychiatric disorders). Alternatively, including selective groups such as inpatients may result in over-reporting immobility as a

result of undergoing treatments that focus on personal reactions. On the other hand, moderate TI was not unusual, even in those without trauma (6.5%), suggesting that frightening events do not have to be traumatic in order to elicit TI. Moreover, the data partly confirm previous findings that the highest TI rates are observed for sexual trauma (childhood or adulthood; Kalaf et al., 2015). This is in line with the theory that TI occurs under conditions of extreme fear and restraint, i.e., physical contact with the perpetrator. High TI rates were also found for those that experienced childhood emotional abuse and war-related traumas though. Investigating TI in different trauma types was not the aim of the present study, but future studies should examine specific trauma characteristics that elicit TI, such as interpersonal, physical contact with the perpetrator, perceived threat, and unpredictability.

Interestingly, TI was a stable predictor of PTSD that held after controlling for several other strong predictors. Trauma itself did not necessarily lead to TI: the no-PTSD trauma group did not experience higher levels of TI than the no-trauma group. TI therefore seems to be a significant response that may play an important role in PTSD development. This is in line with most studies that investigated the relationship between TI and PTSD (Heidt et al., 2005; Rizvi, Kaysen, Gutner, Griffin, & Resick, 2008; Rocha-Rego et al., 2009). It is not in line with Abrams et al (2012). This might be explained by the fact that TI was operationalized differently, though. Abrams et al. (2012) used a composite measure for TI comprising the Physical immobility and Dissociation subscales of the Tonic Immobility *Questionnaire* (a measure resembling the TIS). They additionally controlled for peritraumatic dissociation in their analyses. Note that in the current sample PTSD was related to immobility per se, not to the fear factor associated with TI responses, nor to peritraumatic dissociation, again indicating the relevance of automatic threat-related behavioral responses. Action tendencies such as fight or flight (e.g., avoidance) have indeed been found to be related to psychopathology (Brewin & Holmes, 2003; Von Borries et al., 2012), now it seems that automatic immobility is also associated with psychopathology. It is not clear which part of the TI response is responsible for the link with PTSD, though. Freezing or feeling paralyzed is addressed in one of the items included in the TIS-TI. At this point more research is needed to clarify whether this pure immobility response is driving the effects or the complete TI construct, including various (subjective) restraint symptoms.

It is also not clear what drives the TI-PTSD association. At this point, several moderating and mediating factors could play a role. For example, (tonic) immobility may activate dysfunctional emotions and cognitions (such as shame, self-blame and guilt; Mezey & Taylor, 1988). It might be associated with peritraumatic factors such as fear of life, trauma severity (Bovin et al., 2008; Brewin, Andrews, & Valentine, 2000; Ozer et at., 2003), inescapability and uncontrollability (Bovin et al., 2008; Foa, Zinbarg, & Rothbaum, 1992). It might also provoke negative judgements from others leading to reduced social support (McCaul, Veltum, Boyechko & Crawford, 1990). Finally, TI may be related to altered processing of trauma information (Gallup, Boren, Suarez, Wallnau, & Gagliardi, 1980). That is, defensive immobility responses are associated with optimal attentional processes and maximal sensory intake (Bradley, Codispoti, Cuthbert, & Lang, 2001), as well as physical responses such as increases in cortisol and bradycardia. These may affect (re)consolidation of trauma information, leading to the formation of vivid, sensory-rich intrusive memories of the trauma (Brewin, Dalgleish, & Joseph, 1996; Ehlers & Clark, 2000).

Finally, note that there may be an alternative explanation for the findings: over-reporting of symptoms. PTSD patients may be more likely to over-report symptoms because of malingering, misattribution, memory bias, or as a “cry for help” (Constans et al., 2014; Guriel & Fremouw, 2003; McNally & Frueh, 2013). Future studies with longitudinal designs should clarify the exact relationship between peritraumatic TI and PTSD, preferable while controlling for over-reporting (Merckelbach, Langeland, De Vries & Draijer, 2014). More research is needed to examine explanatory mechanisms underlying the TI-PTSD association. To date, only one prospective study has been done (Maia et al., 2015), and a start has been made to examine moderation (Hagenaars & Putman, 2011) and mediation (Bovin et al., 2014; Bovin et al., 2008). In addition to the use of a longitudinal design, future studies should also assess medication or substance use at the time of the trauma, as well as illness and injury, as these may also be confounding factors. Another note should be made on the relatively high prevalence of PTSD both within the trauma-exposed sample and in the total sample. Lower PTSD rates have been reported in the Netherlands as well as in other countries (e.g., De Vries & Olff, 2009; Kessler et al., 2005). The high PTSD rates in this study may be related to the age of the cohort. A previous study indicated that 45-59 age cohort had the highest PTSD rates (Kessler et al., 2005), which was exactly the predominant age in the present study. Also, the use of the PSS as a diagnostic measure resulted in higher PTSD rates (Engelhard et al., 2007), and higher PTSD rates were found when the impairment/distress criterion was not

included (Stein, Walker, Hazen & Forde, 1997). Having said that, analyses with the PSS as a continuous measure were not affected by PTSD categories.

As expected dissociative tendencies and trait anxiety were also strongly associated with PTSD. This is in line with previous studies on PTSD stressing the predictive value of trait dissociation (Hagenaars & Krans, 2011; McCaslin et al., 2008), and trait propensity to anxiety (Engelhard, Van den Hout & Schouten, 2006; Laposa & Alden, 2008; Lawrence & Fauerbach, 2003; Weems et al., 2007).

Equally interesting is the fact that some variables did not predict PTSD severity. First, although peritraumatic fear was related to PTSD in univariate analyses, its effect was small when controlling for TI and even not a significant predictor at all after controlling for trait predictors. Previous studies have quite consistently found that peritraumatic emotional responses predict PTSD (Ozer et al., 2003; Bovin et al., 2008; Brewin et al., 2000). It is possible that peritraumatic TI is a stronger predictor and there is an overlap in variance explained by the two. Also, TI may be mediating the effects of peritraumatic fear (Bovin et al., 2008). Alternatively, the operationalization of peritraumatic fear (the fear subscale of the TIS) may not have been adequate. The TIS-Fear subscale might need to be reconsidered indeed; Although original factor analyses found a 2-factor solution for the TIS (TI and Fear), later examinations of the TIS did not confirm this solution but instead favoured a one-factor solution without 2 of the 3 TIS-fear items (shaking and derealisation; Reichenheim et al., 2014), thus leaving in 1 TIS-Fear-item only. A factor analysis in the present sample confirmed a 2-factor solution, although one of the Fear-items was at odds. Moreover, some studies found effects for the TIS-TI subscale but not for the TIS-Fear subscale (Hagenaars & Putman, 2011) and low internal consistency for the TIS-Fear subscale was reported previously as well (α = .44; Bovin et al., 2008). This may indicate that the TIS-Fear subscale is not well applicable for all populations and trauma types and peritraumatic emotional responses are better assessed with other instruments.

Peritraumatic dissociation is a second variable that was no longer significantly related to PTSD after controlling for trait variables. Previous findings on peritraumatic dissociation as a predictor of PTSD are mixed (Ozer et al., 2003; Van der Velden & Wittmann, 2008). Some studies on TI and PTSD controlled for peritraumatic dissociation, with mixed results too. The present study used a one-item measure for dissociation, which raises validity questions. Conceptual overlap between TI and dissociation has already been suggested, although some evidence suggests both are associated with distinct cognitive processing: dissociation impairs higher cognitive functioning, whereas consciousness and learning in TI is intact or even enhanced (Gallup et al., 1980; Spiegel, 1995).

Another variable without predictive power was behavioural inhibition. Although behavioral inhibition was related wit PTSD severity in univariate analyses, it lost its predictive power when other variables were included in the model. Several studies found a link between behavioural inhibition and PTSD, especially with avoidance symptoms (Contractor, Elhai, Ractliffe & Forbes, 2013; Gudiño, 2013). Possibly, behavioural inhibition as a general tendency to respond with withdrawal was overruled by TI because peritraumatic responses may be stronger predictors than trait variables (Hagenaars & Krans, 2011; Ozer et al., 2003). The predictive power of behavioural inhibition may also have been overruled by trait anxiety, being a closely related concept and a strong predictor of PTSD as well. Behavioural inhibition was indeed strongly related to trait anxiety in this study (r = 57). Theoretically, TI can be considered an expression of the fear system, whereas behavioural inhibition can be categorized as an anxiety response (McNaughton & Gray, 2000), with the fear system being more relevant in a trauma context and behavioural inhibition more closely related to shyness. Behavioral inhibition was indeed a relevant precursor for later social anxiety (Gladstone, Parker, Mitchell, Wilhelm & Malhi, 2005).

In conclusion, the present study investigated prevalence of TI and its association with PTSD. TI was strongly associated with PTSD, even after controlling for several related factors such as peritraumatic dissociation, trait anxiety and dissociative tendencies. Our findings are in line with other studies using selective or smaller samples (e.g., Heidt et al., 2005), and with experimental findings (Hagenaars et al., 2008; Hagenaars et al., 2010; Hagenaars & Putman, 2011), and underscore the importance of future research of immobility responses and threat-related psychopathology.

Acknowledgements

M. Hagenaars was supported by a grant for innovative research (#451-09-018) from the Netherlands Organization for Scientific Research (NWO). The LISS panel data were collected by CentERdata (Tilburg University, The Netherlands) through its MESS project funded by NWO.

References

Abrams, M.P., Carleton, R.N., & Asmundson, G.J.G. (2012). Tonic immobility does not uniquely predict posttraumatic stress symptom severity. *Psychological Trauma: Theory, Research, Practice, and Policy, 4*(3), 278-284. http://dx.doi.org/10.1037/a0023272

Abrams, M.P., Hons, B.A., Carleton, R.N., Taylor, S., & Asmundson, G.J.G. (2009). Human tonic immobility: Measurement and correlates. *Depression and Anxiety, 26*, 550-556. http://dx.doi.org/10.1002/da.20462

Barker, T.V., Reeb-Sutherland, B.C., Fox, N.A. (2014). Individual differences in fearpotentiated startle in behaviorally inhibited children. *Dev. Psychobiol. 56*,133–141. http://dx.doi.org/10.1002/dev.21096

Bernstein, E.M., & Putnam, F.W. (1986). Development, reliability and validity of a dissociation scale. *Journal of Nervous and Mental Disease, 174*, 727–735. http://dx.doi.org/10.1097/00005053-198612000-00004

Bovin, M.J., Dodson, T.S., Smith, B.N., Gregor, K., Marx, B.P., & Pineles, S.L. (2014). Does guilt mediate the association between tonic immobility and posttraumatic stress disorder symptoms in female trauma survivors? *Journal of Traumatic Stress, 27*, 721-724. http://dx.doi.org/10.1002/jts.21963

Bovin, M.J., Jager-Hyman, S., Gold, S.D., Marx, B.P., & Sloan, D.M. (2008). Tonic immobility mediates the influence of peritraumatic fear and perceived inescapability on posttraumatic stress symptom severity among sexual assault survivors. *Journal of Traumatic Stress, 21*, 402-409. http://dx.doi.org/10.1002/jts.20354

Bradley, M.M., Codispoti, M., Cuthbert, B.N., & Lang, P.J. (2001). Emotion and motivation I: Defensive and appetitive reactions in picture processing. *Emotion, 1*, 276-298. http://dx.doi.org/10.1037/1528-3542.1.3.276

Brewin, C.R., Andrews, B. & Valentine, J.D. (2000). Meta-analysis of risk factors for posttraumatic stress disorder in trauma-exposed adults. *Journal of Consulting and Clinical Psychology, 68*(5), 748-766. http://dx.doi.org/10.1037/0022-006X.68.5.748

Brewin, C.R., Dalgleish, T. & Joseph, S. (1996). A dual representation theory of posttraumatic stress disorder. *Psychological Review, 103*(4), 670-686. http://dx.doi.org/10.1037/0033-295X.103.4.670

Brewin, C.R. & Holmes, E.A. (2003). Psychological theories of posttraumatic stress disorder. *Clinical Psychological Review, 23*, 339-376. http://dx.doi.org/10.1016/S0272-7358(03)00033-3

Carlson, E., & Putnam, F.W. (1993). An update on the Dissociative Experiences Scale. *Dissociation*, 6, 16–27.

Carver, C.S., & White, T.L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: The BIS/BAS scales. *Journal of Personality and Social Psychology*, 67, 319-333. http://dx.doi.org/10.1037/0022-3514.67.2.319

Clark, D.M. (1999). Anxiety disorders: Why they persist and how to treat them. *Behaviour Research and Therapy, 37*, S5-S27. http://dx.doi.org/10.1016/S0005-7967(99)00048-0

Constans, J.I., Kimbrell, T.A., Nanney, J.T., Marx, B.P., Jegley, S. & Pyne, J.M. (2014). Over-reporting bias and the modified Stroop effect in Operation Enduring and Iraqi Freedom veterans with and without PTSD. *Journal of Abnormal Psychology, 123*, 81-90. http://dx.doi.org/10.1037/a0035100

Contractor, A.A., Elhai, J.D., Ractliffe, K.C., & Forbes, D. (2013). PTSD's underlying symptom dimensions and relations with behavioral inhibition and activation. *Journal of Anxiety Disorders, 27*, 645-651. http://dx.doi.org/10.1016/j.janxdis.2013.07.007

De Kleine, R., Van Minnen, A., & Hagenaars, M.A. (2009). De Tonic Immobility Scale, Dutch translation. Unpublished manuscript.

De Vries, G. & Olff, M. (2009). The life-time prevalence of posttraumatic stress disorder in the Netherlands. *Journal of Traumatic Stress, 22*, 259-267. http://dx.doi.org/10.1002/jts.20429

Draijer, N. & Boon, S. (1993). The validation of the dissociative experiences scale against the criterion of the SCID-D, using receiver operating characteristics (ROC) analysis. *Dissociation, 6*, 28-37.

Ehlers, A. & Clark, D.M. (2000). A cognitive model of posttraumatic stress disorder. *Behaviour Research and Therapy, 38*, 319-345. http://dx.doi.org/10.1016/S0005-7967(99)00123-0

Eilam, D. (2005). Die hard: A blend of freezing and fleeing as a dynamic defense—implications for the control of defensive behavior. *Neuroscience and Biobehavioral Reviews, 29*, 1181-1191. http://dx.doi.org/10.1016/j.neubiorev.2005.03.027

Engelhard, I.M., Arntz, A. & Van den Hout, M.A. (2007). Low specificity of symptoms on the post-traumatic stress disorder (PTSD) symptom scale: A comparison of individuals with PTSD, individuals with other anxiety disorders, and individuals without psychopathology. *British Journal of Clinical Psychology*, 46, 449-456. http://dx.doi.org/10.1348/014466507X206883

Engelhard, I.M., Van den Hout, M.A., Kindt, M., Arntz, A., & Schouten, E. (2003). Peritraumatic dissociation and posttraumatic stress after pregnancy loss: A prospective study. *Behaviour Research & Therapy*, 41, 67-78. http://dx.doi.org/10.1016/S0005-7967(01)00130-9

Engelhard, I.M., Van den Hout, M.A., & Schouten, E.G. (2006). Neuroticism and low educational level predict the risk of posttraumatic stress disorder in women after miscarriage or stillbirth. *General Hospital Psychiatry*, 28, 414-417. http://dx.doi.org/10.1016/j.genhosppsych.2006.07.001

Fiszman, A., Mendlowicz, M.V., Marques-Portella, C., Volchan, E., Coutinho, E.S., Souza, W.F., . . . Figueira, I. (2008). Peritraumatic tonic immobility predicts a poor response to pharmacological treatment in victims of urban violence with PTSD. *Journal of Affective Disorders, 107*, 193-197. http://dx.doi.org/10.1016/j.jad.2007.07.015

Foa, E.B., Riggs, D.S., Dancu, C.V., & Rothbaum, B.O. (1993). Reliability and validity of a brief instrument for assessing post-traumatic stress disorder. *Journal of Traumatic Stress, 6*, 459–473. http://dx.doi.org/10.1002/jts.2490060405

Foa, E.B., Zinbarg, R. & Rothbaum, B.O. (1992). Uncontrollability and unpredictability in post-traumatic stress disorder: An animal model. *Psychological Bulletin, 112*, 218-238. http://dx.doi.org/10.1037/0033-2909.112.2.218

Forsyth, J.P., Marx, B., Fusé, T.M.K., Heidt, J., & Gallup, G.G., Jr. (2000). *The Tonic Immobility Scale—Child Form*. Albany, NY: Authors.

Franken, I.H.A., Muris, P. & Rassin, E. (2005). Psychometric properties of the Dutch BISBAS scales. Journal of Psychopathology and behavioral Assessment, 27, 25-30. http://dx.doi.org/10.1007/s10862-005-3262-2

Fusé, T., Forsyth, J.P., Marx, B.P., Gallup, G.G., & Weaver, S. (2007). Factor structure of the Tonic Immobility Scale in female survivors of sexual assault: An exploratory and confirmatory factor analysis. *Journal of Anxiety Disorders*, *21*, 265–283. http://dx.doi.org/10.1016/j.janxdis.2006.05.004

Galliano, G., Noble, L., Travis, L.A., & Puechl, C. (1993). Victim reactions during rape/sexual assault: A preliminary study of the immobility response and its correlates. *Journal of Interpersonal Violence*, *8*, 109–114. http://dx.doi.org/10.1177/088626093008001008

Gallup, G.G., Jr. (1974). Animal hypnosis: Factual status of a fictional concept. *Psychological Bulletin*, *81*, 836–853. http://dx.doi.org/10.1037/h0037227

Gallup, G.G., Jr., Boren, J.L., Suarez, S.D., Wallnau, L.B., & Gagliardi, G.J. (1980). Evidence for the integrity of central processing during tonic immobility. *Physiology and Behavior*, 25, 189–194. http://dx.doi.org/10.1016/0031-9384(80)90206-1

Gallup, G.G., Jr., & Rager, D.R. (1996). Tonic immobility as a model of extreme states of behavioral inhibition: Issues of methodology and measurement. In P. R. Sanberg, K.P. Ossenkopp, & M. Kavaliers (Eds.), *Motor activity and movement disorders* (pp. 57–80). Totowa, NJ: Humana Press. http://dx.doi.org/10.1007/978-1-59259-469-6_2

Gladstone, G.L., Parker, G.B., Mitchell, P.B., Wilhelm, K.A. & Malhi, G.S (2005). Relationship between self-reported childhood behavioural inhibition and lifetime anxiety disorders in a clinical sample. *Depression and Anxiety, 22,* 103-113. http://dx.doi.org/10.1002/da.20082

Gudiño, O.G. (2013). Behavioral inhibition and risk for posttraumatic stress symptoms in Latino children exposed to violence. *Journal of Abnormal Child Psychology, 41*, 983-992. http://dx.doi.org/10.1007/s10802-013-9731-2

Guriel, J. & Fremouw, W. (2003). Assessing malingered posttraumatic stress disorder: A critical review. Clinical Psychology Review, 23, 881–904. http://dx.doi.org/10.1016/j.cpr.2003.07.001

Hagenaars, M.A., Brewin, C.R., Van Minnen, A., Holmes, E.A., & Hoogduin, C.A.L. (2010). Intrusive images and thoughts after an aversive film. Memory, 18, 76-84. http://dx.doi.org/10.1080/09658210903476522

Hagenaars, M.A. & Krans, J. (2011). Trait and state dissociation in the prediction of intrusive images. *International Journal of Cognitive Therapy, 4*, 145-153. http://dx.doi.org/10.1521/ijct.2011.4.2.145

Hagenaars, M.A., Oitzl, M. & Roelofs, K. (2014). Updating freeze: Aligning anima land human research. *Neuroscience and Biobehavioral Reviews, 47*, 165-176. http://dx.doi.org/10.1016/j.neubiorev.2014.07.021

Hagenaars, M.A. & Putman, P.L.J. (2011). Attentional control affects the relationship between tonic immobility and intrusive memories. *Journal of Behavior Therapy and Experimental Psychiatry, 42*, 379-383. http://dx.doi.org/10.1016/j.jbtep.2011.02.013

Hagenaars, M.A., Van Minnen, A., Holmes, E.A., Brewin, C.R., & Hoogduin, C.A.L. (2008). The effect of hypnotically-induced somatoform dissociation on intrusion development after an aversive film: An experimental study. *Cognition and Emotion, 22*, 944-963. http://dx.doi.org/10.1080/02699930701575151

Heidt, J.M., Marx, B.P., & Forsyth, J.P. (2005). Tonic immobility and childhood sexual abuse: a preliminary report evaluating the sequela of rape-induced paralysis. *Behaviour Research and Therapy, 43*, 1157–1171. http://dx.doi.org/10.1016/j.brat.2004.08.005

Hofmann, S.G., Alpers, G.W., Pauli, P. (2009). Phenomenology of panic and phobic disorders. In M.M. Antony & M.B. Stein (Eds.), Oxford Handbook of Anxiety and Related Disorders (pp. 34-46). New York, NY: Oxford University Press.

Jorm, A.F., Christensen, H., Henderson, A.S., Jacomb, P.A., Korten, A.E., & Rodgers, B. (1999). Using the BIS/BAS scales to measure behavioural inhibition and behavioural activation: Factor structure, validity and norms in a large community sample. *Personality and Individual Differences, 26*, 49-58. http://dx.doi.org/10.1016/S0191-8869(98)00143-3

Kalaf, J., Vilete, L.M.P., Volchan, E., Fiszman, A., Coutinho, E.S.F., Andreoli, S.B., Quintana, M.I., De Jesus Mari, J., & Figueira, I. (2015). Peritraumatic immobility in a large representative sample of the general population: association with posttraumatic stress disorder and female gender. *Comprehensive Psychiatry, 60*, 68-72. http://dx.doi.org/10.1016/j.comppsych.2015.04.001

Kalin, N.H., Shelton, S.E. (1989). Defensive behaviors in infant rhesus monkeys: environmental cues and neurochemical regulation. *Science, 243*, 1718–1721. http://dx.doi.org/10.1126/science.2564702

Kessler, R.C., Berglund, P., Demler, O., Jin R., Merikangas, K.R., & Walters, E.E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the national Comorbidity Survey Replication. *Archives of General Psychiatry, 62*, 593-602. http://dx.doi.org/10.1126/science.2564702

Laposa, J.M. & Alden, L.E. (2008). The effect of pre-existing vulnerability factors on a laboratory analogue trauma experience. *Journal of Behavior Therapy and Experimental Psychiatry, 39*, 424-435. http://dx.doi.org/10.1016/j.jbtep.2007.11.002

Lawrence, J.W. & Fauerbach, J.A. (2003). Personality, coping, chronic stress, social support and PTSD symptoms among adult burn survivors: A path analysis. *Journal of Burn Care and Rehabilation, 24*, 63-72. http://dx.doi.org/10.1097/00004630-200301000-00016

Lima, A.A., Fiszman, A., Marques-Portella, C., Mendlowicz, M.V., Coutinho, E.S., Maia, D.C., ... Figueira, I. (2010). The impact of tonic immobiity reaction on the prognosis of posttraumatic stress disorder. *Journal of Psychiatric Research*, 44, 224-228. http://dx.doi.org/10.1016/j.jpsychires.2009.08.005

Lin, T., Vaisvaser, S., Fruchter, E., Admon, R., Wald, I., Pine, D.S., Bar-Haim, Y. & Hendler, T. (2015. A neurobehavioral account for individual differences in resilience to chronic military stress. *Psychological Medicine, 45*, 1011-1023. http://dx.doi.org/10.1017/S0033291714002013

Maia, D.B., Nobrega, A., Marques-Portella, C., Mendlowicz, M.V., Volchan, E., Coutinho, E.S., Figueira, I. (2015). Peritraumatic tonic immobility is associated with PTSD symptom severity in Brazilian police officers: a prospective study, Revista Brasileira de Psiquiatria, 37, 49–54. http://dx.doi.org/10.1590/1516-4446-2013-1267

Marx, B.P., Forsyth, J.P., Gallup, G.G., Fusé, T., & Lexington, J.M. (2008). Tonic immobility as an evolved predatory defense: Implications for sexual assault victims. *Clinical Psychology: Science and Practice, 15(1)*, 74-90. http://dx.doi.org/10.1111/j.1468-2850.2008.00112.x

McCaul, K.D., Veltum, L.G., Boyechko, V., & Crawford, J.J. (1990). Understanding attributions of victim blame for rape: Sex, violence, and foreseeability. *Journal of Applied Social Psychology*, *20*, 1–26. http://dx.doi.org/10.1111/j.1559-1816.1990.tb00375.x

McCaslin, S.E., Inslicht, S.S. Metzler, T.J. Henn-Haase, C., Maguen, S, Neylan, T.C. Choucroun, G. & Marmar, C.R. (2008). Trait Dissociation Predicts Posttraumatic Stress Disorder Symptoms in a Prospective Study of Urban Police Officers. Journal of Nervous and Mental Disease, 196, 912-918. http://dx.doi.org/10.1097/NMD.0b013e31818ec95d

McNally, R.J. & Frueh, B.C. (2013). Why are Iraq and Afghanistan War veterans seeking PTSD disability compensation at unprecedented rates? *Journal of Anxiety Disorders, 27*, 520–526. http://dx.doi.org/10.1016/j.janxdis.2013.07.002

McNaughton, N. & Gray, J.A. (2000). Anxiolytic action on the behavioural inhibition system implies multiple types of arousal contribute to anxiety. *Journal of Affective Disorders, 61*, 161-176. http://dx.doi.org/10.1016/S0165-0327(00)00344-X

Merckelbach, H., Langeland, W., De Vries, G. & Draijer, N. (2014). Symptom overreporting obscures the dose–response relationship between trauma severity and symptoms. Psychiatry Research, 217, 215-219. http://dx.doi.org/10.1016/j.psychres.2014.03.018

Mezey, G.C., & Taylor, P.J. (1988). Psychological reactions of women who have been raped: A descriptive and comparative study. *British Journal of Psychiatry*, *152*, 330–339. http://dx.doi.org/10.1192/bjp.152.3.330

Morgan, H. J., & Janoff-Bulman, R. (1994). Positive and negative self-complexity: Patterns of adjustment following traumatic versus non-traumatic life experiences. *Journal of Social and Clinical Psychology, 13,* 63-85. http://dx.doi.org/10.1521/jscp.1994.13.1.63

Ozer, E.J., Best, S.R., Lipsey, T.L., & Weiss, D.S. (2003). Predictors of posttraumatic stress disorder and symptoms in adults: A meta-analysis. *Psychological Bulletin*, *129*, 52–73. http://dx.doi.org/10.1037/0033-2909.129.1.52

Ratner, S.C. (1967). Comparative aspects of hypnosis. In J.E. Gordon (Ed.), *Handbook of clinical and experimental hypnosis* (pp. 550-587). New York: Macmillan.

Reichenheim, M., Souza, W., Coutinho, E.S.F., Figueira, I., Quintana, M.I., de Mello, M.F., Bressan, R.A., de Jesus Mari, J., Andreoli, S.B. (2014). Structural validity of the tonic immobility scale in a population exposed to trauma: Evidence from two large Brazilian samples. PloS One, 9, e94367. http://dx.doi.org/10.1371/journal.pone.0094367

Rizvi, S.L., Kaysen, D., Gutner, C.A., Griffin, M.G., & Resick, P.A. (2008). Beyond fear; The role of peritraumatic responses in posttraumatic stress and depressive symptoms among female crime victims. *Journal of Interpersonal Violence, 23*, 853-868. http://dx.doi.org/10.1371/journal.pone.0094367

Rocha-Rego, V., Fiszman, A., Portugal, L.C., Pereira, M.G., De Oliveira, L., Mendlowicz, M.V., . . . Volchan, E. (2009). Is tonic immobility the core sign among conventional peritraumatic signs and symptoms listed for PTSD? *Journal of Affective Disorders, 115*, 269–273. http://dx.doi.org/10.1016/j.jad.2008.09.005

Schmidt, N.B., Richey, J.A., Zvolensky, M.J., & Maner, J.K. (2008). Expploring human freeze responses to a stressor. *Journal of Behavior Therapy and Experimental Psychiatry, 39*, 292-304. http://dx.doi.org/10.1016/j.jbtep.2007.08.002

Spiegel, D. (1995). Hypnosis and suggestion. In D. Schacter (Ed.), *Memory distortion* (pp. 129–149). Cambridge, MA: Harvard University Press.

Spielberger, C.D., Gorsuch, R.L., Lushene, R., Vagg, P.R., & Jacobs, G.A. (1983). *Manual for the State-Trait Anxiety Inventory (FormY)*. Palo Alto, CA: Consulting Psychologists Press.

Stein, M.B., Walker, J.R., Hazen, A.L., & Forde, D.R..(1997). Full and partial posttraumatic stress disorder: Findings from a comminity survey. *American Journal of Psychiatry, 154*, 1114-1119. http://dx.doi.org/10.1176/ajp.154.8.1114

Van der Ploeg, H., Defares, P. & Spielberger, C. (1980). *Handleiding bij de Zelf-Beoordelings Vragenlijst. Een Nederlandse bewerking van de Spielberger State-Trait Anxiety Inventory*. [Manual of self-reported questionnaire. A Dutch translation of the Spielberger State-Trait Anxiety Inventory]. Lisse, Netherlands: Swets and Zeitlinger BV.

Van der Velden, P.G. & Wittmann, L. (2008). The independent predictive value of peritraumatic dissociation for PTSD symptomatology after type I trauma: A systematic review of prospective studies. *Clinical Psychology Review, 28*, 1009-1020. http://dx.doi.org/10.1016/j.cpr.2008.02.006

Van IJzendoorn, M.H. & Schuengel, C. (1996). The measurement of dissociation in normal and clinical populations: meta-analytic validation of the Dissociative Experiences Scale (DES). *Clinical Psychology Review, 16*, 365–382. http://dx.doi.org/10.1016/0272-7358(96)00006-2

Von Borries, A.K.L., Volman, I., De Bruijn, E.R.A., Bulten, B.H., Verkes, R.J., & Roelofs, K. (2012). Psychopaths lack the automatic avoidance of social threat: Relation to instrumental aggression. *Psychiatry Research, 200(2-3)*, 761-766. http://dx.doi.org/10.1016/j.psychres.2012.06.026

Watsky, M.A. & Gruber, S.A. (1990). Induction and duration of tonic immobility in the lemon shark. *Negaprion Brevirostris. Fish Psysiology and Biochemistry,* 8(3), 207-210. http://dx.doi.org/10.1007/BF00004459

Weems, C.F., Pina, A.A., Costa, N.M., Watts, S.E., Taylor, L.K., & Cannon, M.F. (2007). Predisaster trait anxiety and negative affect predict posttraumatic stress in youth after Hurricane Katrina. *Journal of Consulting and Clinical Psychology*, *75*, 154–59. http://dx.doi.org/10.1037/0022-006X.75.1.154

Wohlfarth, T.D., Van den Brink, W., Winkel, F.W., & Ter Smitten, M. (2003). Screening for posttraumatic stress disorder: An evaluation of two self-report scales among crime victims. *Psychological Assessment, 15*, 101-109. http://dx.doi.org/10.1037/1040-3590.15.1.101

Zoellner, L.A. (2008).Translational challenges with tonic immobility. *Clinical Psychology Science and Practice, 1*, 98-101. http://dx.doi.org/10.1111/j.1468-2850.2008.00114.x