

An Exploratory Study into the Development and Maintenance of Posttraumatic Stress Symptoms Following Large-Scale Disasters

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Abstract

Following a life-threatening event some survivors continue to suffer from clusters of hyperarousal, intrusion, and avoidance symptoms. In an attempt to understand maintaining and mitigating factors for these symptom clusters, exploratory studies were conducted in Sri Lanka with a population exposed to the immediate aftermath of the 2004 tsunami and in Africa with a population exposed to war-related trauma. Results revealed similar significant correlations in both populations between current perceived risk of life-threat and the three symptom clusters. A broader study conducted with the African population also revealed significant correlations between: hyperarousal and exposure to life-threat; hyperarousal and current refuge; and intrusion and current refuge. Analysis of strategies adopted to negotiate trauma revealed that compared to no strategy, a spiritual strategy was the only strategy to have significantly lower mean scores on intrusions, current perceived risk of life-threat and current refuge. Results are discussed within an ecological model of preparatory antipredator defensive responses. Implications for interventions following large-scale disasters and limitations of the study are discussed.

1. Introduction

Traumatic events, both natural (e.g., earthquakes, floods) and man-made (e.g., war, rape, accidents) are part of the human experience and one that the majority of people will adaptively negotiate. However, for reasons not yet fully understood some people do not recover and go on to suffer debilitating physical and psychological symptoms. One cluster of posttraumatic symptoms that is particularly debilitating if experienced in an ongoing manner is trauma-related intrusion, hyperarousal and avoidance symptoms.

These posttraumatic symptom clusters have been described and identified as problematic symptoms after a traumatic event in various literary sources for centuries (Lipton, 1994). However, in 1980, these symptom clusters became operationalised as a distinct psychological disorder and included in the Diagnostic and Statistical Manual of Mental Disorders (DSM-III) as Posttraumatic Stress Disorder (PTSD). In order to meet criteria for PTSD the symptom clusters became gated by the following criteria: the symptoms had to be present (1) a minimum of one month after a traumatic event, (2) the traumatic event had to be one in which the person experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others and (3) the person's response involved intense fear, helplessness, or horror (American Psychiatric Association, 1980). Thus the symptom clusters have to be present one month after an actual life-threatening event that had been associated with powerful negative emotions in order to be diagnosed with PTSD.

Although operationalised in a Western context, descriptions of PTSD symptoms in early literature suggest that it is not a new or culture-bound phenomena (Lipton, 1994). The recent diagnosis of PTSD in non-Western communities such as the Kalahari bushman (McCall & Resick, 2003), American Indians (Beals et al. 2005), Guatemalan refugees (Sabian, Cardozo, Nackerud, Kaiser & Varese, 2006) and Africans exposed to war atrocities (Dawson, 2005) also reveal that PTSD is not culture bound. However, despite its seeming universal presence over centuries and between cultures, the precise mechanisms that underlie the disorder remain largely unknown.

Early psychological theories explained the symptoms as an ongoing stress reaction. Later research challenged this explanation when it was discovered that underlying biological changes

went in the opposite direction to a stress reaction. For example, in chronic stress cortisol levels are commonly high, glucocorticoid receptor levels are low, negative feedback inhibition is eroded and the hypothalamic-pituitary-adrenal (HPA) axis is progressively desensitised (Yehuda, 1998). In contrast to chronic stress, PTSD is reported to have low cortisol levels, an increase in glucocorticoid receptor sensitivity and stronger negative feedback inhibition (Yehuda, 1998; Yehuda, Golier, Yang & Tischler, 2004). Subsequent influential theories have proposed various combinations of fear conditioning principles, memory and information processing problems, and idiosyncratic cognitive distortions to explain the ongoing presence of these symptom clusters in PTSD (e.g., Foa, Huppert, & Cahill, 2006; Elzinga & Bremner, 2002; Ehlers & Clark 2000; Brewin, Dagleish & Joseph 1996). However, the dominant psychological theories do not adequately address recent neurobiological data that suggests that PTSD is largely driven by neurobiological pre-attentive processes that enhance survival.

Neuroimaging studies have shown that in neutral conditions there is an increase in cerebral blood flow in brainstem regions in PTSD subjects compared to non-PTSD subjects indicating increased baseline arousal of the autonomic nervous system (Bonne et al., 2003). The limbic region, in particular the amygdala, exhibits exaggerated functioning in PTSD, whilst cortical regions have been shown to have reduced functioning in PTSD subjects compared to non-PTSD subjects (see Bonne et al., 2003; Armony, Corbo, Clement, & Brunet, 2005; Chae et al., 2004; Shin et al., 2005; Williams et al., 2006).

In life-threatening situations the amygdala is known to initiate defensive survival responses (e.g., fight, flight or freeze) through activating the autonomic nervous system to a heightened sense of arousal (Le Doux, 1998). Under life-threatening conditions cortical areas such as the medial prefrontal cortex (mPFC) are known to become hypoactive, diminishing cognitive processing and thus allowing sympathoexcitatory circuits to be disinhibited and energy reserves released to maximise survival (Thayer & Brosschot, 2005). The similar pattern across brain regions in PTSD suggests that underlying neurobiological defensive survival processes may drive PTSD symptoms. The underlying neurobiological changes outlined previously and those outlined as follows are consistent with this hypothesis. For example, PTSD subjects exhibit a higher noradrenergic activity under baseline conditions (Geraciotti et al, 2001), reduced pre-pulse inhibition (Grillon, Morgan, Southwick, Davis & Charney, 1996), diminished P50 sensory gating (Ghisolfi et al., 2004) and an exaggerated startle reflex (Grillon & Morgan, 1999), all of which

enhance automatic pre-attentive threat processing and responding over conscious emotional evaluation and decision making.

Current theories also do not adequately account for a growing body of research that highlights the role of post-trauma contextual factors in the development and maintenance of PTSD. For example factors such as poor social/emotional support (Joseph, 1999; Ozer, Best, Lipsey & Weiss, 2003), poverty, discrimination, social inequalities (Kubiak, 2005), forced migration (Steel, Frommer, & Silove, 2004), and additional life stressors (Brewin, Andrews & Valentine, 2000; Mayou, Ehlers & Bryant, 2002) have all been identified as risk factors for PTSD. A study by Maes, Mylle, Delmeire and Janca (2001) with survivors from two man-made traumatic events found that stressful life events prior to the traumatic event had no relationship with the development and severity of PTSD. In contrast, post-trauma stressful events such as loss of income, serious illness, broken relationships, death or illness in the family were found to have highly significant relationships between the incidence and the severity of PTSD. Schnurr, Lunney and Sengupta (2004) explored development versus maintenance of PTSD and found that what occurred before, during and after the traumatic event was related to the development of PTSD, but that current PTSD was maintained by current environmental factors.

At present it is unclear how these post-trauma variables interact to prolong the course and severity of PTSD. This gap in knowledge may contribute to the limited efficacy of current therapies in mitigating trauma symptoms (see Scott and Stradling, 1997; Zayfert et al., 2005; Ehlers, Clark, Hackman, McManus & Fennel, 2005) and the reported ineffectiveness or even harm from early debriefing procedures (e.g., Small, Lumley, Donohue, Potter, & Waldenstrom, 2000; Van Emmerik, Kamphuis, Hulsbosch & Emmelkamp, 2002; Rose, Bisson, Churchill & Wessely, 2002). The role of neurobiological defensive survival processes and post-trauma factors in the development and maintenance of PTSD is therefore an important focus of research.

Fear is an adaptive mechanism known to trigger defensive survival responses and appears to utilise similar brain structures and responses across mammalian species (Lang, & Davis, 2006; Rosen and Schilkin, 1998; Blanchard, Hyne, Minke, Minemoto & Blanchard, 2001). In light of this similarity across species, a relevant body of literature that may help in understanding the role of survival processes and post-trauma variables in PTSD is animal predator-prey studies. Animal studies reveal that fear mechanisms triggered by the immediate presence of a predator (threat to

life) will promote a defensive behavioural response of fight, flight or freeze (Le Doux, 1998). If the animal manages to escape the immediate proximity of the predator, or is foraging in a threatening context, fear mechanisms trigger preparatory antipredator responses rather than defensive behaviours such as fight, flight or freeze (Jelen, Soltysik & Zagrodzka, 2003).

Kavaliers & Choleris (2001) outline these preparatory antipredator responses as being predator apprehension and vigilance and threat-sensitive predation avoidance. Predator apprehension refers to the animal reducing attention to their general activities and increasing their attention to detecting and responding to potential predators. Predator vigilance refers to a behavioural state of heightened arousal and scanning for threat. Predation avoidance refers to the avoidance of direct predator cues (visual, tactile, auditory) that indicate a predator is in immediate proximity. The maintenance or extinction of these preparatory antipredator responses is modulated by an interrelationship between predation risk, the prey animals exposure history (intensity and number), the prey animals ability to continue daily tasks such as foraging whilst still remaining vigilant, the prey animals ability to escape pursuit by a predator, and access to refuge/cover from the predator (Kavaliers & Choleris, 2001).

The outlined antipredator behaviours of apprehension, vigilance and avoidance have a striking resemblance to human posttraumatic intrusion, hyperarousal and avoidance symptoms. Intrusion symptoms refer to intrusive thoughts and feelings about the traumatic event and a heightened physiological reactivity and distress to threat cues (i.e., less attention to general activities and more attention to threat cues that intrude into awareness). Hyperarousal refers to symptoms such as difficulty falling or staying asleep, irritability or outbursts of anger, difficulty concentrating, exaggerated startle response and hypervigilance (i.e. heightened arousal and scanning for threat). Avoidance refers to efforts to avoid thoughts, feelings, memories, places, stimuli or conversations associated with the trauma (i.e., avoidance of direct visual, tactile, auditory predator cues).

If similar antipredator/anti-threat mechanisms operate in animals and humans then it is possible that similar mechanisms also modulate their maintenance or extinction. Modulators of posttraumatic stress symptoms in humans analogous to modulators of animal preparatory antipredator responses would be current perceived risk of life threat (e.g., high or low), individual exposure to life threat (chronic or occasional exposure to threat; high or low intensity threat), individual resources to negotiate the threat (e.g., skills, strategies) and access to environmental

refuge from threat. There is already partial evidence to suggest that these are modulators of posttraumatic symptoms. For example, high exposure levels to threat (Carr, Lewin, Webster & Kenardy, 1997; Parslow, Jorm, & Christensen, 2006), a high level of perceived threat (Giannopoulou, et al., 2006), low individual intellectual and emotional resources (Heilemann, Kury & Lee, 2005) and limited environmental resources (Kubiak, 2005) are all associated with PTSD.

The aim of this study is to broadly investigate whether the predator-prey model of preparatory antipredator responses is a useful framework for understanding the development and maintenance of posttraumatic symptoms in humans. Specifically, to explore whether current perceived risk of life threat, threat exposure, individual resources to negotiate threat, and access to environmental refuge also modulate posttraumatic symptoms clusters of intrusion, hyperarousal and avoidance in human trauma survivors. To achieve this aim, self-report data on posttraumatic symptoms and variables analogous to antipredator modulating variables was collected from a cross-cultural community sample of untreated trauma survivors exposed to large-scale disasters (natural and man-made). Trauma populations from large-scale disasters were used to limit differences in type of trauma exposure. A trauma population exposed to horrific war atrocities (Africa) was administered the Impact of Event Scale-Revised (IES-R) and a trauma population exposed to the immediate aftermath of the 2004 tsunami (Sri Lanka) was administered a translated version of the IES-R as a measure of posttraumatic stress symptoms. A single question relating to current perceived risk of life-threat was included in the measure.

The African population was asked additional questions to measure individual resources and environmental refuge. Measurement of environmental refuge was restricted to its use in the animal literature of a safe cover or refuge from predation (life-threat). Subjective rating to the question “Do you feel unsafe now as a result of the trauma?” was taken to indicate the degree of refuge attained post-trauma. “Did you fear you would die throughout the traumatic event?” was taken as an indication of perceived exposure to life-threat. A qualitative open-ended question was asked relating to individual resources/strategies so as to avoid cultural assumptions about the sort of strategies that may be used to negotiate the threat. For example, local leaders from Northern Uganda reported that rebel commanders commonly forced the children they abducted to drink human blood as protection from nightmares and other fear related symptoms. Written trauma narratives were included to enrich statistical data and to ensure that the identified

traumatic event met DSM-IV criteria of a life-threatening event. The relationships between modulating variables and posttraumatic intrusion, hyperarousal and avoidance symptoms were explored using analysis of variance (ANOVA) and correlational analyses.

2. Method

2.1 Participants

Participants resided in two different cultural contexts, Sri Lanka and Africa. The Sri Lankan participants were 96 Sri Lankan adults who had been exposed to the immediate aftermath of the 2004 tsunami through various helping roles. The participants had travelled to assist their countrymen in the immediate aftermath of the tsunami. The African participants were 68 African community leaders or people helpers from Sudan, The Democratic Republic of the Congo (DRC) and Uganda who had either experienced or witnessed horrific civilian war atrocities (e.g., rape, mutilation, massacres, murder, death from HIV) and/or loss of loved ones. There were two participants who referenced fatal motor vehicle accidents as the trauma and one a burns accident. Due to cultural and political factors in both of these countries it was agreed that data such as age, gender and country (for African countries) in which the trauma occurred would not be collected to maximise a sense of complete anonymity.

2.2 Materials

2.2.1 The Impact of Events Scale-Revised (IES-R)

The Impact of Events Scale-Revised (Weiss & Marmar, 1997) was used as a measure of current posttraumatic intrusion, hyperarousal and avoidance symptoms. The scale is comprised of 22 items and is a self-report measure of current posttraumatic symptoms relating to a specific trauma and has a high convergent validity with other PTSD measures (see Ljubotina & Muslic, 2003). Each item asks for a subjective rating on a 5-point Likert scale (0 = not at all; 1 = a little bit; 2 = moderately; 3 = quite a bit; 4 = extremely). It is comprised of three subscales that measure the core PTSD symptom clusters of avoidance, hyperarousal and intrusion. Scoring is computed by using the mean of non-missing items for each subscale and total (Weiss & Marmar, 1997). Cut-off scores above 1.5 (raw score of 33/34) for the total scale have been shown to be reliable for the detection of PTSD (sensitivity = 0.91, specificity = 0.82, Creamer, Bell, & Failla, 2003; sensitivity = 0.86, specificity 0.86, Huang, Zhang & Xiang, 2006). The English version

(IES-R) used with African participants has been validated in relevant studies as a measure of posttraumatic symptoms (see Weiss & Marmar, 1997; Creamer et al., 2003). The Sri Lankan version (IES-R-SL) was validated as having similar construct validity to the English version of the IES-R (see Dawson, Ariadurai, Fernando & Refuge, 2007). A French version of the IES-R was used with three French speaking Congolese participants (see Brunet, St-Hilaire, Jehel & King, 2003 for validation of French version).

2.2.2 Current perceived risk of life-threat

Current perceived risk of life-threat was assessed by a subjective rating on a 5-point Likert scale (identical to IES-R) to the question “Do you fear for your life now as a result of the tsunami” (Sri Lanka) or “Do you fear for your life now as a result of the traumatic event” (Africa). The item was included on the IES-R-SL in Sri Lanka and was included in an additional trauma questionnaire administered to the African population.

2.2.3 Personal trauma questionnaire

The personal trauma questionnaire consisted of four questions and was administered to the African population only. Two questions were scored on a Likert scale identical to the IES-R. “Did you fear you would die throughout the traumatic event?” (Q1 = Threat Exposure) and “Do you feel unsafe now as a result of the traumatic event?” (Q2 = Level of Refuge). Two qualitative questions were asked, “Describe in as much detail as possible the beginning, middle and end-point of the trauma” (Q3 = Trauma Narrative) and “Describe in as much detail as you can any strategies or actions that you have taken to lessen the impact of the traumatic event on your life” (Q4 = Individual Resources). Refer to the introduction for the rationale underlying questions.

2.3 Procedure

Participants were drawn from a pool of community identified rural leaders, nurses, school principals, teachers, youth workers, social workers and lay helpers attending people-helping workshops in Sri Lanka and Africa. The principal researcher gave all participants instructions on how to fill out the relevant questionnaires and procedures to follow should they become distressed. The voluntary nature of the questionnaires was reinforced. Questionnaires were returned anonymously to a central collection point over a 24-hour period.

2.4 Analysis

All statistical analyses were carried out using SPSS version 12. The IES-R and IES-R-SL were scored according to the procedure outlined by Weiss & Marmar (1997). Pearson's correlations were carried out to test the relationship between subjective ratings of posttraumatic symptoms as measured by the IES-R and IES-R-SL total score and current perceived proximity of life-threat score (as per 2.2.2). A second correlational analysis was then conducted on the IES-R/(SL) subscale scores and current perceived proximity of life-threat score. Additional data from the African trauma population was analysed separately. Pearson's correlations were conducted on IES-R scores and subjective ratings of question one and question two. Regression analysis was then applied to the quantitative data to determine if any of the variables predicted scores on the IES-R.

The qualitative question relating to strategies used post-trauma was analysed by the following methodology. Analysis of respondents written answers revealed that the strategies used to mitigate the impact of the trauma naturally fell into five discrete categories: 1 = no strategy at all; 2 = spiritual strategies (prayer, faith/trust in God, spiritual rituals); 3 = avoidance (avoided place, thoughts, reminders); 4 = behavioural action (e.g., whistling when walking past feared place); 5 = use of family and friends (e.g., sought help, advice, comfort). Three independent scorers were then each presented with the randomly shuffled handwritten answers to the question "describe in as much detail as you can any strategies or actions that you have taken to lessen the impact of the traumatic event on your life" and asked to place them in one of the five categories. For the small number of responses where there was not unanimous agreement, the response coded similarly by two of the three raters was entered into the analysis. Analysis of variance (ANOVA) and planned comparisons were then carried out to explore the interrelationship of variables with strategies.

3. Results

Four subjects' responses were discarded from the African data set, as the trauma narratives did not meet DSM-IV criteria of a traumatic event (e.g., they described break-up of relationship, betrayal by a friend) and one was discarded because it was incomplete. Descriptive statistics for mean IES-R and IES-R-SL scores are presented in Table 1.

Table 1. Means and standard deviations (SD) for the IES-R and IES-R-SL total and subscale scores.

	Sri Lanka (N = 96)		Africa (N = 63)	
	Mean	SD	Mean	SD
IES-R (SL) total	1.61	0.67	2.21	0.67
Intrusion	1.95	0.84	2.40	0.74
Hyperarousal	1.48	0.86	2.16	1.01
Avoidance	1.34	0.71	2.03	0.77

Cut-off scores are to be used with caution and can be taken only as an indication of potential PTSD. Further, data on the Sri Lankan population was also collected prior to one month post-trauma so diagnostically cannot be assigned PTSD. However, for purposes of exploring the course of PTSD, percentages above the recommended mean cut-off of 1.5 will be reported. At three weeks post-tsunami, 49% of the Sri Lankan participants were above the mean cut-off of 1.5 on the IES-R, and 82.5% of the African sample was above the mean cut-off of 1.5. This indicates the potential presence of PTSD in a large proportion of the participants, with the African sample exhibiting higher rates of potential PTSD.

3.1 Current perceived risk of life-threat

Pearson's correlations between subjective ratings of current perceived risk of life-threat and mean IES-R and IES-R-SL total scores are presented in Table 2. The relationship between these two measures was significantly and positively correlated and near identical between the two trauma populations.

Table 2. Pearson's correlations between subjective ratings of current perceived risk of life-threat and mean total score on the IES-R and IES-R-SL.

Modulating Variable	Country	<i>n</i>	IES-R & IES-R-SL
Perceived risk of life-threat	Sri Lanka (tsunami)	96	.565**
Perceived risk of life-threat	Africa (War-related)	63	.564**

** Correlation is significant at the 0.01 level (2-tailed)

Pearson’s correlations between subjective ratings of current perceived risk of life-threat as a result of the trauma and mean subscale scores on the IES-R and IES-R-SL are presented in Table 3. The relationship between current perceived risk of life-threat and all three subscales was significantly and positively correlated. Correlations were again nearly identical across the two trauma populations with the exception of hyperarousal in which Sri Lanka evidenced a higher correlation.

Table 3. Pearson’s correlations between subjective ratings of current perceived risk of life-threat and IES-R and IES-R-SL intrusion, hyperarousal and avoidance sub-scale scores.

Modulating Variable	Country	n	Intrusion	Hyperarousal	Avoidance
Current risk of life-threat	Sri Lanka	96	.478**	.553**	.403**
Current risk of life-threat	Africa	63	.477**	.487**	.402*

** Correlation is significant at the 0.01 level (2-tailed)

3.2 Trauma narrative with current high perceived risk of life-threat after witnessing a death

The following African trauma narrative places the above statistics in a human context and demonstrates how a current threat to one’s life can be perceived as high when the life-threat was witnessed rather than experienced. This respondent had answered the question “do you fear for your life now as a result of the trauma” with a 4 (extreme) and responded similarly to most items attempted on the IES-R (mean of completed items = 3.4) indicating she suffered greatly from core PTSD symptoms of hyperarousal, avoidance and intrusions. The following narrative was shared in person and recorded by the principal researcher at the respondent’s request. The two nationalities involved in the narrative have been replaced with an X and Y to maintain anonymity.

“I was looking down the road from the balcony of my apartment - watching two groups of young men. They walked up the main road from the beach, down past the Post Office and then down to an apartment building nearby. They were looking for soldiers. On the bottom floor of the building were Y-nationality and the next three floors were where X-nationality soldiers were living. There was a boy in only shorts because he had been in the bathroom – he saw them coming so he ran outside of the building and went down to the left but they were waiting for him

... they smashed his head in with bricks and stones. After the two groups left I walked down to where the body was – from afar I wasn't afraid – I walked closer and closer and there was blood everywhere (the rest of the description of what was left of the boy is too graphic to record here). I became scared and wandered around and then around in bigger and bigger circles and then I don't remember anymore but I was told that I had fallen down onto the pavement near the body. This was at 12pm I collapsed and then I woke up 3 days later at 10.30 am in the hospital – the doctors had given me a drip in my arm so that I would stay asleep because I was not myself. When I woke up I could feel my arms and myself again. Before this time I was not afraid because it is the X-nationality soldiers who are hated where I live". As she went to form her next sentence she became distressed so the narrative was stopped and she was taken through braking and calming techniques (see Rothschild, 2004 for description of techniques) until her arousal levels were safely reduced. She then continued her trauma narrative whilst holding the principal researcher's hand in a vice-like grip "Up close I realised that the boy was Y-nationality (like her) not X-nationality - so that meant that the same thing could happen to me – I could be killed in the same way". The threat had now been personalised – the young woman now perceived that her life was at high risk because she too was of Y-nationality.

3.3 Correlations between IES-R subscales and modulating variables

Pearson's correlations were carried out between mean IES-R subscale scores and modulating variables (refuge, exposure and current risk of life-threat). Correlations are presented in Table 4.

Table 4. Pearson's correlations between subjective ratings of level of refuge, threat exposure, perceived current risk of life-threat and mean IES-R intrusion, hyperarousal and avoidance subscale

Variable	n	Intrus	Hyper	Avoid	Refuge	Exposure	Risk
Risk	n = 62	.477**	.487**	.402**	.524**	.550**	1
Exposure	n = 62	.221	.434**	.125	.538**		
Refuge	n = 62	.412**	.505**	.135			
Avoidance	n = 62	.329**	.348**				
Hyperarousal	n = 62	.753**					

** Correlation is significant at the 0.01 level (2-tailed)

All three modulating variables were significantly correlated with each other. There was a significant positive correlation between: hyperarousal and intrusion, hyperarousal and threat exposure, and hyperarousal and level of refuge. Level of refuge was also correlated with intrusion. Avoidance was significantly correlated with hyperarousal and intrusion but to a much lesser degree than hyperarousal and intrusion suggesting that avoidance taps into a separate construct. There were no significant correlations between avoidance and refuge, and avoidance and exposure.

3.4 Predictors

A regression analysis was carried out to determine which modulating variables best predicted scores on the IES-R. Scores from questions regarding threat exposure, refuge, and current perceived proximity of life-threat were entered in a regression analysis to predict scores on the IES-R. Analysis revealed perceived current risk of life-threat was a significant contributor to the explained variance of IES-R scores ($\beta = .483, P \leq 0.001$). The other two variables did not reach significance. Current perceived risk of life-threat threat accounted for 35% [$F(1,57) = 10.165, P = < 0.0001$] of the variance on the IES-R score.

3.5 Strategies to mitigate impact of trauma

Data on post-trauma strategies was analysed separately to the other variables, as it was qualitative rather than quantitative. To examine if type of strategy used impacted IES-R scores a separate ANOVA was conducted. Follow-up planned comparisons between estimated marginal means of the 'no strategy group' versus the other four strategy groups on significant variables were then conducted. Alpha was adjusted for multiple comparisons (alpha of $.05 / 4 = .0125$). Table 5 outlines results of planned comparisons.

The ANOVA revealed a significant effect of type of strategy used on IES-R scores [$F(4,51) = 4.914, P = < 0.01$]. Follow up tests on IES-R subscales and modulating variables revealed a significant effect of strategy on intrusions [$F(4,54) = 3.279, P = < 0.05$], avoidance [$F(4,54) = 4.038, P = < 0.01$], current perceived proximity of life-threat [$F(4,54) = 4.481, P = < 0.01$] and refuge [$F(4,54) = 3.444, P = < 0.05$]. There was no significant effect of strategy on threat exposure [$F(4,54) = 1.467, P = > 0.05$] or hyperarousal [$F(4,54) = 2.436, P = > 0.05$].

Table 5. Planned comparisons between the no-strategy group and the other four strategy groups (spiritual, avoidance, family and friends) on significant variables.

		Strategy	<i>n</i>	Mean	Significance
Intrusion	No strategy <i>n</i> = 14	Spiritual	12	<i>M</i> = 1.932	.009**
		Avoidance	11	<i>M</i> = 2.774	.760
		Behavioural Response	9	<i>M</i> = 2.066	.206
		Family & Friends	10	<i>M</i> = 2.117	.054
Avoidance	No strategy <i>n</i> = 14	Spiritual	12	<i>M</i> = 1.713	.153
		Avoidance	11	<i>M</i> = 2.637	.041
		Behavioural Response	9	<i>M</i> = 2.066	.242
		Family & Friends	10	<i>M</i> = 1.993	.319
Current perceived risk of life-threat	No strategy <i>n</i> = 14	Spiritual	12	<i>M</i> = 1.713	.000 **
		Avoidance	11	<i>M</i> = 2.637	.377
		Behavioural response	9	<i>M</i> = 2.066	.176
		Family & friends	10	<i>M</i> = 1.993	.086
Refuge	No strategy <i>n</i> = 14	Spiritual	12	<i>M</i> = 1.713	.001**
		Avoidance	11	<i>M</i> = 2.637	.223
		Behavioural response	9	<i>M</i> = 2.066	.055
		Family & friends	10	<i>M</i> = 1.993	.143

4. Discussion

This study found that an animal predator-prey model was a valid cross species model to investigate factors that modulate posttraumatic symptoms of intrusion, hyperarousal and avoidance in human trauma populations. Modulating factors analogous to animal preparatory antipredator modulating factors were found to be significant correlated with posttraumatic avoidance, hyperarousal and intrusion symptoms. Correlations between posttraumatic symptoms as measured by the IES-R and IES-R-SL and current perceived proximity of life-threat were near identical across two culturally diverse trauma populations (African and Sri Lanka) who experienced two different types of trauma (man-made and natural) and were at different phases post-trauma (acute and chronic). This similarity in correlations suggests that current perceived risk of life-threat is a stable contributor to posttraumatic symptoms across cultures, types of trauma and course of trauma. Correlations between the three subscales and current perceived risk

of life-threat were also near identical, with hyperarousal just slightly higher in the Sri Lankan population (.533 compared to .487). The higher hyperarousal correlation in this population may be due to the recent nature of the traumatic event (three weeks) in contrast to the African population where events had occurred months or years ago in some cases.

The broader African study revealed that current perceived risk of life-threat was a significant predictor of posttraumatic symptoms as measured by the IES-R, accounting for 35% of the variance. The variables measuring individual exposure to life-threat and available refuge were not significant predictors of posttraumatic symptoms. However, the modulating variables entered into the regression analysis were significantly correlated (see Table 4) with possible causal relationships existing between them thus obscuring the effects of the other two predictors.

The finding that current perceived risk of life-threat is related to present posttraumatic symptoms is consistent with Ehlers and Clark's (2000) hypothesis that a sense of current threat maintains PTSD symptoms. However, in contrast to Ehlers and Clark's (2000) broader sense of current threat, the predator-prey model highlights a specific threat, a current threat to life. Based on the research supporting Ehlers and Clark's threat model (see Ehlers, Mayou & Bryant, 2003; Black & White, 2005), cognitive distortions about the actual risk of life-threat are likely to have a contributing role to the severity of posttraumatic symptoms by inflating the perception of threat. However, the data from this study suggests that broader environmental factors and personal resources to negotiate threat also modulate the severity of posttraumatic symptoms.

Consistent with other studies (e.g., Asukai et al., 2002; Creamer et al., 2003), intrusion and hyperarousal were highly correlated with each other (.753) but minimally correlated with avoidance (.329 and .348 respectively), suggesting that avoidance represents a separate construct to intrusion and hyperarousal. Avoidance was positively correlated with current perceived risk of life-threat only, suggesting that avoidance is associated with a discrete threat to life. The higher the perceived risk of life-threat, the higher the level of avoidance to cues that predict a life-threat/predator is near. In contrast, intrusion and hyperarousal symptom clusters were also significantly correlated with perceived level of refuge, suggesting that these posttraumatic symptoms may also be related to general environmental security/insecurity. A recent study in disaster workers following the 2001 September 11th terrorist attacks in New York supports this distinction between avoidance symptoms and hyperarousal and intrusion symptoms. Lower

perceived safety was reported to be associated with intrusion and hyperarousal symptoms but not avoidance symptoms (Fullerton, Ursano, Reeves, Shigemura & Grieger, 2006).

The exploration of strategies used by the African participants revealed that of the four strategies implemented (spiritual, avoidance, family/friends and behavioural), only those who reported using spiritual strategies had significantly lower intrusion scores, lower current perceived risk of life-threat scores and lower refuge scores (lower score = higher refuge) when compared to those who had no strategy at all (i.e. no action taken). The lack of significant difference in scores between the group who reported talking/crying with friends and family and the group who had no strategy is surprising given the reported mitigating effects of social support on PTSD symptomatology (e.g., see Schnurr, et al., 2004; Haden, Scarpa, Jones & Ollendick, 2007). Talking/crying may provide comfort and understanding but it may not provide a sense of refuge in the African context where family and friends are also in danger.

Behavioural interventions were also not significantly different on mean scores from the no-strategy group. In the context of this study, where participants could affect little change in a violent war zone, the scale of the trauma may have limited the effectiveness and range of possible individual behavioral interventions. The seeming powerlessness against such large-scale ongoing trauma may also explain why spiritual strategies appears to have been the only strategy that had significantly lower intrusion scores, lower perceived current risk of life-threat scores and a perceived higher level of refuge than no strategy in mitigating trauma symptoms. The overwhelming nature of the war atrocities experienced by this group of participants (see Dawson, 2005 for background) may have required a focus beyond that of the individual and the immediate context. Spirituality may have provided a place of refuge, resources outside of oneself and a reduced fear of death. Spiritual beliefs regarding protection (i.e. God will protect us from harm) may also function as a mediator for lowering current perceived risk of life-threat and intrusions.

The effectiveness of spiritual strategies as a modulator of posttraumatic symptoms warrants further attention. Research on the benefits of spirituality is scant, but the limited research that is available suggests that the positive effect of spirituality found in this study may not be unique to an African population struggling with ongoing war atrocities. For example, Mehraby (2002), Calhoun, Cann, Tedeschi, and McMillan (2000), James and Wells (2002), and Castle and Phillips (2003) all highlight the healing benefits of incorporating culturally specific religious beliefs following trauma. Brune et al. (2002) found that a firm belief system (political or spiritual)

functioned as a highly effective coping strategy in refugees and Schiff (2006) found that religiosity buffered against the negative consequences of terrorism in Jewish adolescents. Similarly, Sistica-Castro and Sabatier (2005) report that globally, religiosity had a positive direct impact on adjustment and PTSD amongst Columbians who were internally displaced as a result of political violence.

Spiritual frameworks (e.g., Christianity, Hinduism) generally view death as a doorway to a more positive place or higher form of being. This belief may indirectly reduce posttraumatic symptoms by modulating their fear of life-threat. Linley and Joseph's (2005) study on changes following occupational death exposure lends support for this proposed modulating role. They discovered that death attitudes in funeral directors independently predicted positive and negative psychological reactions after exposure to traumatic deaths. An approach acceptance death attitude (seeing death as entry to a better place) predicted positive changes whereas a fear of death and death avoidance predicted negative changes. Ideological commitment to a cause has also been shown to buffer against PTSD (see Başoğlu et al., 1997; Laor et al., 2006). Immediate death is often not feared when fighting for a cause but rather can be viewed as the highest honour that one can attain.

The above findings are consistent Kavaliers and Choleris' (2001) outline of a prey animal's preparatory antipredator defensive responses to predation. Kavaliers and Choleris (2001) report that when a predator is believed to be in the vicinity but its specific whereabouts are uncertain, a level of general apprehension is adopted. The level of apprehension to the environment leads the animal to adopt an optimal level of vigilance to detecting predator cues in the surrounding environment. Level of perceived risk, exposure history (number and intensity of encounters) individual resources of the prey animal and available refuge from the predator modulate these levels of apprehension and vigilance. If direct predator cues (e.g., visual, tactile, auditory, olfactory) are detected, the animal is primed to rapidly respond with avoidance behaviours so as to minimise the risk of a direct encounter with the predator.

Extrapolating from the significant correlational patterns contained in this study a similar survival pattern is seen in humans. If an encountered life-threat is still perceived to be in the vicinity but its specific whereabouts are uncertain, an optimal level of intrusion (apprehension) and hyperarousal (vigilance) symptoms are adopted. The level of intrusion and hyperarousal

adopted is determined by interactions between the individual's perceived current risk of life-threat (predation risk), available refuge from life-threat (refuge from predator) and individual strategies to negotiate life-threat (resources of the prey animal to negotiate threat).

The trauma survivor's exposure history to life threat (number and intensity) also modulates the level of hyperarousal symptoms. If direct threat cues such as trauma-related visual, tactile, auditory cues are encountered (whereabouts of threat has been detected), the individual is primed to rapidly respond with avoidance behaviours (predation avoidance) minimising the risk of a direct encounter with the life-threat (predator). The level of avoidance adopted upon encountering a trauma cue is determined by current risk of life-threat (real or perceived) and individual resources to negotiate the threat (real or perceived).

The trauma narrative outlined in the Results section (3.2) offers insight into how a survival model still applies when a threat to life is witnessed rather than experienced. The horror of what had been witnessed from a distance and the horror of what had been witnessed up close by the young woman could easily have been mistaken as the central traumatising feature of her experience. However, from the flow of the narrative and the point at which she expressed most distress it appears that discovering the boy was of the same nationality as she, was the central traumatising feature. She now felt vulnerable to being killed in the same manner as she had witnessed, thus increasing her perceived risk of life-threat and triggering preparatory antipredator defensive responses to become operational. Research by Ursano, Fullerton, Vance, and Kao (1999) with disaster workers had similar findings reporting that identification with the deceased predicted PTSD.

The predator-prey model of preparatory antipredator responses and modulating factors investigated in this study offers explanation for why only some people go on to develop PTSD. Research shows that in the immediate aftermath of a traumatic event posttraumatic symptoms are present in a large proportion of people (Carr, et al., 1997; Schnyder, Moergeli, Klaghofer & Buddberg, 2001), suggesting that most people are compromised initially by a life-threatening event (experienced or witnessed). The findings from this study suggest that individual response differences (in the level of posttraumatic symptoms adopted in the aftermath of a life-threatening event) are determined by interrelationships between individual and environmental antipredator modulating variables. These variables continue to interact in a dynamic manner to either

maintain or mitigate adopted posttraumatic symptoms over subsequent weeks and months. Based on existing PTSD research literature and the findings from this study a proposed ecological model of posttraumatic symptoms is outlined below in Figure 1.

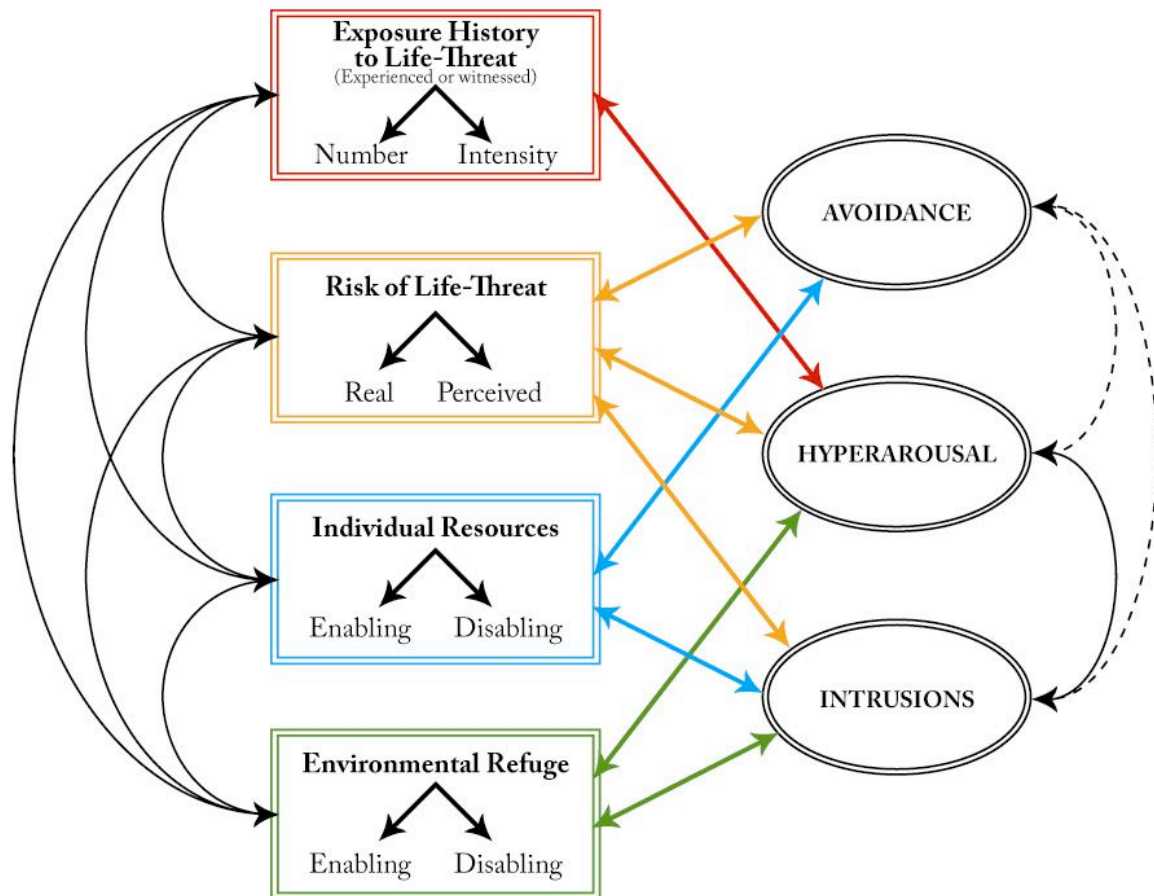


Figure 1. The ecological model of posttraumatic symptoms. In the immediate aftermath of a life-threatening event (experienced or witnessed) individual and environmental variables (real and perceived) interact to modulate the levels of posttraumatic avoidance, hyperarousal and intrusion symptom clusters adopted by the trauma survivor. Arrows represent ongoing dynamic interactions between variables, between symptoms, and between variables and symptoms. Broken arrows represent weaker interactions.

The proposed model highlights interrelationships between preparatory antipredator modulating variables and posttraumatic intrusion, hyperarousal and avoidance symptoms identified in this study. Characteristics of the antipredator modulating variables have been expanded upon to

incorporate existing research knowledge (animal and human). The number of exposures was included as PTSD research shows that a history of prior trauma is a risk factor for PTSD (Ozer et al., 2003). Idiosyncratic cognitions such as perceiving the world in negative manner is associated with higher posttraumatic symptoms (see Foa, Huppert and Cahill, 2006; Dunmore, Clark, & Ehlers, 1999), whilst viewing a traumatic event, as a random incident is associated with lower posttraumatic symptoms (see Winje, 1998). Current risk of life-threat was therefore divided into both real (based on current evidence) and perceived (based on idiosyncratic belief). Enabling and disabling categories were included in both individual resources and environmental refuge to incorporate available PTSD research literature. For example, dissociation (Ginzburg, Solomon, Dekel, & Bleich, 2006), low intelligence quotient (Vasterling et al., 2002), lack of social support (Ozer et al., 2003), low self-efficacy (Heinrichs et al., 2005), low self-confidence and low self-esteem (Rousseau, Drapeau & Rahimi, 2003) have been associated with the development of PTSD. In contrast positive emotion regulation (Cloitre, Stovall-McClough, Miranda & Chemtob, 2004), personal hardiness (Bonanno, 2004), high intelligence quotient (Silva et al., 2000) and social support (Vranceanu, Hobfoll & Johnson, 2007) have been associated with recovery from trauma.

Based on the above rationale, the ecological model of posttraumatic symptoms proposes that high exposure to life-threat (e.g., chronic exposure to war atrocities; high fear of death during the trauma), high current risk of life-threat (e.g., real = living in a war zone, domestic violence; perceived = threat beliefs based on past experience or anxious/fearful disposition), limited individual resources to negotiate threat (e.g., no faith/belief system, spiritual beliefs have been severely challenged by the life-threatening event, low intelligence quotient, poor emotional regulation, low self-efficacy) and low environmental refuge from perceived current threat (e.g., poor social network, civil war, forced migration, dysfunctional or non-existent family/friends, poverty, spiritual community killed or dispersed, meeting place for spiritual rituals destroyed) is hypothesised to lead to high levels of intrusion, hyperarousal and avoidance symptoms to enhance survival in an unsafe environment *i.e. high threat exposure x high current perceived risk of life-threat x low individual resources to negotiate life-threat x low or no refuge from life-threat = high posttraumatic symptoms (i.e. PTSD) to promote survival in an unsafe environment.*

In contrast, low exposure to life-threat (e.g., no prior trauma history, low fear of death during trauma), low perceived current life-threat (e.g., event seen as a one-off random event), high individual resources (e.g., a strong faith/belief system, spiritual belief system can accommodate the life-threatening event, high intelligence quotient, high self-efficacy, developed emotional regulation skills) and high environmental refuge (e.g., positive social network, safe geographical space, supportive family, financial resources, access to spiritual community and spiritual rituals) facilitates inhibition of posttraumatic stress responses and recovery in a safe environment *i.e. low exposure to life-threat x low current perceived risk of life-threat x high individual resources to negotiate life-threat x high refuge from life-threat = inhibition of posttraumatic symptoms (PTSD) and recovery in a safe environment.*

The above outlined model can also explain posttraumatic growth following trauma. Joseph and Linley (2005) report that individuals who experience enhanced relationships, a greater sense of personal resilience, wisdom and strength, and changes in their life philosophy (e.g., life is finite) following a highly stressful traumatic event are most likely to experience posttraumatic growth. Thus, if an individual experiences high exposure to a life-threat, and as a result modifies their perceived risk of life-threat, increases their individual resources and enjoys enhanced environmental refuge then posttraumatic growth will likely occur *i.e. high threat exposure x modified current perceived risk of life-threat (more realistic) x increased individual resources to negotiate life-threat x enhanced refuge from life-threat = inhibition of posttraumatic symptoms and growth in a positive new environment.*

The implications of this study for safe interventions following large-scale disasters are that the facilitation of environmental refuge (e.g., access to physical, emotional, spiritual refuge) and the strengthening of individual resources (e.g., skills-based education) should be targeted and not the trauma memory. Targeting the trauma memory before safety is secured and resources are strengthened may inadvertently enhance posttraumatic symptoms by increasing the survivor's exposure to trauma (e.g., through re-living phenomena) and inadvertently increasing perceived current risk of life-threat. Cognitive processing of the trauma memory may naturally take place once these factors have been addressed. There is some evidence for this in that neuro-imaging studies indicate that medial prefrontal cortex functioning is diminished in the presence of threat to enhance automatic survival functions but will return to normal functioning once safety is secured (Thayer & Brosschot, 2005). Thus, for the majority of trauma survivors the restoration

of higher cognitive functioning through safety being secured may be sufficient to facilitate any required processing and evaluation of the traumatic event. For the minority who continue to suffer posttraumatic symptoms, assessment of antipredator modulating variables may facilitate strategies for safe individualised psychological interventions (elaborated further in final chapter).

A limitation of this study is that in the absence of clinical assessments or additional measures, PTSD cannot be assumed in the individuals above the recommended mean cut-off of 1.5 on the IES-R. However, a categorical inclusion or exclusion criteria for PTSD may not be that relevant to understanding factors that contribute to the development and maintenance of PTSD. Taxometric studies by Broman-Fulks et al. (2006), Ruscio, Ruscio and Keane, (2002) and Forbes, Haslam, Williams and Creamer (2005) found PTSD to be a dimensional construct and not a categorical construct (i.e. PTSD was the upper end of a continuum of posttraumatic stress responses and not a discrete disorder). Information gained from this study regarding factors that modulate the level of posttraumatic symptoms is therefore likely to be relevant for the whole continuum of posttraumatic responses, PTSD included.

It is also important to note that this study is limited due to the use of single items to assess constructs rather than a scale. Despite this limitation, the preliminary information gained from the single items has provided a good basis for the development of future scales to explore these interacting posttraumatic modulators. Future research that utilises a prospective and/or longitudinal design will be important to validate causality and/or directionality of the complex interactions between modulators and posttraumatic symptoms.

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