Threats in dreams, emotions and the severity of threatening experiences in waking

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Summary. One of the prepositions of the Threat Simulation Theory (TST) suggests that the experience of threatening events in waking life would be associated with the experience of oneiric threats, which is consistent with the Continuity hypothesis. Following on that proposition, dream diaries and daily event diaries of the day preceding the dreams were collected from 40 female and 40 male undergraduate students who rated the intensity of anger and fear experienced during the day and in the course of their dreams. The severity and frequency of threatening events in both conditions was evaluated by two independent judges on a scale developed on the basis of the severity component of Revonsuo's Dream Threat Scale. There were significant correlations between the severity of threatening day events and the severity of threats in dream diaries ($r(80) = .22$, $p = .048$), and between the frequency of daytime threats and dream threats ($r(80) = .41$, $p = .001$). There were also significant correlations between pre-sleep anger and anger in dreams ($r(80) = .39$, $p = .01$, and between fear before bedtime and the severity of dream threats ($r(80) = .33$, $p = .003$). In addition, different gender-specific relationships emerged, coincident with the consistently observed predominance of negative emotions in women's dreams. These findings provide some support for both the Threat Stimulation Theory and the Continuity hypothesis. Further exploration over a longer time frame is required to better understand the relationship between these emotions experienced in waking and dreams.

Keywords: Dreaming, Threat Simulation Theory, Dream Threats, Waking Threats, Emotions

1. Introduction

As an evolutionary theory of the function of dreams, the Threat Simulation Theory (TST) proposes that dreaming is a built-in virtual reality program that specializes in the simulation of threatening events (Revonsuo, 2000). When a person is confronted in their waking life by an event deemed threatening, they are likely not only to dream about the threat, but to dream about it repeatedly, in a way that would permit rehearsing realistic ways of coping with that threat. This would have been functionally adaptive for ancestral humans as it would have allowed them to rehearse skills necessary for the recognition and avoidance of threats in a completely safe environment that is the virtual reality of the sleeping mind.

Revonsuo and Valli developed the Dream Threat Scale (DTS ; Revonsuo & Valli, 2000) to test the hypotheses of the TST by comparing the dreams of traumatized and non-traumatized groups of children and adolescents(Valli, Revonsuo, Palkas, Ismail, Ali, & Punamaki, 2005; Valli, Revonsuo, Palkas, & Punamaki, 2006; Valli, Lenasdotter, MacGregor, & Revonsuo, 2007; Valli, Revonsuo, Strandholm, & Silanmaki, 2008). In one study, Valli et al. (2005) found that children exposed to war-related traumatic events were more likely to report more threats per dream than non-traumatized children, and, moreover, that the threats represented in the dreams of the former were likely to be more severe than the threats in those of the latter. In a following study conducted in another war torn country, they found that while traumatized children were likely to report more threats per dream than non-traumatized children, the quality of threat simulations between the groups was statistically negligible (Valli et al., 2006).

In a study intended to test the TST with recurrent dreams, Zadra, Desjardins and Marcotte (2006) found, on the one hand, that the majority of dreams incorporated a threat but that less than 2% of them fulfilled all of the theory's predictions, leading to a debate between the two research groups (Valli & Revonsuo, 2006; Zadra & Desjardins , 2006). Lack of agreement as to what constitutes an actual threat appears to be the source of divergent findings. Another group of researchers became involved in the controversy over a consensual definition of threat: Malcolm-Smith and Solms (2004) have insisted that Revonsuo's definition is problematic. They found that only 21% of dreams collected with the Most Recent Dream method (MRD), contained physical threats to the dreamer, although a large number of the participants in their study had experienced a major, even a life threatening attack in the past. They commented that such physical threats corresponded to the most salient type of threat experienced in the human evolutionary context. Still, events that constituted physical threats in the sampled dreams were largely trivial fantasies, such as being chased by spiders or being clawed to death by a kitten. A mere 8.48% of these threats could be categorized as "real" threats. Additionally, there were no realistic attempts at coping with the threats, as stipulated by TST, a fact already observed by Zadra et al. (2006). Criticisms addressed by Zadra, Desjardins and Marcotte (2006), Malcolm-Smith,

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Solms, Turnbull and Tredoux (2008) to the theory are of a conceptual and methodological nature. What constitutes a "real" threat raises serious problems for a satisfactory evaluation of TST.

Following these controversies, Valli and Revonsuo (2008) stated that if dreaming is a virtual reality replication of the perceptual world, it follows that only threats perceived as such by an individual can be represented in that individual's virtual reality. They therefore proposed to focus on the "activity level" of the threat simulation mechanism for each individual. The "activity level" is defined as the frequency and severity of threatening events in dreams. As far as feasible, that new approach was adopted for the study about to be reported. Its main objective is to determine whether threats, rated as such by the dreamer in waking life, are represented in subsequent dreams and rated accordingly. For this purpose, we used a different system of definitions, proposed by the DTS, in order to identify the threats in the reports. These definitions were deemed appropriate for our conception of what constitutes real threats.

Then, according to the TST, which states that the experience of real threats triggers the activation of the threat simulation system (Valli & Revonsuo, 2009), it would be expected that the severity and frequency of threats in dreams be associated with the severity and frequency of threats experienced during wakefulness. In accordance with the Continuity hypothesis, which refers to the transformation of waking states, experiences and concerns into dreams, this process can be observed specifically between waking experiences of the day preceding the dream and the following dream (Hall & Nordby, 1972; Domhoff, 1996; Strauch & Meier, 1996; Schredl & Hofmann, 2003; King & DeCicco, 2009). In addition, the most severe threat reported in both states was the only one retained for the evaluation of the threat severity in our study, for it represents the most acute experience of encountered threat. Indeed, due to its intensity, this acute experience of threat would be the one having the greatest impact on the development of survival skills.

Despite being an important component of dreams, emotions have not been directly taken into account in the major propositions of the theory nor in the different studies conducted to test it. A second objective of the present study was to further explore the TST by focusing on emotions that would appear as emotional responses to threats. In this regard, some studies suggest that emotions appear to allow humans to rapidly detect threatening stimuli. Indeed, exaggerated fears such as phobias and anxiety, both in children and adults, accelerate the detection of the object of their fear when compared to control participants (Byrne & Eysenck, 1995; Derryberry & Reed, 2002; Flykt & Caldara, 2006; Gilboa-Schechtman, Foa, & Amir, 1999; LoBue & Pérez-Edgar, 2014; Mogg & Bradley, 2002; Öhman & Mineka, 2001; Pishyar, Harris, & Menzies, 2004; Richards, Hadwin, Benson, Wenger, & Donnelly, 2011; Weierich & Treat, 2015). This suggests that certain affects constitute adaptive reactions to threatening situations, permitting individuals to optimally cope with them. Thus, according to the "fight or flight" response (Cannon, 1929), when confronting a dangerous situation, anger is related to the instinct for fighting or attack while fear is linked to the instinct for flight. Moreover, psychosocial studies show that anger and fear are associated with threat detection and they facilitate it (Culley, Madhavan, Heikens, & Brown, 2011; Gordijn, Yzerbyt, Wigboldus, & Dumont, 2006; LoBue, 2014; Matthews & Levin, 2012; Vagnoni, Lourenco, & Longo, 2012). As a consequence, one might expect that the emotions (anger and fear) involved with the response to threats would be associated with the same kind of oneiric emotions implicated into the threats detection, a notion consistent with the continuity hypothesis. One could also expect that these emotions would be related to the various aspects constituting oneiric threatening experiences (i.e. severity and frequency of threats). Finally, as it has been consistently observed and replicated most recently with a Canadian sample, women experience more negative emotions in their dreams than men (Dale, Lortie-Lussier, Wong, & De Koninck, in press). Thus, it would be important to take into account potential gender differences in the experience and expression of emotions and threats in waking and dreaming.

In sum, it would be interesting to ask whether the diverse aspects of threatening experiences during wakefulness are related to oneiric simulations of menacing dreams. From there, the first objective of this study was to assess the potential relationship between the threats severity and frequency of waking and dreaming experiences. The second aim was to evaluate the relationship between the emotions of anger and fear engaged in threats detection while awake and the oneiric experience of threatening situations.

Hypothesis

According to the third proposition of the TST, we hypothesized that the experience of threats in the waking state triggers the activation of the threat simulation system (Valli & Revonsuo, 2009). From there, we formulated the following predictions:

1. The most severe threat of the day prior to the dream will be associated with the most severe dream threat.
2. The frequency of daytime threats will be linked with the frequency of dream threats.
3. The presence of threats the day preceding the dream will be correlating with the presence of oneiric threats.
4. The experience of anger reported before bedtime will be correlated with the experience of anger, the severity and frequency of dream threats in the following dream.
5. The experience of fear reported before bedtime will be also associated with the experience of fear, the severity and frequency of dream threats in the subsequent dream.

It is important to mention that the continuity hypothesis also anticipates these results.

2. Method

2.1. Participants

Participants in this study were randomly selected from a larger sample collected for a normative study of Canadian dreams in the sleep and dreams laboratory at the University of Ottawa. There were 40 males and 40 females between the ages of 18 and 24. The first language of these participants was English. Only one dream per participant was selected. The sample was drawn from a database in which the majority of the participants had reported in average two dreams, but some of them had reported only one dream.

2.2. Materials

2.2.1 Dream questionnaire.

Participants completed a dream and day activity diary questionnaire over a ten-day period, or until such time as they had recorded two dreams. More specifically, the participants were asked to write logs of their daily events at night before going to bed, recording the level of the most stressful moment of their day on a five point scale (0 = null, 1 = low, 2 = moderate, 3 = high, 4 = very high), as well as fill in questions as to what emotions they were feeling and of what intensity. This was done through a four point scale (0 = not at all, 1 = a little bit, 2 = moderately, 3 = a lot). The specific emotions used for the present study were anger and fear. Only the daily log of the day prior to the dream randomly selected was used. The same questions were asked pertaining to the subjects' experience of fear and anger in their dreams. As for the reporting of dreams, participants were asked to keep a copy of the dream report sheet next to their beds. Should they remember a dream upon waking, they were asked to write it down immediately to avoid memory distortion.

2.2.2 Dream Threat Scale.

The Dream Threat Scale, initially elaborated by Revonsuo and Valli (2000), was adapted for the evaluation of threats in waking life. Particular attention was paid to the category "Severity of the Threatening Event for the Self" in the dream scale. More specifically, after having debated about what would constitute a real threat, our group determined that the threat severity descriptions, defined by the DTS, would represent a better system of definitions to investigate the TST, allowing to circumscribe with more structure and precision the waking and dreaming experiences of menacing events. Thus, threats were identified by using the descriptions of the different levels of threats' severity established by the DTS (1.: Life-threatening event, 2.: Socially, psychologically or financially severe threat, 3.: Physically severe threat and 4.: Minor threat). In their latest instructions on how to test their theory, Valli and Revonsuo (2008) leave the means of measuring the severity of a threat largely open. For the purposes of the present study, the 4 four-point scale was changed to an interval scale. Below each report (i.e. dream reports and day reports) judges were provided with a line of exactly 10cm in length. The extreme left side of this line was verbally anchored with the word "low" (for "low" severity threat) while the extreme right side of this line was verbally anchored with the word "high" (for "high" severity threat). This instrument provided the judges with a quick and easy way to evaluate the severity of the most threatening event in dream report and daily log. In the case of no threat the judge would simply make a mark on the extreme left of the scale, before the beginning of the line. The distance in millimetres between the extreme left, or beginning, of the 10cm line and the mark made by the judge on the 10cm line became the report's threat severity score.

2.3. Procedure

Dream reports and day reports of the day preceding the dream were separated into two different documents in an effort to curb the potential biasing that could result from seeing each participant's dream and day reports at a single glance. Both piles of two documents were given to two independent judges, to rate the severity of threats in each individual report. Thus, the judges first identified the threats by using the severity definitions provided by the DTS, and then, as a function of these descriptions, they rated the severity by using the interval scale. Furthermore, judges practiced with dream and day reports from the normative sample that had not been selected for the present study in order to establish an acceptable consensus. The judges then evaluated the narratives independently. The inter-judges' reliability was evaluated using Pearson's correlation coefficient: for severity of threats in dream reports $r = .754$, $p = .001$; for severity of threats in day reports $r = .806$, $p = .001$.

3. Results

Descriptive statistics characterizing the variables of interest are presented in Table 1. The quantity of reported threats, both from daytime and dreams, was not significantly different between men and women (i.e. Daily logs: $t(78) = 1.79$, $p > .05$; dream reports: $t(78) = 1.14$, $p > .05$). However, generally, the dream reports contained significantly more threats than the daily logs: $t(79) = 7.24$, $p = .001$.The first set of statistical analyses was conducted to evaluate the correlation between the severity of threats in the day reports and in dream diaries. The correlation between the severity of threats in dreams and the severity of threats experienced

Table 1. Descriptive statistics

Reports	Total number of threats in reports	Threatening events/reports		Reports including threats	Words/report	
	N	M	SD	%	M	SD
Daily logs of femals	20	1.00	1.20	52.50	62.60	47.18
Dreams of females	102	2.55	2.45	80.00	180.55	136.18
Daily logs of males	24	0.60	1.08	32.50	43.03	32.70
Dreams of males	77	1.93	1.95	75.00	143.30	106.90
Total for daily logs	64	0.80	1.15	42.50	52.81	41.52
Total for dream reports	179	2.24	2.22	77.50	161.93	123.06

Table 2. Mean severity of threatening experiences and gender

Severity	Females		Males				Confidence interval at 95%		
	M	SD	M	SD	t(78)	p	Inferior	Superior	Cohen's d
Dream threats	2.83	1.23	2.65	1.49	0.59	.56	-0.43	0.79	0.13
Daytime threats	1.31	1.14	1.09	1.09	0.87	.39	-0.28	0.71	0.20

the day prior to dreaming was statistically significant at r(80) = .22, p = .048. This relationship was not significant for men: r(40) = .07, p > .05, whereas it was significant for women: r(40) = .39, p = .013.

Moreover, as shown in Table 2, there were no significant differences between men and women regarding the threats severity from both daily logs and dream reports. Through a post hoc analysis, it appeared that the severity of the most threatening experience during wakefulness was correlated with the frequency of dream threats the subsequent night: r(80) = .46, p = .001. Furthermore, both men and women showed this significant correlation between the most severe daytime threat and the quantity of oneiric threats, which was respectively r(40) = .40, p = .01 for men, and r(40) = .50, p = .001 for women. The correlation between the word count of dream reports and the threat severity score of dreams was also statistically significant at r(80) = .30, p = .006. However, it is likely that the severity score is not affected by the length of either the day reports or the dream reports because only the severity of the single most threatening event from both reports was coded and used for the comparison.

The second set of statistical analyses was performed on the frequency of threats in day and dream reports. The correlation between the frequency of threats in both reports was significant: r(80) = .412, p = .001. This relationship was also significant for men: r(40) = .39, p = .012, and women: r(40) = .40, p = .01. In addition, the frequency of threats in women's daily logs significantly correlated with the severity of the most threatening oneiric element: r(40) = .34, p = .033. As well, the correlation between dream reports word count and the frequency of threatening events in dreams was significant: r(80) = .30, p = .008. The third set of statistical analyses was conducted to evaluate the correlation between the presence/absence of threats the day preceding the dream with the presence/absence of oneiric threats. It turned out that the relationship was significant for our total sample: r(80) = .34, p =.002, and for women: r(40) = .40, p =.01.

Finally, in order to control the familywise error rate, we used the Holm-Bonferroni correction to test our fourth and fifth predictions. The corrector was used only with the main predictions. Thus, the correlation between the intensity of anger experienced before bedtime and the intensity of anger experienced in dreams was statistically significant at r(80) = .29, p = .01. Conversely, the intensity of anger experienced before bedtime was not correlated with both the most threatening dream experience (i.e. r(80) = .12, p > .05) and the frequency of dream threats (i.e. r(80) = .09, p > .05). No significant relationships were found for men. However, the intensity of anger before bedtime was significantly correlated with the frequency of dream threats for women: r(40) = .31, p = .05. Then, it appeared that the correlation between the intensity of fear before bedtime was not significantly associated with the intensity of oneiric fear: r(80)= -.007, p > .05, and with the frequency of dream threats: r(80)= .24, p =.033 (not significant due to the Holm-Bonferroni adjustment). However, the intensity of daytime fear was significantly correlated with the severity of the most severe dream threat: r(80) = .33, p =.003. Once again, no significant relationships were found for men. Conversely, for women, the correlations between the intensity of fear before bedtime and the frequency (i.e. r(40) = .46, p = .003) as well as the severity (i.e. r(40) = .59, p = .001) of dream threats were significant.

Finally, the grouping variables for the independent samples t-test were anger before bedtime (those who reported anger and those who did not) and fear before bedtime (those who reported fearfulness and those who did not). Those who reported anger before going to bed were more likely to report having experienced anger in their dreams: t(78) = 3.414, p = .001. Those who reported anger before bedtime also reported more fear in their dreams: t(78) = 2.064, p = .044. Those who reported fear before bedtime were not much more likely to experience either anger (t(78) = 1.26, p > .05) or fear (t(78) = .373, p > .05) during their dreams. Table 3 shows different comparisons between

Table 3. Mean emotional intensity and gender

Emotional intensity	Females		Males				Confidence interval at 95%		
	M	SD	M	SD	t(78)	p	Inferior	Superior	Cohen's d
Fear before bedtime	1.04	0.45	0.96	0.42	0.81	.42	-0.11	0.27	0.18
Fear during dreaming	0.38	0.45	0.19	0.38	1.95	.053	-0.03	0.37	0.46
Anger before bedtime	0.88	0.41	1.03	0.48	-1.30	.20	-0.33	0.07	-0.34
Anger during dreaming	0.23	0.42	0.20	0.43	0.32	.75	-0.16	0.22	0.07

men and women concerning emotional intensity experienced during wakefulness and dreaming.

4. Discussion

The significant correlation between the severity of daily threats and threats in dreams supports a main prediction of the TST (Valli & Revonsuo, 2009). Findings relevant to each hypothesis will be examined in turn, with a focus on differences between genders. The first one specified that the most severe threat reported before bedtime would be associated with the highest level of threat in the dream of the following night. It was supported for participants as a whole although the correlation was high in the case of women but almost null for men. It suggests that the TSS of women would induce oneiric threat simulations whose maximal severity level would be proportionate to the intensity of the most severe threat experience of the day preceding the dream episode, this being consistent with the continuity hypothesis. Interestingly, it was also found for both men and women that the higher the severity of the most severe diurnal threat, the higher was the frequency of threat in the dream content.

Our second prediction was confirmed. The frequency of daytime threats was associated with the frequency of dream threats. Once more, it is interesting to point out that there was a significant association between the frequency of diurnal threats with the intensity of the most threatening dream element for women only. The number of daytime threats reported by women could exacerbate the maximal severity of the following dream threats. Our third prediction was partially confirmed. The correlation between the dichotomous variables of presence/absence of daytime threats with the presence/absence of dream threats was significant for the whole sample, for women, but not for men. In this regard, while a causal relationship was not tested here, these findings suggest that recent threatening experiences can have an impact on the activation of the threat simulation mechanism, consistent with Valli et al's (2006) hypothesis that threats in dreams can be traced to very recently encoded threatening experiences. The recency of the threatening event could therefore be a critical factor for the activation of threat simulations, and this, especially for women. If this is so, it could explain why the Most Recent Dream method (MRD) adopted by Malcom-Smith and Solms (2004) to test the TST was not appropriate to elicit recall of severe threatening events that had occurred in their participants' past, that should have prompted simulation, according to these authors.

An original contribution to the operationalization of the TST consists in the inclusion of emotions to assess the relationship between threats in the waking and dreaming states. There was a significant correlation between the anger level reported upon bedtime and anger experienced in dreams. However, the experience of this emotion while awake was not related to the frequency and severity of oneiric threats. This pattern was, though, different for women as their anger level before bedtime was significantly associated to the frequency of dream threats. Thus, it suggests that the pre-sleep experience of anger could contribute to the activation of the TSS, engendering the subsequent simulation of threatening dreams. Psychosocial studies show that the role of anger is associated with the perception of environmental threats (Gordijn, Yzerbyt, Wigboldus, & Dumont, 2006; Matthews & Levin, 2012) and, more specifically, to adaptive mechanisms, allowing people to take action in hazardous situations. Such as proposed by Cannon (1914), anger would be associated with the desire to attack or combat the threatening element (Cheung-Blunden & Blunden, 2008). Thus, if anger is an emotional response implicated in threats perception, then the positive correlations observed here were anticipated by the third proposition of the TST, which states that the experience of real threats engenders the activation of the threat simulation system (Valli & Revonsuo, 2009).

On the order hand, relative to the fifth prediction, the intensity of daytime fear was correlated only with the intensity of the most threatening element of the dream. However, in the women's group, the intensity of pre-sleep fear was significantly associated with the oneiric threats' frequency and severity, suggesting a role of fear in the activation of the TSS. Indeed, fear is, as well as anger, involved in the facilitation of environmental threats detection (LoBue, 2014; Weierich & Treat, 2015). In comparison to anger, fear would permit to detect more accurately diverse surrounding dangers (Culley, Madhavan, Heikens, & Brown, 2011). Thus, if fear is an emotional response involved in threats detection, such as proposed by Canon (1914), then the relationships observed here were predicted by the TST (Valli & Revonsuo, 2009). It should be added that all these relationships were also anticipated by the continuity hypothesis (Schredl, 2003).

In addition, the individuals who reported anger before going to bed were more likely to report having experienced anger and fear in their dreams than those who did not report anger or fear before bedtime. As mentioned above, anger is an emotion ensuing from the perception of a threat. Consequently, according to the TST and the continuity hypothesis, the fact that participants who experienced anger before bed reported more anger in their dreams was anticipated (Schredl, 2003; Valli & Revonsuo, 2009). However, the result that these participants also reported more fear was not expected. An explanation for this result could be that anger before bed was an indirect clue of the experience of a threatening situation, which then induced the activation of the threat simulation system as predicted by the TST (Valli & Revonsuo, 2009).

Finally, the gender differences observed here remain to be explained. Evidence arising from neuroimaging studies could provide an explanation. Indeed, from a neurological point of view, it appears that, depending on gender, stimuli processing engages different brain regions during the execution of diverse tasks (Domes et al., 2010; Mak, Hu, Zhang, Xiao, &Lee, 2009; McRae, Ochsner, Mauss, Gabrieli, & Gross, 2008). More precisely, the brain centers involved in emotional processing are more activated in women during the realization of different cognitive tasks, whereas men tend to use brain areas more involved in cognition per se and cognitive control (Gohier et al., In press; Koch et al., 2007). Besides, this tendency is even more pronounced in negative contexts. From there, we could speculate that the greater involvement of women' emotional brain regions in the processing of stimuli, such as threatening events, might be extended to the TSS functioning, which would explain why only the emotions of women were associated with the simulation of oneiric threats the subsequent night. In other words, in the case of women, the threat simulation system would be triggered by fear and anger, whereas other cogni-

tive cues could activate the TSS of men, such as the perception of several threats in a specific time window.

Finally, these observations raise a question as to whether threats in dreams are remnants of rehearsals not only of threatening events, but also of intense emotions such as anger and fear. An observation made by Hartmann and Basile (2003) can be cited as supporting evidence. After the traumatic event of 9/11/01 there was a significant increase not of threatening events, but of the intensity of emotions, whatever their nature, in the dreams reported by regular keepers of dream diaries. Another question follows from this finding: is the threat simulation mechanism more effective if an acute emotion such as anger or fear is rehearsed in the dreaming state? The threat simulation theory itself does not explain how such emotions could subside in time and in so doing improve the task-oriented learning aptitude of the dream-self during threat simulation. Hartmann's functional theory of dreaming (1996; 2010) could provide an answer to this question. He proposed that the adaptive function of dreaming is the solving of emotional problems, especially as they pertain to trauma (Hartmann, 1996). His theory could be integrated into Revonsuo's theory. If negative emotions such as fear and anger are not resolved from dream to dream, as is the case with recurrent dreams, then the dream-self could not resort to an effective resource such as the simulation of coping with threatening events. In order to examine this issue, dreamers who had reported threatening events in their waking life and had experienced corresponding negative dream emotions could also be asked to rate their emotional state upon awakening the following morning. The effectiveness of the simulation mechanism to eliminate or reduce the threat could therefore be assessed. In this respect, further studies are needed to examine whether the resolution of emotions involved in response to threats, such as anger and fear, increases the effectiveness of oneiric threat simulations and improves the abilities to cope with threatening events.

There are limitations to this study. It has been made clear that in order to establish the threat activation gradient of a population, certain requirements should be met (Revonsuo & Valli, 2008). For instance, the recommendation that each dreamer reports at least 10 dreams, so that a pattern can be drawn from this sample, was not respected since only one of their dreams was selected. Another limitation is that we have studied the relationships between our variables in a time window of only 24 hours, which would mainly support the day-residue effect. Future studies should extend their investigation to the relationships between waking and dreaming experiences into a longer time window; for instance, future studies should comprise a larger sample of dream reports and daily logs from each participant so that the researchers can cross-reference the dreams with the events that took place two or more days preceding the dream episodes. Furthermore, they should also take into account the dream lag effect by performing multiple comparisons across days and nights to check for this phenomenon (Blagrove et al. 2011; Blagrove, Henley-Einion, Barnett, Edwards, & Seages, 2011). Another limitation is related to the fact that the correlational relationships that we observed were based on inter-individual differences. Factors, such as thin boundaries or neuroticism personality traits, could have mediated the relationships observed in this study (Hartmann, Rosen, & Rand, 1998; Schredl, 2003; Blagrove & Fisher, 2009). Future studies should consider these potential mediators.

There are many avenues open for research to test the TST, although its scope and its foundations in different disciplines ranging from biology to philosophy make the task difficult according to research methods accepted in the field (Domhoff, 2000). Turning back to the underpinnings of the theory may provide a new approach to the operationalization of threat. For instance, the theory stipulates that real threats are represented in dreams, a position challenged by Malcom-Smith and Solms (2004), Zadra, Desjardins, and Marcotte (2006), who noted that threats are frequently represented by trivial fantasies and fabulous dangerous animals, which evoke the characters present in children's dreams until adolescence. We could speculate that these representations belong to the realm of symbolism that our pre-history ancestors already mastered, although we have no written records to document it. But we have a vast quantity of artefacts that attest to their symbolic attempts to prevent or control the occurrence of various threats by resorting to ritual sacrifices of animals or by representing them in paintings. Evidence of such practices to empower them symbolically, and maybe to rehearse coping strategies, can be found in many parts of the world. Remnants of these magical procedures are still current in our technologically advanced societies, even on the part of sophisticated and educated individuals. Assuming that human beings of these periods had the neurophysiological substrate and cognitive aptitude to dream (Foulkes, 1985), it can indeed be speculated that dreaming was one of the means they had at their disposal to attempt to control their environment.

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