Threats in dreams: Are they related to waking-life?

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Summary. According to the Threat Simulation Theory (TST) dreaming has developed, and was maintained during evolution, because its function of rehearsing threats is essential for survival. The present study analyzed 1612 diary dreams reported by 425 participants (mainly psychology students). The study results indicate that threats play an important role in dreams and, thus, support the idea that dreaming might have a function of rehearsing problematic or threatening situations. Comparing the present results to previous findings shows a considerably large variability regarding the number of threats per dream, the proportion of minor threats, and the reality of threats. As neuroticism and openness to experience were related to the number of threats per dreams, future research should investigate inter-individual differences in waking life which might help explain the variability regarding the dream threat characteristics..

Keywords: Threat simulation theory, neuroticism, openness to experience

1. Introduction

The question about the function of dreaming has been discussed for a long time (Strauch & Meier, 1996). Table 1 provides an overview of the common theories and hypotheses (Schredl, 2014). According to the Threat Simulation Theory (TST) it is assumed that dreaming has developed and was maintained over the course of evolution because its function is essential for survival. The basic idea is that threatening events are simulated in dreams for rehearsing avoidance skills thereby improving behavioral skills in waking-life (Revonsuo, 2000). Overall the TST contains six propositions which are briefly reviewed in the following (see Table 2).

The first proposition says that dream contents are not random and disorganized, but rather they present an organized and selective simulation of the perceived world. However, dream researchers do not agree on this notion. The activation-synthesis hypothesis (Hobson & McCarley, 1977) postulated that dream imagery is not organized but random, bizarre and incoherent – a reaction of activation produced by the brain stem. However, empirical dream studies showed that dream content is linked to waking-life and is thus not random (Domhoff, 2003; Foulkes, 1985; Schredl, 2003). Bizarre dream elements merely bring about a small degree of disorganization in the otherwise organized character of dreams (Revonsuo & Salmivalli, 1995).

Proposition 2 states that dream consciousness is specialized in simulating threatening events. Already in 'The interpretation of dreams' Freud wrote about the imbalance of positive and negative events in dreams, contending that most manifest dream contents are negative (Freud, 1991). Furthermore, a dream report collection consisting of 1000 student dreams showed a preponderance of negative emotions: 80% of the dream reports were rated as negative, whereas the remaining 20% were rated as positive. If self-ratings of emotional intensity were used, there was a balance between positive and negative dream emotions (Schredl & Doll, 1998) but this 50/50 ratio is still higher compared to waking life for most people (Schredl & Reinhard, 2009-2010). Dream-characters interacted with the dream ego mostly in hostile ways (Hall & Van de Castle, 1966).

For example, Revonsuo and Valli (2000) analyzed 592 dream reports of 52 participants regarding the characteristics of threats in their dreams. The general frequency of threats in dreams was higher than in waking-life: On average, there were 13 threats per participant and 1.2 threats per dream. Overall, 79% participants reported at least one life-threatening situation in a dream. On the one hand, a considerable number of the threats (60%) are not life-threatening or socially severe but, on the other hand, certainly more life-threatening situations occur in dreams than in waking-life (Revonsuo & Valli, 2000). About 50% of the nightmares include physical threats (Robert & Zadra, 2014) and, thus, also support the notion that dreaming is specialized on re-playing threatening events.

The findings that the emotions experienced in dreams are appropriate for most dream sequences (Foulkes, Sullivan, Kerr, & Brown, 1988; Merritt, Stickgold, Pace-Schott, Williams, & Hobson, 1994) are also in line with the TST (Revonsuo, 2000). According to the theory, traces from long-term-memory are used for the dream-plot and linked with currently relevant threatening events. This function is useful for rehearsing difficult situations, thereby avoiding life-threatening events without being exposed to real dangers (Valli & Revonsuo, 2007).

Further, the findings regarding brain activity during REM sleep support the TST, since the brain areas (e.g., the amygdala) that are active are the same ones that respond to emotional and threatening events in waking-life and trigger fight-or-flight responses (Revonsuo, 2000). Disorders which are characterized by the enhancement of REM physiology (e.g., narcolepsy and depression) are characterized by in-

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Submitted for publication: February 2016
Accepted for publication: March 2016

Table 1. Theories about function of dreaming (adapted from Schredl, 2014)

Theory	Author	Explanation
Dreams as epiphenomena	Flanagan (2000)	Dreams are pure epiphenomenon and do not have any additional functions such as memory consolidation.
Iterative programming	Jouvet (1999)	During REM sleep dreaming reinforces periodically genetic programs to restore the individuality and diversity of the human species, despite a changing environment.
Guardian of sleep	Freud (1991)	Dreams prevent a sleeper from awakening to permit the catharsis of unconscious impulses.
Compensation	Jung (1979)	Dreams provide a compensatory mechanism for waking consciousness. Essentially those aspects occur in dreams which the dreamer neglects during waking-life.
Reverse learning hypothesis	Crick and Mitchison (1983)	Human memory can be modeled as a neural network. During learning processes, many unnecessary models will be learned in addition to useful material. While dreaming, these unnecessary (parasitic) models are activated and unlearned. Therefore, bizarre components do occur quite frequently in dreams.
Mastery hypothesis	Wright and Koulack (1987)	Dreams serve the function of problem-solving in waking-life. Dreams can combine old information of the dreamer's past with current waking-life issues and playing through different scenarios for evaluating the possible outcomes.
Mood regulation	Kramer (1993)	Dreams regulate mood. Especially extreme emotions in the evening or during the night are evened out by morning.
Systematic desensitization	Perlis and Nielsen (1993)	REM sleep is the ideal modus for anxiety extinction. While dreaming, the sleeper can experience anxiety while being deeply relaxed. This state helps to unlearn anxiety.
Threat simulation theory	Revonsuo (2000)	Potential threat simulations from waking-life are simulated in dreams for improving skills of avoidance behavior. This simulation was relevant for surviving in ancestral times and developed during evolution.
Protoconscious-ness theory	Hobson (2009)	REM sleep may constitute a protoconscious state, providing a virtual reality model of the world that is of functional use to the development and maintenance of waking consciousness.
Reward Activation Model	Perogamvros and Schwartz (2012)	Activation of the mesolimbic dopaminergic system reward system during sleep contributes to memory processes, to generation and motivational content of dreams.
Social simulation theory	Revonsuo et al. (2015)	Dreaming is a simulation primarily specialized in training the social skills and bonds most important for us humans as a social species.

creased nightmare frequency (Schredl, 2009; Skancke, Holsen, & Schredl, 2014). This led to the suggestion that REM mechanisms produce emotionally-loaded threat simulations in dreams (Revonsuo & Valli, 2000; Valli & Revonsuo, 2007).

Proposition 3, states that threats in waking-life increase the threat occurrence in the threat simulation system and can be tested by investigating participants who are quite frequently exposed to threatening situations in waking-life (Revonsuo, 2000). In the study of Valli et al. (2005), dream reports of children from Northern Iraq were analyzed; one group was traumatized whereas the other was not. Dream reports of Finnish children served as a control. In general, the traumatized children reported more threats in their dreams when compared to the other two groups; all participants from the trauma-group dreamed of a threat at least once (Valli et al., 2005). In addition to the fact that the traumatized children dreamed more frequently of social and financial threats, the consequences of their threats were generally

Table 2. Propositions of the Threat simulation theory (Revonsuo, 2000)

Proposition	Explanation
Proposition 1	Dream experience is not random or disorganized; instead, it constitutes an organized and selective simulation of the perceptual world.
Proposition 2	Dream experience is specialized in the simulation of threatening events.
Proposition 3	Encountering real threats during waking has a powerful effect on subsequent dream content: real threats activate the threat simulation system in a qualitatively unique manner, dissimilar from the effects on dreaming of any other stimuli or experience.
Proposition 4	The threat simulations are perceptually and behaviorally realistic and therefore efficient rehearsals of threat perception and threat-avoidance responses.
Proposition 5	Simulation of perceptual and motor skills leads to enhanced performance in corresponding real situations even if the rehearsal episodes were not explicitly remembered.
Proposition 6	Recurring, realistic threat simulations led to improved threat perception and avoidance skills and therefore increased the probability of successful reproduction of any given individual.

more severe. However, contrary to the experimenters' expectations, the traumatized children reacted less frequently to threats (Valli et al., 2005).

A second study (Valli, Revonsuo, Pälkäs, & Punamäki, 2006) about threats in the dreams of traumatized children contained a sample of overall 413 Palestinian children. Of this, 269 participants lived in Gaza, whereas 144 participants lived in Galilea, a peaceful region. Again, the traumatized children reacted less frequently to threats than the non-traumatized children. Furthermore, the traumatized children also dreamed more frequently of social and financial threats than of life-threatening threats. Nevertheless, in the trauma group, reacting to threats correlated with life-threatening events. This effect was not found in the sample of children living in Galilea (Valli et al., 2006). Interestingly, the dreams of persons with limbic hyper-function included more threats than dreams of healthy persons (Peterson & DeYoung, 2000), a finding supporting the third proposition of the TST.

Proposition 4 states that threat simulations of experience and behavior are realistic. About one third of the dream threats were completely realistic and could also happen in daily-life, whereas another third were realistic but improbable, and the rest were completely unrealistic (Revonsuo & Valli, 2000; Valli, Lenasdotter, MacGregor, & Revonsuo, 2007). Zadra, Desjardins, and Marcotte (2006) found, however, that most threats in recurrent dreams were unrealistic. This finding might not contradict the TST as it has been shown that media (including watching highly traumatizing events) can affect dream content (Van den Bulck, 2004). Furthermore, the occurrence of dream contents about fairytales or movies can also be seen as threat simulation (Revonsuo, 2000).

Concerning the reaction to a threat, it has to be mentioned that in 4-19% of the threats it was not possible to clarify if the dream-self is reacting in a realistic way – due to sudden scene shifts in the dream. In 27% to 46% of all threats, no reaction of the dream-self was found and in about one third to half of the threats, the dream-self was reacting in a reasonable way to the threats (Revonsuo & Valli, 2000; Valli et al., 2007; Valli et al., 2005; Valli et al., 2006; Zadra et al., 2006). Moreover, only in a few exceptional cases did the dream-self react completely unrealistically or inappropriately (Revonsuo & Valli, 2000; Valli et al., 2007; Zadra et al., 2006).

According to Proposition 5, the simulation of perceptive and motor abilities leads to improved skills in comparable situations in waking-life, even though the rehearsed episodes in dreams cannot be recalled. This hypothesis is not empirically testable because nobody knows what topics are processed in unremembered dreams. On the one hand, a series of studies indicate that a lack of REM-sleep has a negative effect on memory consolidation (Ackermann & Rasch, 2014), while on the other hand there is conflicting evidence that dreaming is related to memory consolidation (Schredl & Erlacher, 2010; Wamsley, Tucker, Payne, Benavides, & Stickgold, 2010). Even though lucid dream research has indicated that training a skill during the dream improves waking performance (Erlacher & Schredl, 2010; Stumbrys, Erlacher, & Schredl, 2016), it is not easy to differentiate whether the experience of dreaming about the task or solely the physiological processes of REM sleep are responsible for memory consolidation (Valli, 2008).

Proposition 6 says that reoccurring and realistic threat-simulations improve threat-perception and avoidance-behavior in waking-life, and thereby increase evolutionary fitness. As in Proposition 5, this proposition is not empirically testable, which is always the case in psycho-evolutionary theories (Valli, 2008). Although only four of six propositions of the TST can be investigated empirically, the results of recent research support the hypothesis of a threat simulation system in dreams (Valli & Revonsuo, 2009). One has to keep in mind that the studies are based on different samples (traumatized children, different cultural background, students, persons with recurrent dreams) and, thus, cannot be compared directly.

The aims of the present study were twofold. First, the phenomenology of threats in German students' dreams was investigated in order to compare these characteristics with the Finnish samples. Second, having data regarding the current daytime stress levels of the participants, we hypothesized there would be more threats in the dreams of persons with high distress levels compared to the dreams of less stressed persons.

2. Method

2.1. Participants

Overall, 425 persons participated in the study, whereby 64 persons were male, and 361 female. Most of them were psychology students from the universities of Heidelberg, Mannheim and Landau. Others were persons who were recruited from the circle of acquaintances of the authors of the original study (Schredl, Wittmann, Ciric, & Götz, 2003). The mean age and standard deviation were 23.4 ± 5.4 years with a range of 16 to 61 years (two participants did not mention their age). All in all, 1612 dream reports were recorded by the 425 participants. Mean dream report length was by 153.3 ± 130.1 words.

2.2. Dream diaries

The participants were instructed to keep a structured dream diary over two weeks and to record up to five dream reports in a handwritten form. They were asked to describe their dream contents in as much detail as possible. All the dreams from one night were handled as one dream report in the analysis.

2.3. Personality and stress measures

In addition to the dream diary accounts, stress and personality variables of the participants were measured. To measure personality, the German version of the NEO PI-R personality questionnaire (Ostendorf & Angleitner, 2004) was used. This questionnaire includes 240 five-point items, coded from 0 to 4, for measuring the big five personality dimensions: Neuroticism (emotional instability), extraversion (sociability), openness to experience, conscientiousness (tidiness and loyalty) and agreeableness. The internal consistency of the five NEO-PI-R factors is quite high, from r= .89 to r = .92 (Ostendorf & Angleitner, 2004). In addition, the Boundary Questionnaire (Hartmann, 1991) was presented. Overall, the questionnaire contains 145 items, which measure 12 different boundary subtypes, for example the occurrence of untypical events, the transition from sleep to awakening, etc. The internal consistency of the sum score in the present sample was high (r = .918).

For measuring the current stress level, the participants were asked to fill out three questionnaires. First, the participants answered the EBF-72/3 questionnaire (Kallus, 1995) which measures global stress and recreation. The questionnaire measures perceived consequences to stressful events and recreational events. The EBF contains 72 seven-point items (6 items per subtest), coded from 0 to 6. The internal consistencies of the 12 subtests ranged from r = .80 to r = .97 (Kallus, 1995). The mean global stress score (including 8 subtests) was used in the analysis.

Second, the ATE 36 measures the frequency of negative and positive life events and was developed by Schmidt-Atzert (1989). The purpose of this questionnaire was to measure the effect of minor life events (daily hassles) on well-being. The 36 items (which describe 17 positive and 19 negative events) refer to the previous seven days and the sum score of negative events was included in the analysis.

Third and lastly, the Symptom-Checklist-90-R (short SCL-90-R) was used to evaluate various physiological and psychological symptoms that had occurred in the previous seven days (Derogatis, 1986). The SCL-90-R encompasses 90 five-point Items (coded from 0 to 4). The mean of all 90 items is called the Global Severity Index, which was used for the present study. The internal consistency of the particular scales was between r = .51 and r = .83 and, for the Global Severity Index, r = .94 in a healthy control group (N = 1004; Derogatis, 1986).

2.4. Dream content analysis

For analyzing the threats occurring in the dream report, the Dream Threat Scale developed by Valli and Revonsuo (2000) was used for identifying and classifying threatening events occurring in dreams. For identifying a threatening event in a dream, it should meet at least one of two criteria: The dream event would either, if it was real, endanger the mental or physical well-being of any person (Objective threat), or be interpreted and described as dangerous in any way by the dreamer (Subjective threat). Exclusion criteria for identifying threatening events are that the dream-self acts self-destructively and when the "threatening event" is not experienced as real by the dream-self.

To classify threatening events, there are several rating scales: the nature of the threatening event, the target of the threat, the severity of the threat, the possibility of actively participating in the threatening event, the participation of the dream-self in the event, the reaction of the dream self, the resolution of the threat and the realistic nature of the threat. The particular scales are well described in the test manual. The Interrater-Reliability of the Dream Threat Scale is quite high, between r = .88 and r = .99 (Valli et al., 2007).

2.5. Procedure

The students were recruited on campus and the other participants were approached by one of the authors of the original publication (Schredl et al., 2003). After the dream diaries were returned, dream reports were typed into the computer and sorted in a random order. After that, for measuring the variable of dream length, the words of each dream report were counted. Using the Dream Threat Scale, the individual dream reports were rated by a judge who had no access to any kind of information concerning the participants. In order to obtain the number of threats per participant, the threats of all dreams reported by the participant were summed. As this sum score is affected by dream length and the number of reported dreams, these two possible confounding variables were included in the analysis.

The results were calculated with SAS 9.4 statistical program for Windows. In addition to the descriptive statistics, a multiple regression analysis was performed with all variables entered simultaneously.

3. Results

3.1. Threat contents

In Table 3, the numbers of threats per dream report are presented. In nearly two thirds of the dream reports no threatening event was found and the maximum was six threats per dream. The mean number of threats per dream was 0.50 ± 0.81 and 165 dreams included more than one threat. Table 4 depicts the frequency distribution of all recorded Dream Threat Scale items. Overall, 803 threatening events were found in the 1612 dream reports. Most frequent types of threats were "Dangerous Actions", "Direct physical Aggression", "Disease, illness or medical Problems" and "Being pursued by a human" (see Table 4).

In nearly half of all threats the dream-self was the target of the threatening event. Resources, territory and animals being targets of threats occurred quite rarely. In 418 threats, though, human-like dream characters other than the dream-self were targets of the threat (see Table 4).

The severity of the threats was on average rather low. More than half of the threats were minor, and less than a quarter were life-threatening. In almost three quarters of the threats, the dream-self was generally able to react actively to the threats (see Table 4).

In more than half the cases, the dream-self showed a reaction to the threat in some way. More than a third of the participations could not be scored, and there were not many cases where the dream-self did not show a reaction for any reason. In about 40 percent, the reaction of the dream-self to the threat was realistic and appropriate in a comparable waking-life situation, whereas in half of the threatening events the dream-self did not show a reaction or it was not possible to classify. In 68 events, the reaction was inefficient but generally possible in a comparable situation, whereas in fewer cases the reaction was completely impossible but still efficient (see Table 4).

A third of all threats ended in a favorable way for the

Table 3. Number of threats per dream report (N = 1612 dreams)

Number of threats per dream report	Frequency
0 Threats	1040
1 Threat	407
2 Threats	119
3 Threats	30
4 Threats	13
5 Threats	2
6 Threats	1

Table 4. Results of all Dream Threat Scale categories (N = 1612 dreams)

Variable	Threats (N = 803)	Percent
Nature of the threatening event		
Pursued by human	74	9.22 %
Pursued by animal	25	3.11 %
Fleeing as outlaw	26	3.24 %
Fleeing from unknown	15	1.87 %
Dangerous actions	119	14.82 %
Accident or misfortune	67	8.34 %
Failing in achieving an important goal	37	4.61 %
Being late for significant event	22	2.74 %
Catastrophes forced by nature	16	1.99 %
Catastrophes forced by humans	14	1.74 %
Disease, illness or medical problems	75	9.34 %
Verbal/Psychological aggression	65	8.09 %
Threat of physical aggression	79	9.84 %
Direct physical aggression	101	12.58 %
Cannot be classified	68	8.47 %
Target of threat		
Self	513	47.85 %
Significant others	222	20.71 %
Significant territory	18	1.68 %
Significant resources	56	5.22 %
Insignificant others	196	18.28 %
Insignificant resources	67	6.25 %
Severity		
Life-threatening event	184	23.03 %
Socially/Psychologically severe	129	16.15 %
Physically severe	65	8.14 %
Minor	421	52.69 %
Possibility of active participating		
Dream-self can participate	568	71.63 %
Dream-self cannot participate	225	28.27 %
Participation of the dream-self in the event		
Dream-self reacts to the threat	430	54.22 %
Dream-self does not react because it is not necessary	9	1.13 %
Dream-self is passive, does not care	30	3.78 %
Dream-self cannot react	31	3.91 %
Cannot be scored	293	36.95 %
Nature of reaction of the dream-self		
Reacts in a realistic way	323	40.73 %
Reaction impossible in waking-life, but still efficient	26	3.28 %
Reaction is inefficient but physically possible	68	8.58 %
Dream-self does not react	386	47.71 %
Resolution of the threat		
Happy end	273	34.30 %
Unhappy end	244	30.65 %
Discontinuity	72	9.05 %
Dream ends in threatening event	207	26.01 %
Realistic nature		
Realistic threat	351	43.93 %
Realistic but improbable	211	26.41 %
Fictitious threat	205	25.66 %
Cannot be classified	32	4.01 %
Sum of threats	803	100 %

dream-self, and a third of the threats had an unhappy end. That a threatening event had a discontinuing end occurred rarely, i.e., in less than 10% of all threats. That the participant woke up while the threat was happening occurred in a quarter of the threats (see Table 4).

Concerning the realistic nature, nearly half the threats were completely realistic and could also happen in the daily-life of the participant. A quarter of the threats were completely fictitious, and another quarter was realistic, but would occur very uncommonly in waking-life (see Table 4).

3.2. Threats in dreams related to stress and personality

Table 5 describes the effect of current distress and personality variables on the frequency of dream threats. The percentage of explained variance was (R2 = .3157). The effect of age was significant, the younger the participants are the more threatening events were found in their dreams. Number of dream reports and dream length were highly significant; participants who reported longer dreams during the 14 days had more threats in their dreams, i.e., it was necessary to control for these confounding variables. The higher the Neuroticism-scale was, the more threats occurred in dreams. In addition, there was a negative association between openness to experience and number of dream threats. However, no significant effects were found for current distress variables (see Table 5).

3.3. Nature of threats in the current study compared to previous studies

In order to compare the present findings with previous studies, the following tables were generated. Although the samples were different, e.g., students and children, the comparisons are nevertheless of interest. In Table 6, the frequencies of the natures of the threatening events are shown, compared to previous studies that also used the Dream Threat Scale. For being comparable to the other results, the results of our present study had to be collapsed to their original categories. Additionally, for every study the averaged frequency of threats per dream is shown. At this point it must be mentioned that the study of Zadra et al. (2006) used a quite differentiated coding system. So for an appropriate comparison, the categories were adjusted to the original Dream Threat Scale. The participants of the trauma group of Valli et al. (2005) and the sample of Zadra et al. (2006) were very often escaping and pursued in their dreams, whereas in the sample of Valli et al. (2007) “Escapes and pursuits” were the least frequent, compared to the others. It is interesting that “Accidents and misfortunes” occurred very frequently in the present study compared to the other samples (see Table 6), which is explained by the relatively high percentage of “Dangerous actions” (see Table 4). However, failures occurred relatively rarely in our present study. Also “Illness and Disease” were quite frequent; solely in the sample of Zadra et al. (2006) was a higher frequency found. But this might be explained by their modification of the Dream Threat Scale which included several items concerning illness and disease. Compared to the other studies, aggressions were less frequent in the present sample (see Table 6).

Table 7 shows the frequencies of the threat targets. The sum of the percentages was always substantially higher than 100%, which is due to the fact that one threatening event could have more than one target. In that manner, the

Table 5. Effect of personality and current stress variables on frequency of threats in dreams (multiple regression, N = 412)

Factors	ß	χ^2	p
Age	-.0960	-2.3	.0235
Gender	-.0307	-0,7	.4786
Openness to experience	-.1959	-3.6	.0003
Neuroticism	.1231	2.1	.0340
Extraversion	.0518	1.0	.3012
Agreeableness	-.0425	-1.0	.3288
Conscientiousness	.0122	0.3	.7906
Thin/Thick boundaries	.0769	1.3	.1932
Global stress score	.0042	0.1	.9497
Number of negative events	.0621	1.2	.2208
Global Severity Index	-.0812	-1.2	.2220
Dream length	.2946	7.0	< .0001
Number of dream reports	.4280	9.9	< .0001

β = Standardized estimates

values of the previous studies were divided by the percentage sum, and presented in Table 7. Furthermore, one study (Valli et al., 2007) did not record the "Significant Territory for the Self" item, so the Territory frequencies are added to the Category "Significant Resources". In addition, some studies did not measure the frequency of "Insignificant Resources", so a new category was created, which is named "Insignificant Persons/Resources".

In our present study sample and in the trauma group of Valli et al. (2006), the dream-self is relatively seldom the threat target. In comparison, "Insignificant Others/Resources" were quite often a target of the threat in the present sample (see Table 7). In the present study, the Revonsuo and Valli (2000) study and in the non-traumatized children's sample (Valli et al., 2005), more than half the threats are minor (see Table 8). The dream-self had the opportunity to react to the threat more frequently in this dream sample compared to previous studies (see Table 9).

In Table 10, the types of reactions are presented. Compared to the previous studies, the dream-self does not react frequently by itself (see Table 10). Table 11 shows the results to the resolutions of the threats. It is interesting that the threats of the present study had a good ending relatively often (see Table 11) and the threats were more frequently fictitious than in the other samples (see Table 12).

4. Discussion

The results of the present study indicate that threats play an important role in dreams and, thus, support the idea that dreaming might have a function of rehearsing problematic or threatening situations. The present results are very well in accordance with previous findings, with only some exceptions: the number of threats per dream, proportion of minor threats, and the reality of threats, even when the present student sample is compared with other student samples. Even though everyday stress was not related to the number of threats per dream, neuroticism (positive) and openness to experience (negative) was, indicating that inter-individual differences in waking life might help to explain the variability regarding the dream threat characteristics.

In this study, the participants who reported longer dreams and recorded more dreams had more threats in their dream; clearly emphasizing the necessity to control for these possibly confounders when investigating relationships of dream threats with waking-life variables. The finding of more threats in younger persons' dreams should not be overestimated as the number of older persons in the present sample was very small (N = 11 older than 40 yrs.); it would be very interesting to expand the present data base regarding dream threats which is mainly based on children and students by studying population-based samples with a large age range.

Furthermore, most previous studies used the original form of the Dream Threat Scale. Previous studies, e.g., Valli and Revonsuo (2000) and Zadra et al. (2006), showed sufficient interrater reliability for the different categories of the scale. In the present study only one rater judged the mate-

Table 6. Nature of threatening events (N = 803) collapsed to their categories, compared to results of previous studies

	Present study (N = 1612)	Valli et al 2008 (N = 419)	Revonsuo & Valli 2000 (N = 592)	Valli et al 2005 (N = 764)			Zadra 2006 (N = 212)	Valli et al. 2007 (N = 248)
				Trauma[1] (N = 331)	Control[2] (N = 216)	Non-Trauma[3] (N = 217)		
Threats per dream	0.5 ± 0.81	1.39	1.2	1.2	0.7	0.4	0.69	1.6
Escapes & pursuits	17.44%	12%	11%	19%	16%	15.5%	25.9%	6.9%
Accidents & misfortune	23.16%	22%	22%	9%	15.5%	15.5%	19.7%	17%
Failures	7.35%	28%	26%	8%	19%	12%	6.8%	35.7%
Catastrophes	3.73%	3%	3%	4%	2%	2,5%	3.4%	3.1%
Disease	9.34%	3%	8%	1%	5%	11%	17%	3.3%
Aggression	30.51%	32%	31%	46%	37%	37%	26.6%	33.5%
Cannot be classified	8.47%	---	---	14%	6%	5%	0.7%	0.5%
Threats per sample	803	581	672	388	144	81	147	400

[1]Trauma group (children), [2]Control group (children), [3]Non-traumtized children

Table 7. Target of the threat (N = 803), compared to results of previous studies

	Present study (N = 1612)	Valli et al 2008 (N = 419)	Revonsuo & Valli 2000 (N = 592)	Valli et al 2005 (N = 764)			Valli et al. 2006 (N = 1348)		Valli et al. 2007 (N = 248)
				Trauma[1] (N = 331)	Control[2] (N = 216)	Non-Trauma[3] (N = 217)	Trauma[1] (N = 986)	Control[2] (N = 362)	
Self	47.85%	53.45%	52.52%	53.57%	54.27%	57.05%	44.86%	58.81%	54.27%
Significant others	20.71%	17.93%	19.43%	26.77%	24.39%	20.13%	25.10%	22.07%	21.74%
Significant resources/territories	6.9%	11.38%	8.63%	6.56%	9.15%	5.37%	11.62%	7.06%	7.65%
Insignificant others/ resources	24.53%	17.24%	19.42%	13.1%	12.19%	17.45%	18.42%	12.06%	16.34%

[1]Trauma group (children), [2]Control group (children), [3]Non-traumtized children

rial and, thus, interrater reliabilities have not been computed but, due to the high reliability indices obtained in different research groups, it can be assumed that systematic bias and increases in error variance due to unskillful coding is relatively small. The rater had several questions which had been answered by the author about the scale and this might indicate that the current form of the scale might need slight revisions.

Several results support the proposition that dreams are specialized in threat simulation. Despite merely one third of dreams containing one or more threatening events, in nearly half of all the threats the dream-self was able to solve the situation successfully. In addition, in most threats the dream-self was the target, followed by significant others, which also supports the TST. Compared to the other studies, life-threatening events occurred quite rarely but nevertheless do occur definitely more often in dreams than in waking-life for European students. The finding that minor threats occur relatively frequently might be explained by a modification of the TST, i.e., the difficulties of daily-life are also rehearsed supporting the problem-solving function of dreams (Moffitt, Kramer, & Hoffmann, 1993). Potentially, the threats do not have to be life-threatening or severe to confirm the theory. At least, the findings that the dream-self was able to participate actively in almost three quarters of the threats may lead to the assumption that dreams simulate threats for rehearsing comparable situations in waking-life. Furthermore, the findings that over 40% of all threats were caused by humans, fits former findings that dream characters are often hostile to the dream-self (Hall & Van de Castle, 1966).

Our hypothesis that current waking-life stress affects the frequency of threats in dreams was not supported; solely neuroticism was, as expected, related to the threat frequency. As neuroticism is a personality trait associated with worry, moodiness, and other negative feelings, the question arises as to whether rehearsing threats is adaptive. One can argue that the benefit of threat rehearsal has long gone, i.e., was important at some point in history but is no longer helpful for the daily hassles occurring in students' lives. This might also explain why stress was not related to threat frequency in the sample of German students while more extreme life conditions, like living in an area of conflict, is reflected by an increasing number of threats per dream (Valli et al., 2005; Valli et al., 2006).

The finding that openness to experience is negatively correlated with threats in dreams seems very interesting. One might argue that persons who are not that open experience more every-day challenges as threatening. In order to follow up this hypothesis, it would be very interesting to discover whether worries about those every-day challenges is related to the frequency of threats in dreams. On the other hand, the concept of thin boundaries includes day-time conflicts (Hartmann, 1991), e.g., in relationships, but was not related to threat frequency in dreams. One has to keep in mind, however, that all variables were entered simultaneously, so openness to experience seems to be the more important factor regarding threats in dreams.

The number of threats per dream in the present sample (mainly German students) is considerably lower compared the figures of the Finnish students (see Table 6). Looking at the distribution of threats, the main difference seems to be failures that are more present in Finnish students' dreams.

Table 8. Severity of threats (N = 803), compared to results of previous studies

	Present study (N = 1612)	Valli et al 2008 (N = 419)	Revonsuo & Valli 2000 (N = 592)	Valli et al 2005 (N = 764)			Valli et al. 2006 (N = 1348)		Valli et al. 2007 (N = 248)
				Trauma[1] (N = 331)	Control[2] (N = 216)	Non-Trauma[3] (N = 217)	Trauma[1] (N = 986)	Control[2] (N = 362)	
Life-threatening	23.03%	22%	22%	35%	28%	22%	25.6%	28.3%	17.7%
Severe, not life-threatening	24.90%	34%	17%	33%	32%	27%	40.4%	29.2%	49.6%
Minor	52.69%	44%	61%	35%	40%	52%	34%	42.5%	32.6%

[1]Trauma group (children), [2]Control group (children), [3]Non-traumtized children

Table 9. Active Participation (N = 803), compared to results of previous studies

Study	Present study (N = 1612)	Revonsuo & Valli (2000) (N = 592)	Valli et al. (2007) (N = 248)
Self can actively participate	71.63%	56%	59.9%
Self cannot actively participate	28.37%	44%	40.1%

Whether this result can be solely explained by different coding habits seems unlikely as the difference is considerable. Also the small number of older participants (non-students) seems not to explain the difference. Thus, it would be interesting to see whether personality traits are different between Finnish and German students, especially those that are related to dream threat frequency.

According to the threat simulation theory, threat simulations have to be realistic; as the present study showed, a significant percentage of threats are fictitious. However, this can be reconciled with the TST as the sources of those threats might be fairytales or films/TV productions etc. heard or watched in waking-life. It would be interesting to test whether violent news clips, for example, might have an effect on subsequent dreams, i.e., increasing the number of fictitious threats.

To summarize, this study provided new data on threats in dreams and showed that waking-life variables (neuroticism and openness to experience) are related to the number of threats. Further research can expand the present findings as to whether specific aspects of dream threats are related to waking-life parameters, e.g., stressful novelties, worries, etc. Still there is no empirical possibility to test whether threat simulation in dreams leads to better threat avoidance skills in waking-life and thus to better evolutionary fitness. So far, four of the six TST propositions that are empirically testable have been supported by the findings. As the environmental threats have changed over the millennia (in modern civilization the threat of predators is extremely rare), it might be interesting to look at other possible functions of dreaming, for instance with regard to social skills, as formulated in the Social Simulation Theory (Revonsuo, Tuominen, & Valli, 2015).

Table 11. Resolution of the threat (N = 803), compared to results of previous studies

Study	Present study (N = 1612)	Revonsuo & Valli (2000) (N = 592)	Zadra et al. (2006) (N = 212)	Valli et al. (2007) (N = 248)
Happy end	34.30%	32%	17%	23.4%
Unhappy end	30.65%	37%	40%	40.4%
Discontinuity	9.05%	14%	6%	18.5%
Dream ends in threatening event	26.01%	17%	37%	17.7%

Table 10. Reaction to threats (N = 803), compared to results of previous studies

Study	Present study (N = 1612)	Revonsuo & Valli (2000) (N = 592)	Zadra et al. (2006) (N = 212)	Valli et al. (2007) (N = 248)
Self reacts	40.73%	64.4%	54%	67.4%
Irrelevant reaction	3.28%	2.7%	4%	2.5%
Impossible reaction	8.58%	1.4%	3%	0.9%
Self does not react	47.71%	31.5%	39%	29.2%

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Table 12. Reality of the threats (N = 803), compared to results of previous studies

Study	Present study (N = 1612)	Valli et al. 2008 (N = 419)	Revonsuo & Valli (2000) (N = 592)	Zadra et al. (2006) (N = 212)	Valli et al. (2007) (N = 248)
Realistic threat	43.93%	67.8%	63%	20%	59.9%
Realistic but improbable	26.41%	20.8%	33%	34%	32.9%
Fictitious threat	25.66%	11.4%	4%	47%	6.7%
Cannot be classified	4.01%	1.7%	0%	0%	0.5%

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