Testing Revonsuo's Threat Simulation Theory of dreaming

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COMPULSORY DECLARATION:

This work has not been submitted in whole, or in part, for the award of any degree. It is my own work. Each significant contribution to, and quotation in, this dissertation from the work, or works, of other people has been attributed, and has been cited and referenced.

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Abstract

Revonsuo's Threat Simulation Theory of dreaming asserts that dreaming was selected during human evolution because it has the adaptive function of providing a threat-free context in which threat perception and avoidance can be rehearsed. This study aimed to test the prediction that the threat simulation mechanism will activate differently depending on waking exposure to ecologically valid threat cues. It also compared the impact of waking threat events on dream content with that of waking positive events, as TST asserts that only threat impacts on dream content. Data was collected from three contexts: a high threat context (the Western Cape in South Africa; n = 208); a medium threat context (a black southern university in the US; n = 34); and a low threat context (North Wales; n = 116). Questionnaires included a Most Recent Dream report, details of exposure to waking threatening and positive events, and dreams of such events. Chi-square analysis indicated the groups differed significantly in terms of recent exposure to an ancestral type life-threatening event ($\chi^2_{[2,N=208]} = 17.25$, $p < 0.0002$). However, the differential activation predicted by Revonsuo for the different threat contexts did not occur: participants in the low threat context reported significantly more realistic physical threats in dreams ($\chi^2_{[2,N=314]} = 6.18$; $p < 0.0455$); and dream life-threats and escapes from threats were equally low in all contexts. It was also found that most participants did not report dreaming of actual recent life-threatening experiences; and those who did, tended not to escape the dream threat. Ancestral life-threatening experiences were no more likely to lead to dream simulations than modern life-threatening experiences ($\chi^2_{[1,N=104]} = 0.808$, $p < 0.3687$). Furthermore, as many people reported dreaming of positive waking events as reported dreaming of actual life-threatening events ($\chi^2_{[1,N=389]} = 0.17$, $p < 0.6772$), and these dreams were also reported to have recurred. The mean estimates of recurrence for dreams subsequent to actual life-threatening events were similar to those for dreams subsequent to positive events. These results contradict TST's predictions, and cast doubt on the validity of the theory.

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CHAPTER ONE
LITERATURE REVIEW

In 2000, Behavioral and Brain Sciences, the most influential journal in the field of cognitive neuroscience, published a special issue on sleep and dreaming. It contained the most important recent research and theorizing on dreaming, along with extensive peer commentary. This issue was later reprinted in book form by Cambridge University Press, and updates on relevant subsequent research findings were included (Pace-Shott, Solms, Blagrove & Harnad, 2003). Revonsuo's Threat Simulation Theory (TST) was presented as one of five target articles. TST asserts that dreaming was specifically selected during human evolution. The theory postulates that dreaming has the biologically adaptive function of providing a cost-free context in which threat perception and avoidance can be rehearsed, thus improving waking performance.

TST drew a mixed response from the BBS commentators. The theory seems highly speculative, and the bases of Revonsuo's arguments are perhaps somewhat shaky. Aside from a study by Revonsuo and Valli (2000), very little attention has since been paid to testing the theory, although it continues to be cited. This is problematic, because as Domhoff (2003a) has pointed out, the field of dream research contains many speculative theories. Despite having no empirical evidence in their favour, they persist because they are difficult to refute. The aim of this study is thus to investigate the plausibility of some of TST's assertions.

TST is very detailed, and incorporates a great deal of evidence from widely disparate sources. It will initially be presented in brief and without comment, as first put forward by Revonsuo (2000a).

Revonsuo's Threat Simulation Theory

In the initial exposition of the theory, Revonsuo contends that the appropriate context for considering any possible biological function for dreaming is that of human evolution in the Pleistocene era. His stated aim is to explain dreaming at the phenomenal level, attempting to ascertain whether the subjective conscious experience of dreaming could be functional. Functional means biologically adaptive, hence dreaming must have provided a selective advantage, which led to its propagation in the population. Revonsuo adds the caveat that whatever function dreaming may have served in the ancestral past, we need not expect it to be retained in our current, vastly different environment. He includes multidisciplinary evidence from the areas of content analysis; neurophysiology and evolutionary psychology, but because he accepts that REM and dreaming are dissociable, Revonsuo argues that explanations of dreaming need not refer to REM or any physiological sleep processes. The resultant Threat Simulation Theory (TST) is expressed in 6 propositions, each of which is followed by specific predictions.

Proposition 1: "Dream experience is not random or disorganized; instead it constitutes an organized and selective simulation of the perceptual world" (p.882)

Revonsuo argues that dream content shows too much organization to have arisen by chance.

> "The dreaming brain constructs a complex, organized offline model of the world in which there typically is an active dream self with a body-image much like the one we experience when awake, surrounded by a visuo-spatial world of objects, people, and animals, participating in a multitude of events and social interactions with other dream characters" (Revonsuo, 2000, p.883).

Revonsuo argues that if dreams were simply due to random activation, as originally suggested by Hobson (Hobson & McCarley, 1977), they should be experienced as static images; or as weird visuals like the aura of a migraine, and not as a complex world model. He refers to Penfield's experiments (as discussed in Penfield, 1975), where stimulation of the temporal cortex resulted in vivid and realistic perceptual flashbacks.

Revonsuo claims these were dissimilar to dreams, being short and unelaborated. He also cites Foulkes' (1985) characterization of dreams as coherently organized, and claims they take the same general form as our waking experience. Revonsuo argues that, given the perfection of the simulation, there is no reason for us not to believe that the dream experience is entirely real.

Regarding selectivity, Revonsuo refers to Hartmann's (1998) findings, which indicate the three R's (reading, writing and arithmetic) are absent from dream content. He concludes that dreaming is selective in what it represents.

Predictions derived by Revonsuo from Proposition 1:

1) The neural mechanisms underlying dream production are selective and organized, not random.
2) Threat simulations are not randomly generated, but originate in episodic memory traces in the amygdala-centered emotional memory system, and are systematically modulated by an associated negative emotional charge.

Proposition 2: "Dream experience is specialized in the simulation of threatening events" (p.883)

Revonsuo claims this proposition is supported by evidence of more negative than positive elements in dream content:

- *Negative emotions* prevail in dreams. A study by Snyder (1970) found a majority ($2/3^{rds}$) of negative emotions, the most common being fear. According to the Hall and Van de Castle norms (in Domhoff, 1996), about 50% of negative dream emotions are apprehension; the other half being coded as sadness, anger, and confusion.
- *Misfortunes* occur 7 times more frequently than good fortune (Hall & Van de Castle, 1966, in Domhoff, 1996).

- *Aggression* is the most frequent social interaction and occurs in 45% of dreams (Hall & Van de Castle, 1966, in Domhoff, 1996); the dreamer is involved in 80% of these interactions, and is more often the victim than the aggressor.

Revonsuo goes on to argue that dream content is not only predominantly negative, it is also consistent with our ancestral rather than our current environment.

- *Enemies in dreams:* Animals and male strangers are the most common enemies in dream reports (Domhoff, 1996). Revonsuo also argues that this, and the frequent occurrence of running away and hiding, indicate the presence of ancestral threat avoidance scripts in dreams.
- *Children's dreams:* Revonsuo claims that if his hypothesis is true, we should expect to find more aggressions and animals in dreams earlier in life, before the brain has adjusted to the non-ancestral environment. Research indicates that there are more animal characters in children's dreams; comprising 25 – 30% of all characters in two to six year olds; 15% in seven to twelve year olds; and only 5% in adult dream reports (Hall & Domhoff, 1963; 1964). Many studies confirm this trend. Moreover, Revonsuo claims that wild or frightening animals constitute 40% of these dream animals. (See Revonsuo, 2000a, for a review of this literature).
- *Recurrent dreams and nightmares:* The most common recurrent dream theme is of being chased. Being chased or attacked is also the most common nightmare theme (Domhoff, 1996; Feldman & Hersen, 1967; Hartmann, 1984).
- *Absence of the three R's:* Hartmann (1998) indicated that these activities are underrepresented in dream reports. Revonsuo argues that this is not simply because they have little emotional significance: other activities which vary in terms of emotional intensity and relevance nonetheless occur as frequently in dreams as in waking (i.e. walking, talking with friends, and sexual activity; Hartmann, 1998). Revonsuo concludes that the three R's are absent because they did not exist in our ancestral environment.

He then proposes that the activation patterns of REM reflect the neural correlates of threat simulation. He refers to recent memory research which posits 2 memory systems: a 'hot', amygdala centered emotional system; and a 'cool', hippocampally centered episodic system (Revonsuo cites Metcalfe & Jacobs, 1998, for a review of this literature). It is proposed that the 'hot' system highlights highly emotional species-specific or learned memory traces. This system is thought to be more primitive and automatic than the 'cool' system, and is involved in releasing rapid species-specific responses such as fear and defensive behavior. Revonsuo concludes:

> "neurophysiological studies and functional brain imaging reveal the dream-production mechanisms at work during REM sleep, searching for and processing emotionally charged memory traces in the evolutionarily ancient, 'hot' memory system." (p.887).

Predictions derived by Revonsuo from Proposition 2:

1) If we define a content category that includes all threatening events, these should be over-represented in dreams.
2) Severe or mortally dangerous threats should occur more frequently in dreams than in waking life.
3) When activated by real threats, the threat simulation mechanism should simulate ancestral threats (e.g. animal attacks, direct physical aggression, natural forces) more efficiently than modern threats (e.g. smoking, traffic accidents, explosives)

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 experience" (p.887)

- *Traumatic experience impacts on dream content:* The literature indicates that trauma commonly leads to nightmares (Nader, 1996; Wilmer, 1996). Revonsuo argues that this fact is impressive, given the difficulty encountered in laboratory studies attempting to influence dream content.

> "The sense of severe personal threat probably is the most powerful factor we know of in the modulation of the content of dreams: the experience of a severe trauma can induce nightmares in almost anyone; the majority of people, especially children, involved in traumatic events do report nightmares..." (p.887)

- *Real threats are cues that activate the threat simulation system:* Real threats constitute the only ecologically valid cues for triggering the threat simulation mechanism. Revonsuo dismisses the idea that strong positive emotions may also impact on dreams, citing Hartmann's (1998) contention that even positive events are dreamed about in terms of possible problems/threats.

Predictions derived by Revonsuo from Proposition 3:

1) No other class of event will be found that impacts on dream content in the same manner as the experience of threatening events.
2) Real threats will activate the threat simulation mechanism universally, independent of culture.
3) The intensity (i.e. frequency and persistence) of simulations triggered by an actual threat will depend on the degree of personal threat experienced.

Proposition 4: "The threat simulations are perceptually and behaviorally realistic and therefore efficient rehearsals of threat perception and threat-avoidance responses" (p.889).

- *Perceptual realism and lack of insight:* Revonsuo argues that because these factors are present, the simulation is taken seriously as real.
- *Motor Realism:* Dream imagery uses the same motor circuits that generate actual movement. When motor inhibition mechanisms fail, the result is REM Sleep Behavior Disorder, where violent behaviors can occur in REM sleep. Complex behaviors can manifest in REM without atonia: in cats we see searching for and orienting toward prey; as well as attack behavior (Morrison, 1983). From this Revonsuo concludes that "...threat simulation during sleep includes realistic and adequate motor activation in the brain in response to the perceived threats"

(p.890). He also argues that the theta rhythm present in REM is crucial to survival in waking – it is linked to predatory behavior in the cat and to prey behavior in rabbit (Winson, 1990).

> "Thus, to dream about threat perception and threat-avoidance behaviors is to realistically rehearse these functions in a safe environment" (Revonsuo, 2000a, p.890)

Predictions derived by Revonsuo from Proposition 4:

1) In the face of life-threatening dream events, the dreamer is most likely to react in a reasonable and realistic defensive manner.
2) The neural correlates of visual awareness will be found to be the same in dreaming as in waking.
3) Without atonia, all the movements experienced in the dream will be carried out by the dreamer's physical body.

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" (p.890)

- *Mental training:* Motor imagery and mental training leads to increased muscle strength; learning new motor skills; and improved sports performance (Hall, Bukolz & Fishburne, 1992; Lejune, Decker & Sanchez, 1994; Yue & Cole 1992). Revonsuo thus hypothesizes that dream rehearsals could result in similar improvements. In the waking training situations, however, we explicitly remember the content, which is not the case with most dreams. Revonsuo thus invokes implicit learning and memory to explain the advantage dream rehearsals may convey.

Predictions derived by Revonsuo from Proposition 5:

1) Simulations involve behavior that requires perceptual, cognitive and motor skills that improve through implicit procedural learning.

2) Implicit learning in waking amnesic patients should form a model for implicit learning for normal subjects during dreaming.

Proposition 6: "The original environment in which humans and their ancestors have lived for more than 99% of human evolutionary history included frequent dangerous events that threatened human reproductive success and presented severe selection pressures on ancestral human populations. The ecologically valid threat cues in the human ancestral environment fully activated the threat simulation system. Recurring, realistic threat simulations led to improved threat perception and avoidance skills and therefore increased the probability of successful reproduction of any given individual. Consequently, the threat-simulation system was selected for during our evolutionary history" (p.891).

Revonsuo argues that the ancestral environment was extremely harsh and contained threats such as predation, exposure, disease, risks in hunting, and intergroup aggression. These ecologically valid cues would have resulted in the threat simulation mechanism being constantly activated. "In effect the dream production system must have been in a more-or-less constant post-traumatic state" (2000a, p.891).

Revonsuo argues that if the threat simulation mechanism exists, we should expect it to be activated in present day hunter-gatherer populations because their living conditions are similar to ancestral ones. We should predict frequent threat simulations and many animal characters in their dreams. He claims that this prediction is born out in published studies (Domhoff, 1996; Gregor, 1981).

Predictions derived by Revonsuo from Proposition 6:

1) Children old enough to use threat recognition and avoidance skills will be capable of threat simulations in dreams if exposed to ecologically valid threats.
2) Ontogenically early exposure to experienced real (ancestral) threats will stimulate the threat simulation system, leading to earlier, more frequent, and more intensive threat simulations, lasting throughout life. Conversely, if there is no exposure to

real threats, the dream production system will develop more slowly or stay in a resting state and threat simulations will remain less frequent and milder.

Revonsuo's model of dream production and threat simulation

Revonsuo asserts that dream production is a hardwired feature of brain function, which has two distinct stages:

1) *Threat recognition:* salient emotionally charged memory traces are selected; and the selected visual imagery is realized by the occipito-temporal visual stream. When the threat is present in visual consciousness, the amygdala is activated to evaluate it as rapidly as possible.
2) *Threat avoidance:* this involves the rapid selection of an appropriate response (e.g. fleeing, hiding, defending, attacking) and the immediate realization of this response. Dream production mechanisms tend to use ancestral scripts: i.e. attacks, fights, pursuits, escapes, intrusions, loss of resources; dream self or kin being threatened.

> "Threat avoidance simulation primes the connections between specific perceptual-emotional content and specific behavioral responses, and rehearses the efficient release of these behavioral responses through the activation of cortical motor programs" (Revonsuo, 2000a, p.894).

Revonsuo concludes that this mechanism is biologically functional.

Mechanisms behind post-traumatic nightmares

Revonsuo argues that memory traces with an overwhelming emotional charge may remain highly salient, and thus keep getting selected. Constant dream rehearsal may contribute to this process. He points out that we should not expect these dreams to be adaptive in war-related PTSD – the conditions resulting in PTSD are too different from the ancestral environment.

Why we dream about 'current concerns'

When no threats are present in waking life, any recent or active memory traces may be selected; particularly those that are emotionally charged. Hence we dream about 'current concerns'. TST, however, predicts dreams can be disconnected from current concerns: nightmares and recurrent dreams are not always prompted by actual events. These dreams are generated from ancestral threat scripts. The current concerns theory cannot explain these dreams and Revonsuo concludes that TST is more parsimonious as it can explain both types of dreams with one mechanism.

Threat simulation as a biological defense mechanism

Revonsuo likens the threat simulation mechanism to the immune system: both aim to protect the individual. Like the immune system, the threat simulation mechanism is activated by the presence of threat; and is deactivated once the threat is eliminated. Critically, it remembers the response to any particular threat in future, resulting in a better response.

Revonsuo contends that our non-threat dreams have no function. They are produced in the same way that the immune system produces granulocytes in the absence of pathogens. He also points out that our immune system has elements which appear to be nonfunctional or dysfunctional. He argues that nightmares and PTSD should be seen in this perspective: allergies and autoimmune diseases occur, and both can be fatal. Nonetheless the immune mechanism was selected because it produces more benefits than costs overall.

RESPONSES TO TST

Thirty-six authors provided detailed peer commentary on Revonsuo's target article. It is clearly impossible for this review to give adequate coverage of all these responses. The following constitutes a brief overview of both positive responses to TST, and of some of the most telling criticisms presented. Following each criticism a brief synopsis of

Revonsuo's response, if any, will be included. An analysis of his response will also be attempted.

Positive responses to TST

Many commentators welcomed Revonsuo's evolutionary approach to investigating the possibility of dreams being functional, even if not all accepted TST (Antrobus, 2000; Ardito, 2000; Bednar, 2000; Cheyne, 2000; Conduit, Crewther & Coleman, 2000; Humphrey, 2000; Kramer, 2000; Kriekhaus, 2000; Montangero, 2000; Moorcroft, 2000; Panksepp, 2000; Rotenberg, 2000; Shackelford & Weekes-Shackelford, 2000; Thompson, 2000; Wichlinski, 2000).

Gottesmann (2000) sees a link between Revonsuo's concept of ancestral scripts and Freud's idea of phylogenetically transmitted primal fantasies. He cites the dream 'The man and the wolves' as a paradigm of threat simulation. Shackelford and Weekes-Shackelford (2000) accept TST wholeheartedly, and suggest looking for gender differences in threat simulations, as women and men faced different selection pressures.

Cheyne (2000) draws attention to the similarity of dreams to play – both allow simulation of unusual and exaggerated actions or situations; while dreaming has an even greater advantage than play in providing a safe context for the simulation. Humphrey (2000) also notes this analogy, but nonetheless thinks TST is too narrow: play does not only simulate dangerous situations, but contributes to social and psychological development. He argues we should expect the same function for dreams.

Domhoff (2000) does not think that dreams are adaptive, but he does agree that repetitive dreams may be linked to the fear/vigilance system of the amygdala. Kriekhaus (2000), on the other hand, agrees that dreaming of threat would bestow great selective advantage, but argues that the focus should move away from the amygdala to the Papez circuit, which mediates explicit learning. He, however, points out that as this system is present in all mammals, TST is not likely to be specific to humans. Panksepp (2000) applauds

Revonsuo's acknowledgement of the importance of emotion in dreams, but argues that we should examine all basic emotion systems, not just fear.

Wichlinksi (2000) also applauds TST, and examines related pharmacological data. He says that although the evidence is tentative and there are some contradictions, there are some consistencies with TST. Generally, pharmacological suppression of REM leads to a reduction in nightmares, while REM enhancement results in an increase in bad dreams. The conclusion Revonsuo (2000b) draws from this is that REM suppression/enhancement correlates with the activity level of the threat simulation mechanism.

Criticisms of TST

Criticisms based on dream research methods

The report ≠ the dream:

This is a fundamental constraint on all dream research, and one which is often ignored. The actual dream cannot be accessed, and it is impossible to verify the accuracy of dream reporting (Coenen, 2000). An extreme position contends we cannot exclude the possibility that nothing exists but the report (Feinberg, 2000; Thompson, 2000). Hobson Pace-Shott and Stickgold (2000a) suggest that because the report is generated in the waking state, waking phenomenology is likely to be confused with dreaming phenomenology, obscuring important differences in experience across the two states. Nonetheless, most theoretical models of dreaming, including Revonsuo's, are built on the assumption that dream reports provide a valid sample of cognitive activity during sleep (Conduit et al., 2000). Coenen (2000) questions whether dream reports are a reliable enough reflection of actual dream experience to justify this. Given the disagreement around dream experience in terms of the location and character of complex sleep mentation (Antrobus, 1983; 2000; Foulkes, 1962; Foulkes & Schmidt, 1983; Hobson et al., 2000a; Nielsen, 1998; 2000a; Solms, 1997; 2000; Zimmerman, 1970), Revonsuo's implicit assumption that dreams = REM-type or 'apex' dreams (Nielsen, 2000a), and that

dream reports unproblematically reflect these dreams, is one that is open to challenge. He, however, ignores the existence of this problem entirely.

Failing to problematize recall of dreams is another major oversight. The fact that dreams are so easily forgotten is one that any theory of dreaming should attempt to explain (Hobson et al., 2000a). Lehman and Koukkou (2000) argue that dream recall is problematic due to state differences: optimal recall occurs in the same state as the initial experience. Hobson et al (2000a) postulate a state dependent amnesia: aminergic activation falls by 50% in NREM, and by almost 100% in REM – thus they suggest that for recall to occur, the intense activation of REM must overcome this and persist into waking. It is for this reason that very vivid dreams tend to be recalled. This intense activation argument could hold equally for recall of dreams from sleep onset and late stage NREM. Braun (1999) has indicated that prefrontal deactivation in REM degrades working memory – dream memory traces become relatively inaccessible because they are not linked to simultaneously encoded contextual cues.

Both these concerns – the inaccessibility of the actual dream experience combined with poor recall - need to be acknowledged and addressed by any theory that aims to establish an understanding of dreaming. It should be noted that Revonsuo assumes a one-to-one relationship between dreams and reports. He justifies this by claiming that laboratory and dream content studies should give a clear idea of dream content, and "if this is not the case, then the content of dreams must be beyond the reach of systematic empirical investigation" (Revonsuo, 2000b, p.1067). This response does not address the chief concern: if systematic recall biases exist, due to different sleep states and the transition from sleep to waking, they will impact on findings in all contexts. This possibility must at least be acknowledged.

Selective bias in memory for dreams:

Clearly the possibility exists that selective bias operates in the recall of dreams. Chapman and Underwood (2000) are researching a waking memory phenomenon which may be related to dream recall biases. They propose that recall of internal mental events

s to an existing external narrative. During routine tasks
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rdest to recall are those which have no link to external

recall follows the rules of classical memory theory:
nsity are predictive of recallability. Schredl (2000) has shown that dreams recalled immediately on awakening show a balance of positive and negative affect, while delayed recall yields a preponderance of negative emotion. Mealey (2000) states that comparing REM awakening reports, dream diary entries and delayed free recall shows the least interesting and emotional dreams are forgotten first, until only the most salient dreams remain in memory. She argues that reports of salient dreams are thus likely to form the bulk of content research studies: a highly selective and unrepresentative sample. Conduit et al. (2000) agree, claiming that memory research has shown that emotional and unusual events attract attention and are thus more easily recalled. A majority of emotional and unusual content in dream reports may simply reflect these biases in memory processes.

It is thus possible that dream recall follows biases evident in waking cognition. Mealey (2000) points out that a variety of threat-related cognitive biases have been demonstrated, with survival related threats being selectively perceived, attended to, remembered and discussed. Bednar (2000) concurs, as do Chapman and Underwood (2000), who state: "Two key factors that determine the likelihood of events being represented in memory are precisely the degree of threat posed and the unpleasantness of the incident... Unpleasant, traumatic events are routinely over-represented in memory" (p.918). Conduit et al. (2000) dismiss Revonsuo's argument as follows:

> "all of the events we dream about must have an origin in memory. Therefore, it is the selective nature of attention and memory consolidation during waking that can provide an explanation for the proposed over-representation of "threatening" dream content, rather than a biased dream generation mechanism" (Conduit et al., 2000, p.927).

We may thus have a systematically biased sample of dream content: as Montangero (2000) argues, everyone can recall a nightmare, but most people are unaware of mundane dreams that occur throughout the night. Subject selection may be an issue too – Nielsen (2000b) points out that sufferers of nightmares and other parasomnias may be more inclined to volunteer for sleep studies. Domhoff (1996) strongly defends the validity of certain content research, pointing out that arbitrary cues throughout waking can cue recall of dream events. However, even he concedes that some dreams may be more easily forgotten, and that there does seem to be a recall bias in favor of dramatic dreams. Aside from the comments already cited, Revonsuo makes no response to criticisms based on problems inherent in dream research methodology.

Criticisms based on conflicting evidence

Threat Simulation Theory is too narrow:

Montangero (2000) makes the point that TST is too narrow, calling it conjectural, and asserting it cannot explain the majority of our dreams. Similarly, Cheyne (2000) questions the contention that only a proportion of dreams have evolutionary significance while the rest reflect random error, commenting: "If the remainder of dreams were an undifferentiated morass, perhaps the narrowness of the threat simulation hypothesis would be less problematic" (p.918). This, however, is not the case. It is well established that there are other common and consistently occurring dream themes. Bednar (2000) states that assuming these are simply side-effects seems arbitrary, and accuses Revonsuo of not treating dream content systematically.

Germain, Nielsen, Zadra and Montplaisir (2000) have studied the prevalence of dream themes in over 1000 students and nearly 1000 sleep-disordered individuals. They confirm Revonsuo's contention that chase dreams are very common, ranking among the

three most prevalent themes. However, they find some of the most prevalent themes are positive, for example sex and flying. Also, many prevalent themes are of current rather than ancestral concerns, for example, schoolwork. For students, 'school, teachers and studying' ranks 3rd most prevalent. Importantly, many ancestral themes rank among the least prevalent. Natural disasters are not common: fire ranks 33rd, tornados or gales 45th and earthquakes 48th. Very interestingly, in terms of Revonsuo's argument concerning enemies in our dreams, threatening animals rank 35th and wild violent beasts rank 40th.

Zadra and Donderi (2000a) analyzed recurrent dream content, and argue against Revonsuo's use of these dreams as exemplars of the threat simulation mechanism. They point out that many recurrent dreams do not contain threats; threats in recurrent dreams are not always realistic; and that successful threat avoidance rarely occurs. Additionally, research indicates recurrent dreams are associated with a deficit in psychological health. This seems counter to Revonsuo's contention that the threat simulation mechanism is adaptive.

Zadra and Donderi (2000a) agree that chase dreams are the most frequently reported recurrent dreams. Nonetheless, they constitute less than 15% of adult recurrent dreams. They find 30% of recurrent dreams to be idiosyncratic, and unrelated to threats; with consistent themes such as house maintenance; finding new rooms; losing one's teeth; and driving occurring in the remainder. They conclude:

> "Based on the range of thematic content and affective expression represented in recurrent dreams, it may be misleading to conclude that most recurrent dreams are dissociated from the dreamer's current concerns. It would appear that a great many recurrent dreams are not realistic rehearsals of a threatening event but rather pictorial metaphors of current concerns" (Zadra & Donderi, 2000a, p.1018).

Other criticisms of the focus on threat also arose. Kramer (2000) points out that familiar characters are more frequently incorporated into dreams than strangers, which is not what would be expected from the threat simulation mechanism. Ardito (2000) argues that the prevalence of negative emotions does not necessarily support the threat simulation

hypothesis. Negative emotions are varied, and many have no relation to threat. Other research (Strauch & Meier, 1996) shows the most common specific emotion in dreams may be joy. Ardito (2000) also argues against using prevalence of misfortunes as supporting evidence: these events are usually inevitable or uncontrollable, so it is hard to see how dreams could lead to more adaptive response. Flanagan (2000) contends that the prevalence of animal characters in children's dreams can be explained by their constant exposure to fairy tales and cartoons.

Nielsen and Germain (2000) point out that "the observation that interactive character imagery is virtually universal to dreaming could lead forthright to a theory of dreaming as simulation of attachment relationships" (p.979) - these are also fundamental to survival. Similarly, the constant occurrence of self-imagery in dreams could suggest a theory of dreaming as vital to ego and self-state development. The consistency of place imagery could suggest dreaming is involved in spatial learning and orientation. They are suggesting that Revonsuo's narrow focus on one aspect of dream content is arbitrary.

Revonsuo's response (2000b):

Revonsuo did not directly address all the criticisms mentioned above. In response to Flanagan's contention that the source of pervasive animal characters in children's dreams could be exposure to fairy tales and cartoons, Revonsuo counters that these animals are bizarre and humanlike, and thus an unlikely source of images. He insists animal characters reflect ancestral scripts.

In response to Germain et al.'s comments, Revonsuo argues that evidence from typical dreams is not relevant. Prevalence is not the same as frequency – his research indicates that many memorable and prevalent themes do not occur frequently, for example sex and flying (Revonsuo & Valli, 2000). In contrast, his research indicates threat themes are both prevalent and frequent. He claims that sexual dreams are often negative or threatening. His only comment on the low prevalence of ancestral themes is that natural disasters are rare in sub-Saharan Africa (i.e. the ancestral environment). He also queries what response could be adaptive in the face of an uncontrollable event of this kind.

Revonsuo insists that dreams show a unique preference for threatening events. Only threats impact markedly on dream content – he claims that there are no 'post-triumphant' dreams. He argues that the critics "cannot account for these systematic biases and causal relationships between real threats and dreaming" (Revonsuo, 2000b, p.1065)

Criticisms based on flaws in Revonsuo's reasoning

Bizarreness and reduced volitional control:

Many researchers consider bizarreness and reduced volitional control to be core features of dreaming (Hobson et al., 2000a; Mancia, 2000; Nielsen, 2000a; Solms, 2000). There is some evidence that dreaming brain processes contribute to these features. The deactivation of the prefrontal cortex means that executive monitoring is absent (Clancey, 2000; Hobson et al., 2000a; Solms, 2000). It is also possible that changes in neuromodulation are involved: Hobson et al. (2000a) suggest that neuromodulation helps regulate "directed attention, deliberate thought, self-reflective awareness, orientation, emotion, memory and insight" (p.833). Increased cholinergic activity in REM may reduce the reliability of cortical circuits, increasing the possibility of bizarre temporal sequences and associations, which are accepted uncritically because of reduced insight. They comment:

> "While it may well be true that many dreams are concerned with mundane, everyday themes, they are interconnected in an incongruous and discontinuous manner" (Hobson, Pace-Shott & Stickgold, 2000b, p.1020).

Given the bizarre nature of dreams, the commentators find them unlikely sites for realistic rehearsals of survival skills (Flanagan, 2000). Zadra and Donderi (2000a) see this as particularly relevant to nightmares, one of Revonsuo's paradigm dream types. Contrary to Revonsuo's assertion that dream simulations are highly realistic, Bednar (2000) cites Dennett's (1991) contention that brain activity need not be realistic at all, provided the processing machinery treats it as such. This is perhaps precisely what

occurs in dreams, and thus unrealistic, bizarre features are only recognized in retrospect (Bednar, 2000). While instinctual programs, especially fight-flight responses, are often incorporated in dreams, reduced volitional control leads to dreamers seldom considering the possibility of controlling the sequence of events (Hobson et al., 2000a). This argues against dreams being adaptive rehearsals of responses to threat.

Revonsuo's response (2000b):

Revonsuo maintains that dreams are more organized than bizarre, claiming the degree of bizarreness is assumed rather than demonstrated. His research indicates only 15 – 20% of descriptions of objects, actions, persons or places were rated bizarre (Revonsuo & Salmivalli, 1995), while 50% of human characters were rated as identical to waking (Revonsuo & Tarkko, 2000). These codings, however, ignore the incongruous and discontinuous combinations that often constitute bizarreness. Revonsuo concludes "dreams are remarkably organized. No random process could ever create such a complex simulation of the waking perceptual world" (2000b, p.1066). It should be noted that Revonsuo assumes critics must subscribe to the idea of random activation in order to characterize dreams as bizarre. This is not the case (e.g. Solms).

Not content to rely on one line of reasoning, Revonsuo then asserts that if bizarre elements occur, it is because the system is not functioning properly in the modern context. He claims recurrent dreams of ancestral threats and PTSD dreams prove that dreams are more realistic and less bizarre when activated by valid cues. His third and final argument, again admitting that bizarreness occurs, refers to a suggestion put forward by Cheyne (2000): some bizarre elements may be "functional exaggerations that test the limits of the system" (Revonsuo, 2000b, p.1067). Terrified slow motion running, for instance, may thus be the dreaming equivalent of training with a heavy pack. Revonsuo's argument seems inconsistent to say the least: his research indicates dreams are not bizarre; if they are bizarre, it is because the threat simulation mechanism is not working correctly; or perhaps it is working, and bizarreness exists specifically to enhance threat simulation training.

Revonsuo pays little attention to the contention that executive functions are absent in dreams, and that volitional control and insight are consequently reduced. Referring specifically to Clancey's (2000) argument that dreams lack goal directed sustained attention, he argues this is an unfounded assumption rather than an empirical observation.

Nightmares/PTSD dreams:

Revonsuo's use of these dreams as exemplars of the threat simulation mechanism drew a great deal of criticism. Firstly, it was argued that problems are seldom solved in threat dreams:

> "it is difficult to see how our widely described paralyzed fears, slow motion running and escape tactics based on absurd reasoning could be a rehearsal or simulation of anything adaptive" (Hunt, 2000, p.955).

Zadra and Donderi (2000a) concur. In their analysis of nightmares from non-traumatized adults, they found threats but not adaptive responses, with many reports containing only a fear reaction.

Schredl (2000) points to the marked relationship between psychopathology and negative dream emotions (e.g. Schredl & Englehardt, 2001; Hartmann, 1991), and many authors point to the negative impact recurrent nightmares have on waking life. Kramer (2000) and Levin (2000) agree: Revonsuo presents the nightmare as the prototype dream fully realizing its biological function and completely ignores its non-adaptive consequences. Levin (2000) points out that both PTSD and lifelong nightmare sufferers show 'impaired psychological functioning and attenuated information processing' (p.965), and that lifelong nightmare sufferers are at increased risk for developing schizophrenic-type disorders. He questions Revonsuo's analogy with the human immune system, which suggests that early exposure to threats would result in a better response in later life. "In fact, research has repeatedly demonstrated that exposure to early averse environmental events is a primary pathogenic pathway to later psychopathology" (Levin, 2000, p.965). Nielsen and Germain (2000) point out the obvious - Nightmare Disorder and PTSD are classified as dysfunctional, and are included in the DSM-IV.

Particular points were made regarding PTSD dreams. Levin (2000) queries why, if TST is valid, PTSD sufferers are overwhelmed by the very symptoms that should be adaptive. He points out that repetitive nightmares can last for fifty years post trauma without any reduction in psychological distress. Kramer (2000) and Schredl (2000) counter Revonsuo's contention that modern PTSD (referring to that engendered by war and concentration camps) is an aberrant response to threats not present in the ancestral environment. They point out that many other traumas resulting in PTSD (e.g. rape, incest, natural disasters and physical beatings) approximate traumas experienced in that period. Nielsen and Germain (2000) find it hard to reconcile PTSD sufferers' disturbed and debilitating waking and sleep function with TST, especially since PTSD dreams are triggered by ecologically valid cues, and are paradigm dreams in terms of Revonsuo's arguments. Yet PTSD sufferers show waking disturbances of key cognitive and physiological systems that would decrease chances of survival.

> Hunt concludes: "The view that nightmares and stress dreams show the essence of all dreaming is like saying the underlying purpose of the vestibular system...is nausea and vomiting, because that is what happens when the system is overloaded in extreme dizziness" (2000, p.955).

Revonsuo's Response (2000b):

To the argument that threat dreams seldom contain meaningful responses, Revonsuo counters that his research (Revonsuo & Valli, 2000) indicates that if the dream self reacts to the threat, 94% of these reactions are appropriate. Irrelevant and impossible reactions are rare (6%). Note this does not tell us how often the dream self does react. Revonsuo acknowledges we need more investigation of both threat and response in dreams. With regard to Hunt's comment about paralyzed fears not being adaptive, Revonsuo asserts an initial freeze response is adaptive when a predator is noted in the distance.

Revonsuo also questions the idea that threat simulation necessarily causes disturbing nightmares, stating his belief that the vast majority of threat simulations do not disturb sleep. Regarding the correlation between nightmares and psychological problems, Revonsuo points out that TST does not predict that the mechanism is adaptive in the

current context. He also points out that correlational data does not allow the assumption that dreams are causing psychopathology. He suggests these people tend to suffer from nightmares as a result of feeling more chronically threatened than the rest of the population. However, regardless of the direction of the relationship, disturbing dreams do not seem to improve waking functioning.

Revonsuo acknowledges that the criticism around PTSD is an important issue to be addressed. He claims we need to establish whether threat simulation can be adaptive even if it leads to insomnia, fatigue and impaired performance. This question seems to answer itself. He further contends that ancestral humans did not suffer from PTSD because they were adapted to higher levels of stress, and the threats in their environment were "mostly familiar and predictable" (Revonsuo, 2000b, p. 1072). This argument begs the question of why familiar and predictable threats would require constant simulation in dreams.

Revonsuo again contends that 'real' recurring PTSD dreams occur in war veterans, and victims of concentration camps – i.e. those who have been exposed to severe and prolonged threat that does not resemble ancestral conditions. On the other hand, he speculates, if ancestral humans did have PTSD, some features of the disorder, such as an increased startle response and hypervigilance, would be adaptive in a dangerous environment.

It is difficult to regard speculation about PTSD in the Pleistocene as a serious attempt to address criticisms aimed at the logic of using these dreams as evidence for his hypothesized mechanism. Revonsuo's argument has become totally circular – PTSD dreams are used to support the hypothesis, and then the hypothesis is used to rationalize away contradictory aspects of PTSD.

Direction of the relationship between emotion and dream content:

Revonsuo assumes dream plots cause the preponderance of negative dream emotion. Bednar (2000) challenges this assumption regarding the direction of the relationship

between emotion and plot. The established dream feature of emotional continuity despite narrative discontinuity suggests the opposite relationship: an emotion is activated, and this prompts recall of events associated with that emotion. Whether the activation of emotion is due to brainstem processes (Hobson et al., 2000a); to the engagement of the basic emotion SEEKING system (Solms, 2000); or to the brain's current emotional state (Hartmann, 1998); the direction remains the same: emotion → narrative.

Some researchers claim REM brainstem processes activate the adjacent emotional centers in the limbic and paralimbic regions (Hobson et al., 2000a; Kramer, 2000). This bottom-up model sees emotion as the primary shaper of dream plots. "Since most of the basic emotions are negative, the associated dreams are also likely to be negative" (Flanagan, 2000, p.938). They argue this explanation is more parsimonious because it explains dream content without needing to refer to specific selection pressures. Panksepp (2000) subscribes to a similar view, stating that in REM basomedial appetitive-emotional systems and other limbic areas become highly aroused. This argument, however, does not imply an acceptance of random brainstem processes being responsible for dream content. As Panksepp points out

> "Solms' point would still hold – the cognitive contents of dreams are not choreographed in any detail by REM processes; rather, REM is simply the most emotionally minded conductor of one dream symphony" (p.988).

Hartmann's (1998) clinical analysis of dreams also suggests emotion shapes dream plots. He concludes that dreams serve to contextualize emotion:

> "in a classic anxiety dream, the plot may shift from feeling lost, to not having proper credentials, adequate equipment or suitable clothing, to missing a train. These plots all satisfy the driving emotion – anxiety – while being only very loosely associated with one another..." (in Hobson et al., 2000, p.825).

In contrast, Revonsuo's current model has an unspecified mechanism for selecting memories by their emotional salience (Bednar, 2000).

> "Such a mechanism is difficult to imagine because it would supposedly operate independently of the current emotional state of the brain, since limbic areas like the amygdala are activated only later in his process" (Bednar, 2000, p.909).

He argues that reversing the sequence results in the simpler, more concrete model presented above.

Revonsuo's response (2000b):

In his response to these criticisms, Revonsuo again assumes that all critics raising this point subscribe to what he calls Random Activation Theory, which sees dreams as epiphenomena of REM activation. It must be stressed that this is not the case. Even Hobson now acknowledges that REM forebrain activation is not random – imaging studies have clearly indicated consistent activation of specific areas. Stickgold (2000) claims that brainstem processes are not random, but are aimed at generating specific sequences of activity. Neither Panksepp nor Solms, who invoke basic emotion systems in explaining dreams, endorse RAT.

Instead of addressing the question of the direction of the relationship between emotion and narrative, Revonsuo focuses on discrediting RAT ideas. His rebuttal is thus largely off topic. His chief argument is once again the contention that dreams are organized simulations, not random activation patterns. "Dreams are not noisy patterns of activation, but organized as simulations of 'self-in-world': when we dream, we find ourselves as an experientially embodied self in the center of a visuo-spatial world of objects, persons and events" (p.1064) – this requires "highly coordinated interaction between several cognitive modules in the brain" (p.1064), and shows that "dreaming is designed to be a sophisticated simulation of waking experience" (p.1064). If Revonsuo took any note of Damasio's (1999) theory of consciousness, he would perhaps not find this so startling, and would notice that the experience of 'self-in-world' begins from the level of core consciousness. The first 'I', or basic conscious experience of self, is located in the brainstem, surrounded both by maps of the self and the basic emotions. Providing consciousness of 'self-in-world' is precisely what the brain is designed to do, from this

level up. From this perspective noting that dreaming consciousness reflects this 'self-in-world' is not remarkable, but is rather to be expected.

Problems with memory consolidation – restricted to SR responses:

Clancey (2000) views Revonsuo's proposal that procedural memory can be consolidated in dreaming as problematic. Clancey argues that without aminergic sequencing (which is absent in cholinergic REM), procedural relations cannot be coordinated. "Dream experiences are indeed multi-modal, but they are not sequentially coordinated and therefore cannot be simulations of real experience" (Clancey, 2000, p.921). He continues that dream experience lacks insight into our true condition, which is what we depend on for flexible and appropriate responses in waking life. Clancey (2000) also points out that Revonsuo does not distinguish between stimulus-response association and human inference. Given that dreams lack goal-directed attention, logic, and analogical reasoning, it is hard to accept that they could constitute training episodes for highly skilled, complex responses in threat situations. They seem to be restricted to primitive SR/fight-flight responses.

Montangero (2000) concurs, and questions the need for rehearsal: 'threat avoidance 'skills' represented in dreams, such as fleeing or hiding, are so elementary and instinctual that it is difficult to imagine how their representation could help to improve them (Montangero, 2000, p.973). Schredl (2000) makes a similar point: classical conditioning of avoidance responses happens very quickly; thus repetition is unnecessary. Domhoff (2000) agrees, stating he cannot see how

> "chase and attack dreams, which rarely contain successful defensive actions in any event, could make human beings any more primed for reacting to threat than they are due to the one-trial fear-conditioning system that is already found in reptiles" (p.930).

Clancey concludes:

> "One implication of Revonsuo's theory is that dreaming reinforces an unthinking way of responding to threat situations, merely based on reactive, perceptually and emotionally driven

behavior. If this was indeed an evolutionary advantage, it was originally conferred on other mammals, not Pleistocene man. Such learned associations, if any, are not like skilled human knowledge, because they are not procedurally integrated and flexibly controlled" (Clancey, 2000, p. 921).

Revonsuo's response (2000b):

In response to the above critiques, Revonsuo again asserts that the claimed lack of goal-directed attention, logic, analogical reasoning in dreams is an assumption. He ignores the established fact of prefrontal deactivation entirely. He insists that threat simulations were necessary, as threat perception and avoidance are complex skills, not compatible with SR conditioning. This is precisely the point critics are making, while questioning a) whether what we know of dreaming brain activity supports the possibility of high level problem solving occurring within this context; and b) whether dream threats and responses are not usually more primitive. These concerns are not addressed.

A product of human evolution?

Revonsuo's proposition that the threat simulation mechanism of dreaming was selected specifically during human evolution does not seem to hold water. Kriekhaus (2000) disputes that this mechanism was selected in hunter-gatherer period – "both the phenomenon of dreaming and its neural substrates are present throughout mammalia" (p.962). Clancey (2000) points out that primitive emotion response patterns evolved before Revonsuo's proposed timeframe in the Pleistocene era. Bednar (2000) finds the idea that dreams may rehearse species-specific skills for all animals more credible than the limited application to humans. This theory, however, has already been put forward by both Jouvet (1975) and Winson (1993). Bednar also points out that threat simulation would surely be more useful for prey species than predators. Panksepp (2000) calls this an empirical difficulty for Revonsuo: research indicates predators tend to have more REM than prey.

Revonsuo's response (2000b):

Regarding the query as to why predators exhibit more REM, Revonsuo responds that predators lacking hiding places have to be eternally vigilant. He does not address the

issue of the timing of the selection of dreaming mechanisms – he has claimed that this occurred specifically during *human* evolution. Once again, his response does not satisfactorily address critical concerns.

Formally evaluating Threat Simulation Theory

Clearly Revonsuo's proposed theory has drawn a great deal of criticism. Despite this fact, it must be remembered that it passed a stringent peer review process and was published in a highly respected, high impact journal. Many approve of an evolutionary theoretical approach, and some welcome TST as a viable theory (Gottesmann, 2000; Humphrey, 2000; Kriekhaus, 2000; Shackelford & Weekes-Shackelford, 2000; Wichlinski, 2000). It thus remains important to formally address the question of TST's scientific worth.

Revonsuo appears to have arrived at TST through a process of induction. He has sifted through masses of empirical evidence about dreaming and dream content, and has used ampliative reasoning to arrive at a conclusion not inherent in the premises of the argument: namely, that dreaming is an adaptive mechanism selected during human evolution. Induction confirms theories as follows: a theory gives rise to predictions, and if many predictions turn out to be true, the theory is confirmed (Putnam, 1981). Strength of confirmatory support, however, is a relative matter: many observations lend more support, but can never completely confirm the conclusion (Salmon, 1992). Revonsuo & Valli (2000) conducted a study in which they assert predictions derived from TST were supported, and that the theory is confirmed. This study will be discussed below, and the authors' confidence in the confirmation of the theory will be called into question.

Induction has been severely criticized (Putnam, 1981). Because inductive reasoning is ampliative, its conclusions are not necessitated by its premises. Hence, an argument may contain true premises and yet have a false conclusion; for example: 'all observed ravens have been black' may be true, but the conclusion 'all ravens are black' may nonetheless

be false. Critically, the argument is prone to erosion – the addition of the single premise 'one observed raven was white' erodes the argument entirely (Salmon, 1992). The Requirement of Maximal Specificity attempts to address this concern: when constructing an inductive argument, all available relevant knowledge must be included (Salmon, 1992). Revonsuo has been accused of ignoring evidence that is inconsistent with his theorizing.

Popper (1934, in Gillies, 1993) adopts Hume's critique of induction: it is logically unjustifiable, and should be excluded from science. If induction is rejected, where does that leave TST? In order to both maintain the rejection of induction, and yet allow knowledge to move beyond what is already known, Popper argues science should progress through a process of conjecture and refutation. Theory generation should be bold and creative, and not subject to any logical restrictions. Popper would thus have no problem with TST being speculative.

The crux, however, lies in the justification of theories. Any scientific theory must be subjected to logical scrutiny. Knowledge may well advance through unjustifiable conjectures, but these must be constrained by the stringent critique of testing and refutation. According to Popper, the scientific method should aim to falsify conjectures by subjecting them to the most rigorous testing possible. The most important question to ask about a theory thus is: can it be tested? Untestable theories belong in the realm of metaphysics.

> 'Theories are ...*never* empirically verifiable...But I shall certainly admit a system as empirical or scientific only if it is capable of being *tested* by experience' (Popper, 1934, in Gillies, 1993, p.180).

> 'It is not so much the number of corroborating instances which determines the degree of corroboration as the *severity of the various tests* to which the hypothesis in question can be, and has been, subjected' (Popper, 1934, in Gillies, 1993, p.215).

Although Popper's demarcation criterion (falsifiability) has been rejected, the common assumption that the method of falsification is also suspect is unfounded (Gillies, 1993). Donald Gillies, a student of both Sir Karl Popper and of Imre Lakatos, has strongly argued for the acceptance of a demarcation criterion based on confirmability, and for retaining falsification for the purposes of testing theories. In the case of theories that, like TST, are perhaps confirmable, but are not falsifiable by any one test, it remains essential to turn parts of them into hypotheses to be tested:

> '...in order to get to theories which are well confirmed, it is necessary to submit any theory we propose to harsh criticism with severe experimental testing. Only if a theory survives this ordeal can it become well confirmed' (Gillies, 1993, p.223).

The various predictions derived from each of TST's propositions have been listed above. Revonsuo (2000a) claims these are all testable in principle, and that most tests could be actually be carried out. In concluding his target article, Revonsuo (2000a) attempts to preempt critiques of TST's untestability:

> "As an evolutionary hypothesis, the threat simulation theory of dreaming concerns historical events, and the historical events themselves of course cannot be subjected to observation or experimental manipulation. But it would not be correct to say for example, that theories on what caused the mass extinction of the dinosaurs 65 million years ago, or why Asia has got the Himalayas, are not empirically testable because the original events cannot be observed or experimented on. Therefore, the threat simulation hypothesis is open to empirical testing, confirmation and disconfirmation to the same extent as any other hypotheses regarding the causal mechanisms at work in the past, leading the natural world to be as it is in the present" (2000a, p. 894).

Some commentators, however, remain doubtful about TST's testability. Hunt (2000) claims TST is as untestable as Freud's primal horde theory. Mealey (2000) points out that we cannot separate waking cognitive biases relating to threats from possible biases in dream events and dream recall. Thus we cannot test whether dreams are biased towards producing threat scenarios – we cannot set up a null model. Revonsuo's (2000b) claim

that modern dreams are not representative of the function for which the mechanism was selected also seems to put TST dangerously close to the realm of the untestable.

A section on 'how to test TST properly' (2000b, p. 1063) is included in Revonsuo's response to the commentaries. He asserts that the following facts do not disconfirm TST: that many dreams do not simulate threats; that some threat simulations disrupt sleep and have negative effects; that dreams contain bizarre features; and that nightmares and recurrent dreams correlate with psychological dysfunction. He clearly believes he has satisfactorily countered these challenges to the logic of TST.

He argues that only the following facts would be problematic for TST: (2000b, p. 1081)

1. All highly emotionally charged events result in recurrent dream simulations; i.e. there is no specific threat response.
2. Ancestral threats existed which we never dream about.
3. Children and adolescents exposed to ancestral type threats since childhood have dreams which do not simulate these threats or efficient responses to them.
4. Current hunter-gatherer dreams only infrequently simulate threats.
5. A culture exists where threat simulation dreams or nightmares do not occur.
6. Threat simulations do not improve perceptual and motor skills, and do not improve subsequent performance in threatening situations.

We are not bound to agree with Revonsuo about what does and does not tend to refute TST. The critical point is that the theory needs to be tested.

Subsequent research on TST

Very few studies have set out directly to examine aspects of the theory, but there are relevant results from several independent projects. In his introduction to the book edition of the BBS articles, Blagrove (2003) refers to a number of pertinent findings. For instance, he states that Revonsuo's idea of skill rehearsal in dreams leading to improved performance even without explicit memory for the dream, is in line with research

conducted and discussed by Bargh and Ferguson (2000). They show that complex higher mental processes can occur without conscious choice or guidance.

With specific reference to TST, Petersen, Henke and Hayes (2002) argue that as the limbic system is very active both in dreams and during waking threat, individuals with relative limbic hyperfunction should report more threatening dreams. Limbic function was measured using a checklist, and the hypothesis was confirmed, lending support to TST. The limbic region, however, is involved in all emotion, not just fear, so it is possible that this group would report more intense emotional dreams overall, not simply more threat dreams.

Picchione, Goeltzenleucher, Green et al. (2002) examined the possibility that nightmares are adaptive, aiding coping with stress. 412 students completed retrospective self-report questionnaires for course credit. The authors examined relations between stress, coping mechanisms, and nightmares. They found a relationship between nightmares and intensity of waking coping: participants who reported using active coping strategies in waking life also tended to report more nightmares. This appears to be supportive evidence for TST, assuming the direction of the relationship to be nightmare simulations leading to better coping. Picchione and Hicks (2002), commenting on the same study, characterize dreams as problem solvers which may operate in various ways: 1) through systematic desensitization; 2) assisting with emotional problem solving and insight; and 3) as threat simulations which improve performance. As an example of TST functioning adaptively, they suggest a person worried about giving a presentation may dream about it and thus do better in the actual event. It should be noted that this is not precisely what TST proposes. Revonsuo has explicitly stated that the mechanism is not likely to be adaptive in our current context, and would only be efficient at handling ancestral threats. Additionally, the mechanism only activates in response to actual threat events - benefits accrue to future occasions of the same threat. The function these authors seem to envisage for nightmares seems to cohere more with Cartwright (1996) and Hartmann's (1998) concepts of dreams being processors/integrators of emotional material, rather than as contexts in which new learning (i.e. better threat perception and enhanced threat avoidance) occurs.

Another study reports very different results regarding dream content and stress. Delorme, Lortie-Lussier and Koninck (2002) had students keep dream diaries for two ten-day periods, one during examinations and one during an examination free period. The students also recorded their moods and their coping strategies. Stress level and waking negative emotions were found to be equivalent across all students. The authors found a significant negative correlation between harm/threat waking emotions and negative dream emotions – namely, the more apprehensive/fearful the students were feeling, the more likely they were to have positive dreams that night. This is not what TST predicts. Additionally, in apparent contradiction of Picchione et al.'s (2002) results, they found that students who did incorporate examination themes in their dreams had less active waking coping strategies, while those who did not incorporate stress themes used active problem solving strategies more frequently in waking life. Given the relative unreliability of retrospective self-report data (used by Picchione et al.), more weight should perhaps be given to Delorme et al.'s findings, which are based on a prospective study. These contradict TST's claims that exposure to threat leads to threat simulations, and that threat simulations lead to improved performance in waking life. Of course, Revonsuo could dismiss both studies as irrelevant, because they do not specifically refer to ancestral threat cues – the mechanism may not be functional in this modern context.

In another study mentioned by Blagrove (2003), Roussy et al. (2000) had participants record daily events and dreams for six days. Independent judges were unable to detect any correspondence between daily events and dream content. Once again, as Blagrove also notes, these results may be of questionable relevance if we accept that the threat simulation mechanism is not currently activated. TST only predicts that severe threat experiences will impact on dream content in any consistent fashion.

Blagrove (2003) then points to a study by Hartmann, Zborowski, Rosen, & Grace (2001), which he suggests may give some support to Revonsuo's argument that exposure to threats activates the threat simulation mechanism. These authors found that Contextualizing Images are more intense in those who have been traumatized (a CI is a

powerful image that provides a context for the dominant emotion of the dream). Note, however, that having more intense CI's does not mean the participants are experiencing simulations of the threat event – as stated previously, a dominant dream emotion can be contextualized in several unrelated plots.

In a later study, Hartmann and Basile (2003) examined dream content in individuals who regularly record their dreams, from records prior to and after the 9/11 terrorist attacks in the USA. They found that after the trauma, dreams became significantly more emotionally intense, but did not contain material directly related to the attacks. Interestingly, in terms of dream emotion, the trend was towards an increase in fear, but this did not reach significance – other emotions were also highly represented. The authors conclude that intensity rather than specific emotion differentiates between pre and post 9/11 dreams. Contrary to TST, these individuals did not report threat simulation dreams, and it appears that all dream emotions became intensified in response to the trauma. However, although many Americans felt traumatized after the event, it could be argued that only actual, personal exposure to a life-threatening event can be expected to activate the threat simulation mechanism.

In the following study, actual personal exposure did occur. In a prospective study, Mellman, David, Bustamante and Torres (2001) examined dreams in the aftermath of life-threatening injuries. They found that subjects who reported dream simulations of the trauma had more severe PTSD symptoms at both initial and follow-up assessments (6 months later), than those reporting dreams with other content, or no dreams. This clearly argues against an adaptive function for threat simulation dreams.

Another Finnish researcher, Raija-Leena Punamaki, works in the area of trauma and dreams. Interestingly, Revonsuo makes no reference to her work, although given that Punamaki is working with children growing up in life-threatening conditions, her findings are highly pertinent to his assertions. Her sample consists of two groups of Palestinian children, one living in a peaceful area in Galilee, and the other in the chaotic conditions of the Gaza strip, consistently exposed to life-threats. In her 1993 project,

households were randomly selected within the two areas, and families and children agreed to participate in the study, keeping a dream and mood diary for seven days.

The traumatized group was found to have more frequent dream recall; and the hypothesis that frequent dream recall would be associated with poor psychological adjustment was confirmed. More frequent recallers had more depressive, somatic and anxiety symptoms (Punamaki, 1997). There was an association between pre-sleep mood and dream content in the trauma group, but this relationship was in the opposite direction to that expected. The more negative the evening mood, the more the children reported positive dreams, and vice versa (Punamaki, 1999). This corresponds with Delorme et al.'s (2002) finding, and contradicts the idea that trauma impacts directly and immediately on dream content.

Factor analysis of all the dream data yielded a five-factor model which explained 46.2% of the variance in the dreams (Punamaki, 1999). Children in the trauma group had both more Threatening Stranger dreams and more Family dreams (which are positive). TST would predict more Threatening Stranger dreams, but would not expect an increase in positive affiliation dreams. Moreover, Threatening Stranger Dreams (the 2nd factor) had the following aspects: strangers involved as actors; unpleasant atmosphere; *dreamer as observer*; low vividness; attacking human relationships; *unfavorable outcomes;* anxiety, persecution; hostile and aggressive themes. Thus although threatening stranger dreams were more common in the children exposed to life threats, contrary to TST's predictions these dreams tended not to feature the dreamer actively responding to the threat, and did not tend to end in escapes from the threat. This is critical, given that Revonsuo has repeatedly hypothesized that the mechanism should be most active in children, particularly those exposed to severe threatening events.

Revonsuo himself appears to have conducted only one project related to TST: a study by Revonsuo and Valli (2000) set out specifically to test TST, and the authors concluded that the theory was empirically confirmed. The only other work by Revonsuo relating to TST, an article published in the Finnish journal Psykologia (Valli & Revonsuo, 2000),

reports the same study. The remainder of Revonsuo's recent work seems to be focused on other aspects of consciousness and cognition.

In the 2000 study, fifty-two Finnish university students kept dream diaries for four weeks, resulting in a sample of 592 dreams. These were analyzed using a rating scale specifically designed by the authors to quantify threatening events in dreams. Two threat categories were defined:

1) *Objective threat:* any situation where the dreamer's physical or mental well-being, physical resources or territory is threatened. The threat could either occur directly in the dream, or the dreamer could hear about it. (Note how broad this category is: including psychological/emotional threats as well as actual physical threats; and situations where the dream threat is hearsay rather than a simulation per se).
2) *Subjective threat:* any event interpreted or emotionally experienced as somehow dangerous.

Threats were then analyzed on 8 dimensions: 1) the nature of the threat; 2) its target; 3) its severity; 4) the dreamer's participation; 5) the dreamer's reaction; 6) consequences of the threat; 7) its resolution; and 8) its source.

The nature of the threat comprised six categories: pursuits; accidents and misfortunes; catastrophes; disease; failures; and aggression. It should be noted that 'pursuits' included instances of pursuit by monsters, 'animals or comparable living beings' or where the source of pursuit was unclear. There was thus no constraint on the threat being realistic. 'Aggression' included indirect aggression; i.e. verbal aggression, teasing and trespassing. There was no constraint on the aggression being physical. Threat severity was rated as follows: 1) life-threat or physically dangerous; 2) socially, psychologically or financially severe; 3) trivial.

Three judges – all aware of the hypotheses under investigation – coded the dream reports. All content scores were based on agreement between two of the three judges – only if all three disagreed was an item discarded. The authors claim inter-rater reliability was acceptable (simple percentage agreement was accepted at > 65%; Kappa values were accepted at > 0.4; and ranged from 0.43-0.79).

The results indicated that 66.4% of all dreams contained at least one threat. The authors report that 79% of subjects reported at least one life-threatening dream event. It is not clear how they determined this – in the listed content categories and in the attached examples, life-threats and physically dangerous threats comprised a single category. In terms of severity, only 22% of all threats were rated as life threatening or physically dangerous. 78% of threats were thus not physical: 17% were social, psychological or financial threats; and most threats (61%) were rated as trivial. Revonsuo & Valli, however, concluded: "Thus in dreams, about 40% of the threatening events reported by our normal subjects were either life threatening or otherwise more severe than they would be expected to encounter during waking". This seems to be overstating the case somewhat – we do not know how severe the physically dangerous threats were; and social, psychological, and financial threats are hardly rare in waking life.

The results indicated no response to 46% of dream threats. Astonishingly, Revonsuo & Valli conclude: " If you leave out events where participation of self could not or did not occur, in 94% of the remaining cases, the action was appropriate and relevant". Furthermore, only 32% of threats had a 'happy ending'; while 37% ended badly, and 31% were discontinuous/disrupted. Clearly, only a small proportion of threats were resolved, and the information given by the authors does not clarify whether the 'happy ending' was due to the dreamer's actions, and whether these were realistic or not.

Revonsuo claims to have found an association between severity of threat and appropriate response to the threat: the more severe the threat, the more likely the dreamer is to respond appropriately ($\chi^2_{[1,N=?]} = 18.58$, $p < 0.001$). However, Chi-square is perhaps not

the appropriate analysis, as the data are not independent. The sample of 592 dreams comes from only 52 subjects.

In the discussion, Revonsuo and Valli (2000) state that TST is clearly confirmed by this data. Another interpretation is possible. The coding categories are so inclusive that important distinctions are obscured (e.g. physical vs. life-threat; physical vs. indirect aggression; realistic pursuit vs. bizarre/impossible). Despite this; despite coding not being done by blind raters; and despite low inter-rater reliability being accepted; only 22% of dream threats were coded as physically dangerous or life-threatening. In addition, half of the time the dreamer did not respond to the threat; and only 1/3rd of threats had a happy ending. Thus it could be concluded that relevant threats were few, and that the critical successful avoidance response was even less evident. Ultimately, regardless of the interpretation of the results, because of the lenient criteria used throughout this study, it can hardly be regarded as a severe test of TST.

Malcolm-Smith and Solms (2004) attempted a more stringent test. A large sample (N=401) of Most Recent Dream reports was collected and analyzed for threat content. The definition of threat was limited to those that are realistic and physical. The aim was to establish the proportion of dreams containing realistic physical threats to the dreamer; how many of these represent life-threatening events; and whether the dreamer successfully and realistically escapes. Reports were coded by six blind raters, and percentage of perfect agreement between raters was 86%.

The results of this study contradicted aspects of TST's Proposition 2, which predicts that threats should be over-represented in dreams. Only 21.19% of reports contained physical threats, meaning that almost 80% of dream content was not physically threatening in any way. Less than 10% contained realistic life-threats. Relevant threatening content thus does not seem to be over-represented in dreams. Moreover, escapes were even more rare – only 2.74% of dreams contained realistic escapes from realistic, life-threatening events. The proposed threat simulation mechanism can only bestow adaptive advantage if dreams

contribute to escaping threats – merely simulating unresolved threat experiences surely cannot suffice.

The low proportion of dreams containing threats also needs to be considered in context: 62% of our participants reported having experienced a real life-threatening event. Hence our results also run counter to Proposition 3, which asserts that exposure to real threats activates the mechanism. Our sample was drawn from an area where ecologically valid cues are present: the mechanism should be operational.

Two noteworthy limitations of this study were pointed out by reviewers. Firstly, we did not obtain a date for the actual life-threatening event experienced by our participants, so it was argued that assuming the threat mechanism remained activated by this one event was problematic. Our intention was to demonstrate that the participants live in an environment where ecologically valid cues are operational, and where people feel threatened, not that one experience should have resulted in the mechanism operating indefinitely. We were attempting to establish the presence of ancestral type threats in participants' lives – contrary to Revonsuo's assertion that modern life lacks selection pressures. This aspect of the study clearly needs to be addressed more carefully.

The second criticism was that even the low proportion of life-threats in dreams indicated by this study must be more than would be encountered in real life. If we regard the percentages obtained as a proportion of the total night's dream events, we would have to multiply them by four (the average number of dreams per night). 21% physical threats and 8.5% life-threatening events would multiply out to 306 physical dream threats and 123 life-threatening dream events per year – much higher figures than could be expected for actual life experiences. Note, however, that this argument still does not address the issue of successful escape being rare. It also assumes that there are no dream recall biases favouring salient or threatening dreams. Moreover, it is possible that the incidence of many classes of dream event would be greater than that encountered in real life – losing one's teeth for instance, or appearing naked, or flying, certainly happen more frequently in dreams than in any comparable year. Another paper (in preparation) will

examine all dream events in terms of basic emotions to ascertain whether *all* biologically significant events are over-represented in dreams, not just threat/fear as proposed by Revonsuo.

Aims

The aim of this study was thus primarily to address the need for more careful measurement of actual and subjective sense of threat. It was also decided that a comparative study, looking at different groups would greatly strengthen the design. As previously mentioned, the argument that TST is not functional in the modern environment, because of the absence of ecologically valid threat stimuli, very nearly renders the theory unfalsifiable. However, Revonsuo does postulate that if ecologically valid cues are present, the mechanism should activate. He also explicitly states that:

> "The threat simulation system can be activated in different degrees. The lowest level of activation should occur in an environment that is completely safe and where the individual is free from stress and fear. The highest level of activation (a strong threat simulation response) should occur in an environment where the individual's life and physical well-being is seriously threatened" (2000b, p. 1080).

Thus, if two very different contexts could be established, one in which ecologically valid threat cues are present and one in which they are largely absent, TST would predict more threat simulations in the dreams of people living in the high threat context. One way in which this comparison could be accomplished would be to contrast dream content from a region where violent crime is prevalent with that from an area where it occurs very rarely. Violent crime – comprising murder; rape; assault; and armed robbery - is both an ecologically valid threat in terms of TST, and one whose levels are objectively recorded in national crime statistics databases. My main aim was thus to identify two such regions and to compare the incidence of threat simulations in the dreams of individuals living in these two contexts. It was also considered advisable to identify a third region, ranking between the two extremes of threat prevalence, to provide a calibration point. Given that some ecologically valid threat cues are operational in the middle context, TST would then

predict a gradient: most threat simulation dreams should occur in the context containing the highest prevalence of ecologically valid threat cues; fewer in the 'in between' context; and the lowest frequency of dream threat simulations should occur in the low ecologically valid threat context. The incidence of physical threats; life-threats; and realistic escapes in dreams will be compared across the groups.

Another assertion that this study aims to investigate in a preliminary manner, is TST's contention that only the experience of threatening events impacts on dream content in a consistent fashion.

> "TST predicts that if an individual experiences real events, each one of which elicits different (positive and negative) strong emotions, the events that represent serious threats for the individual or significant others (e.g. physical assault, serious accident) will be incorporated into dreams as threat simulations significantly more often, and such dreams will persist significantly longer than any dreams incorporating the events involved in non-threatening emotional events" (Revonsuo, 2000b, p. 1080).

Revonsuo (2000b) explicitly states that proving otherwise would be the quickest way to falsify TST. I therefore intend to contrast reports of dreams following actual threatening and positive experiences in order to examine this prediction. If it can be shown that participants report dreams subsequent to positive events to a similar degree that they report dreams subsequent to threatening events, Revonsuo's main line of argument would be undermined.

CHAPTER TWO

METHOD

Sample

Non-random, purposive sampling was used to access groups that live in very different contexts, i.e. the Western Cape in South Africa; North Wales in the UK; and an historically black university in the US, located in Tuskegee, Alabama. Much of the credibility of this study rests on establishing that participants are exposed to very different levels of ecologically valid threats. The following crime statistics are intended to provide support for this contention, and hence the inclusion of these particular sample groups (See Appendix A for source statistics, calculations and definitions).

The UK and South Africa are known to differ markedly in levels of violent crime; and within these contexts North Wales ranks significantly lower than the UK national average (Dodd, Nicholas, Povey & Walker, 2004); while the Western Cape ranks higher than the South African national average (Leggett, 2004). In many categories the Western Cape has the country's fastest growing crime problem (Leggett, 2004). It has South Africa's highest murder rate, and is the only province in which the murder rate has increased since 1994 (Leggett, 2003). The South African national murder rate (see Table 1) is similar to that of Washington, DC, the most dangerous urban area in the US (Leggett, 2003). Since 2002, Colombia has adopted South Africa's previous position as murder capital of the world, but the Western Cape 2003/04 rate of 62 murders per 100 000 is close to the Colombian figure of 66 per 100 000 (Leggett, 2003). In fact, in the 2002/03 period, the Western Cape figure was 85 murders per 100 000 (Leggett, 2003), greatly exceeding the Colombian national average.

Table 1: Violent Crime Statistics for the Western Cape and South Africa, 2003/04

	Western Cape	SA National
Murder	62	43
Attempted Murder	80	65
Culpable Homicide	27	24
Armed Robbery	303	287
Rape	138	113
Indecent Assault	62	20
Assault/Grievous Bodily Harm	808	558

Figures per 100 000

Based on Institute of Security Studies statistics

In contrast to South Africa, violent crime in the UK appears to be relatively rare. According to the British Crime Survey (Dodd et al., 2004), crime has decreased by 39% since 1995, and violent crime has decreased by over a third. The risk of becoming a victim of crime has dropped by half. Levels of worry about crime have dropped and confidence in the justice system has increased. Within this milieu, Wales has the lowest personal victimization rates in the country, combined with significantly lower levels of worry about crime (Dodd et al., 2004).

Unfortunately, crime categorization in the UK is sufficiently idiosyncratic to make direct comparisons across countries difficult. In the UK, the category 'Violent Crime' includes three subsections: 'Violence against the person'; 'Sexual offences'; and 'Robbery'. Both 'Violence against the person' and 'Sexual offences' are extensive categories, containing non-violent crimes (e.g. concealment of birth; bigamy; soliciting; etc; see Appendix A for full list) as well as the more typical murder, rape, assault/GBH and armed robbery As a result of this inclusiveness, 52% of reported violent crimes in the UK do not lead to injury of the victim; while 39% lead only to less serious woundings, such as grazes, bruises and black eyes (Dodd et al., 2004). Crime figures for Wales were only reported as totals under these three broad categories, and therefore are not useful for the current purposes. The UK figures for relevant violent crimes are listed in Table 2.

Table 2: Violent Crime Statistics for the UK, 2003/04

	UK Totals for 2003/04	p/100 000
Homicide	853	1.43
Attempted Murder	884	1.48
More Serious wounding	19358	33
Rape	12354	21
Indecent assault	26709	45

Based on statistics provided in Dodd et al (2004)

The third context I attempted to sample was a black population in the US. The university which granted access to participants is a black university in Tuskegee, Alabama. In the US, the category Violent Crime includes homicide, rape, robbery and assault, all of which have a high risk of injury or death for the victim (Mitchell, Goggins & Cobert Roberts, 2003). Table 3 gives comparative figures for Tuskegee and US national rates: Tuskegee rates are clearly higher than the US national average.

Table 3: Violent Crime Statistics for Tuskegee and US National Figures, 2002

	Tuskegee	US National
Murder	8.38	5.6
Rape	75.31	33
Assault/GBH	359.8	310
Robberies	251.03	145.9

Figures p/100 000

Statistics for Tuskegee, Alabama; 2002 (most recent available); based on Federal Bureau of Investigation Crime Reports

Table 4 indicates a comparison between the Western Cape, Tuskegee and the UK. Specific violent crime figures for Wales are not available: we know that they would be lower than the UK average (Dodd et al., 2004). There is a clear gradient across the three different contexts, with most violent crime occurring in the Western Cape, an intermediate level occurring in Tuskegee, and a very low level occurring in the UK/Wales. Ecologically valid threats in the form of violent crime thus differ markedly in the three different contexts: hence the decision to sample specifically from these regions.

Table 4: Comparing Violent Crime Rates Across Contexts

	Western Cape	Tuskegee	UK
Murder	62	8	1
Attempted Murder	80	a	2
Rape	138	75	21
Assault/GBH	808	360	33[b]
Armed robbery	303	251	c

Figures p/100 000

a) Listed as assault

b) This is the 'More Serious Wounding' class, which is more inclusive than Assault/GBH

c) No figure available

Three universities agreed to provide access to participants: the University of Cape Town in the Western Cape; the University of North Wales in Bangor; and the University of Tuskegee in Alabama. Participants were undergraduate psychology and biology students. Revonsuo (2000b) states that because life expectancy in our ancestral past was perhaps 25, the threat simulation mechanism should be optimally active in those under 20. Using samples of students is thus particularly apt in this case. The median ages were 20, 19, and 19 for the Western Cape, North Wales, and Tuskegee participants respectively.

Participation was voluntary and informed consent was obtained. Participants were not informed of the exact aims of the study, but were told it entailed detailed analysis of dream content and its relationship to real life events. The number of participants accessed in the three universities varied widely, and the ratio of females to males was consistently higher in each sample (See Table 5). The possible impact this gender imbalance might have on results will be carefully examined.

Table 5: Sample composition - Gender

Sample	Female	Male	Row Totals
SA	172	36	208
	82.69%	17.31%	
Wales	87	29	116
	75%	25%	
USA	26	8	34
	76.47%	23.53%	

Domhoff (1996) established that a sample of 100 - 120 Most Recent Dream (MRD) reports successfully approximates the established Hall and Van de Castle dream content norms. The sample sizes for the two most divergent and hence important contexts (i.e. the Western Cape and North Wales) were sufficient to provide a representative sample of MRD reports. The US sample is unfortunately very small, hence both power and representativeness are likely to be problematic.

It was anticipated that the Welsh sample would be mainly white: this would be in keeping with targeting a low threat exposure group. The US sample was specifically selected to be black, in order to access a higher level of threat exposure than that of typical white Americans. The South African group is mixed, with two thirds of the participants being white (See Table 6). It can be argued that in South Africa, whites are not exposed to crime to the same degree as blacks. It is thus possible that this sample may not reflect a group that is exposed to high levels of violence, as indicated by the crime statistics. The self-report data collected on experience of actual threats, and on perceived exposure to threats, will be used to examine this possibility. This data will enable verification of relative threat exposure for all groups.

Table 6: Sample composition - Race

	White	Black	Row Totals
SA	136	69	205
%	66.34%	33.65%	
Wales	105	11	116
%	90.52%	9.48%	
USA	0	34	34
%	0	100%	

Materials

Participants were given a questionnaire that began with a Most Recent Dream (MRD) report. The MRD method was developed for efficient collection of large numbers of dream reports, and provides a representative sample if at least 100-125 reports are collected (Avila-White, Schneider & Domhoff, 1999). The method has been used worldwide, across all age groups, and has been found to provide reliable results (Domhoff, 1996). The method yields results that are not appreciably different from REM awakenings, and is thus valid (Domhoff & Schneider, 1999). The instructions used to obtain this report followed those recommended as standard by Domhoff (1996).

Participants were then asked to report whether they had experienced a life-threatening event in real life; to describe it and to note when it happened. They were also asked if they later dreamed of this event; and if so, to record the dream and to indicate whether and how often it recurred. They were then asked to estimate how many physical threats they encounter per week, and to list the type of threats encountered. Finally, participants were asked if they had ever experienced an overwhelmingly positive event in real life; to describe it and to note when it happened. They were then asked if they had later dreamed of this event; to record the dream and to estimate how often it occurred. (See Appendix B for questionnaire).

Procedure

Questionnaires were distributed at the start of lectures. Participants were instructed to complete the questionnaire page by page and not to read ahead, as the focus on threats later in the questionnaire might have primed recall on the Most Recent Dream report. However, I cannot be certain that this instruction was followed in all cases.

Six independent raters coded the responses. They were unaware both of Revonsuo's theory and the aims of the study, and were simply told it revolved around analysis of

dream content and real life experience. They were given a coding guideline outlining important principles and containing examples of both typical and difficult coding decisions. They then completed a rating form for each participant (See Appendix C for rater sheet and guidelines).

The Most Recent Dream reports were rated as follows:

Does the dream contain a realistic physical threat to the dreamer?	Yes/No
If yes	
Is the threat life-threatening?	Yes/No
Does the dreamer escape the threat?	Yes/No
Is the escape realistic?	Yes/No
Is the threat ancestral or modern?	Yes/No

For training purposes, raters were initially given a small sample of dream reports from another source to rate, and percentage of perfect agreement was calculated at 91.5%. Domhoff (1996) recommends this stringent method of estimating agreement between raters when coding dream content. Percentage of perfect agreement is calculated by dividing the number of agreements by the total number of agreements and disagreements for each item. It calculates 'the percentage of times raters agree on the number and types of specific elements occurring in each dream' (Domhoff, 1996, p.28). If only coding totals are compared, similar totals could be the result of different decisions about specific items. Percentage of perfect agreement thus gives a better idea of absolute agreement between raters.

The raters then coded the descriptions of real life threats reported by the participants on the following dimensions:

1: Actual threats: Immediate real possibility of death/severe harm; the person had good reason to believe that they could be killed/severely harmed.

2: Indefinite threats: Report simply of a vague, indefinite threat

3: No description given.

4: No physical threat present.

The real life threat descriptions were then rated as ancestral or modern. The ancestral threat category included assault, rape, mugging, theft, and attacks with weapons. Following a decision from a previous study (Malcolm-Smith & Solms, 2004) threats involving guns were coded as ancestral: the rationale being that being threatened with a gun or shot at is similar to being threatened with any deadly weapon (e.g. spears or arrows). This decision is consistent with Revonsuo's (2000a) inclusion of traumatic dreams of these types of events as evidence for his theory. The modern threat category included major surgery, traffic accidents, airplane disasters, carjackings, and court-related death threats.

Raters again initially performed a training exercise on a small sample of data from another source, and the percentage of perfect agreement obtained was 87%.

Finally, descriptions of dreams subsequent to life-threatening experiences were rated as follows:

Did the dreamer escape the threat? Yes/No

Descriptions of dreams subsequent to real life-positive experiences were rated as follows:

Is the content of the dream

A: Positive

B: Negative

Percentage of perfect agreement on the training sample for these ratings was calculated as 89.3%

CHAPTER THREE

RESULTS

Analysis of the data indicates, firstly, that patterns of self-reported exposure to life-threats in the form of violent crime, match that of official crime statistics. South Africans have the highest exposure to these threats, while Welsh participants have the lowest exposure. Secondly, analysis of threat in MRD reports indicates that it occurs most often in reports from Welsh participants, and that escapes occur extremely infrequently in all three contexts. Thirdly, positive events seem to impact on dream content in a very similar manner to threat events.

Exposure to threat across the samples

It is critical to check that I am not subscribing to an ecological fallacy: assuming that participants are actually exposed to crime along the lines indicated by the crime statistics for the different contexts, particularly given the high number of white participants in the SA sample. Participants were thus requested to indicate whether their lives had ever been in danger and to describe the incident. Incidents which occurred in 2000 or later, and which were rated as ancestral type threats were analyzed. According to Revonsuo, modern threats, like traffic accidents, cannot be expected to impact on the threat simulation mechanism in any consistent manner; and they cannot be expected to cue efficient simulations. Experiences of modern threats should thus be irrelevant to dream content. The ancestral threat category contains the threats that constitute violent crime (viz. murder, rape, assault and robbery); that is, threats that are ecologically valid in terms of Revonsuo's argument.

Table 7: Rate of Exposure to Life Threatening Events

Sample	Life Threat	No Life Threat
Western Cape	58	60
	49.15%	50.85%
North Wales	14	54
	20.59%	79.41%
Tuskegee	5	17
	22.73%	77.27%

49% of SA participants reported having experienced an ancestral-type life-threatening event during the past 4 years, compared to 23% of US, and 21% of Welsh participants (See Table 7). Chi-square analysis indicated a significantly unequal distribution of exposure to threat across the groups ($\chi^2_{[2,N=208]} = 17.25$, $p < 0.0002$; Cramer's $V = 0.29$); and analysis of standardized residuals indicated where the significant differences lie. More South Africans reported experiencing a life threat, while fewer than expected reported not experiencing one. The pattern for Welsh participants is diametrically opposite: fewer reports of life threatening experiences, and more reports than expected of never having had their life endangered (See Table 8).

Table 8: Locating the source of the difference - Analysis of Standardized Residuals

Sample	Real Life Threat	No Real Life Threat
Western Cape		
Std Residual	2.1662	-1.6608
p	**0.0152**	**0.0484**
North Wales		
Std Residual	-2.2269	1.7073
p	**0.0130**	**0.0439**
Tuskegee		
Std Residual	-1.1018	0.8447
p	0.1353	0.1991

The pattern of self-reported exposure to threats which are ecologically valid in terms of Revonsuo's argument thus does match that indicated by the crime statistics. South Africans face significantly more threats; while Welsh participants face significantly fewer.

The size of this significant effect is indicated by Cramer's V (0.29), but although this is conventionally used as the measure of association for Chi-square, interpreting it can be problematic. There are no published rules of thumb outlining what constitutes a small, medium or large effect (Lachenicht, 2002). Calculating the odd's ratio, however, can give a very clear idea of the extent of a variable's influence (Howell, 2002). In this instance, the odds of recent exposure to a life-threatening experience, given that the participant is South African, are 58/60. The odds for a Welsh participant are 14/54. The odd's ratio (SA/Wales) = 3.7. This tells us that South Africans are almost four times more likely than Welsh participants to have been exposed to a recent ancestral type life-threatening event.

Furthermore, the data generated by asking participants to list the types of threats they face routinely was analyzed specifically for mention of crime. Several participants did not complete this section, so meticulous quantitative analysis would be inappropriate. Only a rough impression of subjective sense of threat can be garnered from this data. What is important to note is that this question was specifically phrased so as not to cue primarily crime reports (See Appendix B). Participants were asked to list any and all physical threats they might encounter on a weekly basis (e.g. traffic hazards; sports injuries; etc). 'Crime' was simply one of several listed examples, and was not elaborated any further. This was thus an open-ended question designed to elicit spontaneous reporting of any threats that might be of current concern to the participants.

There were 4 listings of crime threats from US participants (n = 34); 15 from Welsh participants (n = 116); and 199 from South African participants (n = 208). The sense of threat from crime appears disproportionately high in the South African sample.

The crime threats cited by Welsh participants were 'Crime' (3x); 'Murder' (1x); and 'Assault' (11x). US participants listed 'Assault' (2x) and 'Being shot' (2x). South African participants listed 'Crime' (17x); 'Murder' (4x); 'Assault' (55x); Rape (22x); 'Being shot' (6x); 'Being hijacked' (23x); 'Being stabbed' (4x); 'Taxi violence'* (2x); 'Being mugged' (46x); 'Being robbed' (13x); and 'Train violence'* (7x). Thus it would

appear that South Africans' sense of threat from crime is also elevated in terms of a proliferation of types of crime threats perceived. Additionally, note the level of violence inherent in the threats listed by South Africans.

Thus it seems that both in terms of objective threat experiences and subjective sense of threat, the profile of threat exposure for the groups echoes that found in the crime statistics for the Western Cape and North Wales. The US sample does seem to fall in between, although its results for this section are closer to the Welsh sample. It can be regarded as established that the two critical samples differ in terms of exposure to ecologically valid threat cues, with South Africa being a high threat context, and Wales being a low threat context.

**[Note: Taxi violence generally involves fatal shootings as competing owners battle for turf; passengers/passersby get caught in the crossfire. Train violence in the Western Cape often involves the victim being thrown from the train, resulting in death or dismemberment].*

Threat content in Most Recent Dream reports

Revonsuo explicitly predicts that a gradient should be found, in which the threat simulation mechanism should be particularly active in people living in conditions of exposure to ecologically valid threat cues; and relatively inactive in people living in conditions where these cues are not prevalent. This section thus looks at the proportion of threats present in Most Recent Dream (MRD) reports from participants who live in different threat contexts. The logic of Revonsuo's argument suggests that we should be specifically examining the operation of ancestral threat in dreams – modern threats should be rare, and the simulation mechanism cannot be expected to handle them effectively. In this and all subsequent MRD analyses, therefore, only threats coded as ancestral are included. This analysis looks at all MRD threats coded as realistic physical threats to the dreamer. 'Realistic' was defined as anything that could conceivably occur in real life, either currently or in our ancestral past.

Gender differences in Realistic Physical Threat in MRD reports:

Because the Hall and Van de Castle dream content norms indicate a gender difference in aggression (Domhoff, 1996: males have more aggressive interactions), it is important to check whether there is a gender difference in incidence of realistic physical threats in MRD reports. Our previous study (Malcolm-Smith & Solms, 2004) and Revonsuo and Valli's (2000) work indicated no gender difference, and the current results confirm this. No significant differences were found within the samples from SA ($\chi^2_{[1,N=185]} = 0.88$, $p < 0.3474$); Wales ($\chi^2_{[1,N=102]} = 0.78$, $p < 0.3779$); or the US (Fisher's Exact test, 1-tailed; $p = 0.6103$). Males and females are thus equally likely to report realistic physical threats in their dreams, so having a preponderance of female participants in all groups will have no impact on the MRD analysis.

Realistic Physical Threat in MRD reports across threat contexts:

The results indicate that the MRD reports of Welsh participants contained the highest frequency of realistic physical threats (18.63%), followed by US participants (11.11%). South African MRD reports contained the fewest realistic physical threats at 8.65% (See Table 9).

Table 9: Incidence of Realistic Physical Threat in MRD Reports

Sample	Realistic Physical Threat	No Realistic Physical Threat
Western Cape	16	169
	8.65%	91.35%
North Wales	19	83
	18.63%	81.37%
Tuskegee	3	24
	11.11%	88.89%

Chi-square analysis established that the distribution of MRD threats across the groups differed significantly ($\chi^2_{[2,N=314]} = 6.18$; $p < 0.0455$; Cramer's $V = 0.14$). Analysis of standardized residuals indicated the difference lies in the Welsh sample – significantly more realistic physical dream threats than expected were reported by this group (See

Table 10). Note the value for the South African group: MRD reports of realistic physical threats were on the low end of the distribution. Thus the group living in the least threatening context reported the highest proportion of ancestral threat dreams. The gradient evidenced by these results is the exact opposite of that predicted by Revonsuo.

Once again, the odd's ratio can clarify the extent of the difference between the groups: the odds of having a realistic physical threat in dreams, given that the participant is Welsh, are 19/83; while those for SA participants are 16/169. The odd's ratio (Wales/SA) = 2.4. Welsh participants are thus two and a half times more likely to have realistic physical threats in their dreams.

Table 10: Locating the Source of Significant Difference in Incidence of Realistic Physical Threats in MRD reports.

Sample	Realistic Physical Threat	No Realistic Physical Threat
Western Cape		
Std Residuals	-1.3500	0.5010
p	0.0884	0.3082
North Wales		
Std Residuals	1.8945	-0.7030
p	**0.0291**	0.2410
Tuskegee		
Std Residuals	-0.1480	0.0549
p	0.4412	0.4781

Life-threats in MRD reports:

It is still possible in terms of Revonsuo's arguments, that life-threatening events, rather than simply physical threats, occur with greater frequency in the group exposed to the most waking threat cues. Examples of MRD threats coded as life-threatening include dreaming of being shot in both legs; of having severe head injuries; and of being shot in the back by a robber. Examples of MRD threats coded as not life-threatening include the dreamer's dog acting angry but not doing anything specific; being sworn at and punched (once); and being slapped.

Table 11 indicates that South Africa once again had the fewest life-threats in their MRD reports (7.03%), while Wales again had the most (12.75%). This time, however, the difference between the groups was not found to be statistically significant ($\chi^2_{[2,N=314]} = 2.73$; $p < 0.2554$).

Table 11: MRD Realistic Physical Threats rated as Life-threatening

Sample	Life Threatening Realistic Physical Threats	No Life Threatening Realistic Physical Threats
Western Cape	13	172
	7.03%	92.97%
North Wales	13	89
	12.75%	87.25%
Tuskegee	2	25
	7.41	92.59%

Realistic Escapes from Realistic Physical Threats in MRD reports:

Table 12 indicates how many realistic escapes occurred from realistic physical threats. Most dream threats (between 75% & 100%) were not followed by a realistic escape. In these cases, either the escape is unrealistic; or the threat overwhelms the dreamer and no response is recorded; or the dreamer wakes up in fright. Escapes coded as unrealistic include the dreamer being shot in both legs, but seeing no blood, feeling no pain, and being able to walk normally; and the dreamer operating on himself. Examples of no effective response include: the dream ends with the dreamer being shot in the back by armed robbers; the dreamer cannot escape pursuers; the dreamer is unable to move in the presence of a burglar; the dreamer is robbed and shot 6 times in the back; the dreamer drowns in a flood; and the dreamer is caught by a crocodile and drowns. Examples of the dreamer waking up in fright include: the dreamer is shot at in a carjacking, and wakes up just before the bullet hits his face; the dreamer wakes up during pursuit; a threatening stranger looms and the dreamer wakes up; the dreamer's sister threatens to stab and kill her and the dreamer wakes up.

Examples of escapes coded as realistic include: a shark attacks the dreamer's boyfriend and she escapes by abandoning him and swimming for shore; the dreamer's boyfriend shoots a menacing lion; escaping a farm attack by driving off in a car; and escaping pursuers by getting on a train.

Table 12: Incidence of Realistic Escape from Realistic Physical Threats

Sample	Realistic Escape	Unrealistic or No Escape
Western Cape	4	12
	25.00%	75.00%
North Wales	2	17
	10.53%	89.47%
Tuskegee	0	3
		100%

A cross sample comparison using chi-square is not advisable due to low expected frequencies (< 5) in four of the six cells. The US was thus excluded from the analysis, and Fisher's Exact Test was conducted on the SA and Wales groups. This test is recommended in cases where low expected frequencies render Chi-square unreliable (Howell, 2002). For 2 × 2 tables, it calculates the exact probability of obtaining cell frequencies as uneven as those observed. No difference was found between the groups ($p = 0.2478$; 1- tailed). Expressed as a proportion of the total, 2.16% of SA MRD reports; 1.96% of Welsh MRD reports; and 0% of US MRD reports contained realistic escapes from realistic physical threats.

Summary: Analysis of threat content in Most Recent Dream reports

The first coding indicates that most dreams do not contain realistic physical threats to the dreamer: between 81% (North Wales) and 91% (South Africa) of dreams were coded as not containing realistic physical threats. Welsh participants report significantly more realistic physical threats than the other groups ($\chi^2_{[2,N=314]} = 6.18$; $p < 0.0455$; Cramer's V= 0.14): they are two and a half times more likely to report realistic physical threats than South Africans.

The second coding indicates that very few dreams contain life-threatening physical threats to the dreamer: between 87.25% (Wales) and 92.97% (SA) of dreams were coded as not containing life-threatening events. 12.75% of Welsh MRD reports; 7.41% of US MRD reports; and 7.03% of SA MRD reports contained life-threatening realistic physical threats to the dreamer. There is no difference in the distribution across the groups ($\chi^2_{[2,N=314]} = 2.73$; $p < 0.2554$).

The third coding indicates that most realistic physical dream threats are not followed by a realistic escape, and that there is no difference in this trend across the SA and Wales groups (Fisher's Exact Test: $p = 0.2478$, 1-tailed; $n = 35$). In terms of the entire sample, 2.16% of SA MRD reports contain realistic escapes from realistic physical threats, a similar figure to the 1.96% reported in Welsh MRD's.

Examining and comparing dreams subsequent to threatening and positive life experiences.

Life-threatening events and subsequent dreams:

TST predicts that experiencing life-threatening events should activate the dream threat simulation mechanism, cueing recurrent dream simulation/rehearsal of the threat. Participants were thus asked if their life had ever been in danger; and if so, to provide the date and a detailed description of the incident. They were also asked if they subsequently dreamed of the event. Real life experiences which raters coded as Actual threats (i.e. confirmed that there was danger of death to the participant), and which occurred during or after 2000, were further investigated.

104 reports were confirmed as actual recent life-threatening events. Contrary to what TST would predict, it was found that the majority (almost 2/3^{rds}) of these participants did not report later dreaming of the life-threatening event they had experienced (See Table 13). Examples of events coded as actual threats, which were not followed by dream

simulations include: having a knife held to the participant's throat while being robbed (this occurred 3 days prior to filling in the questionnaire); a burglar threatening to shoot the participant (1 yr prior); being threatened and severely beaten by gangsters (3yrs prior); being mugged by 5 men with knives (4 mths prior); being burgled by men wielding axes and knives (2 yrs prior); and having a gun held to the participant's head (2 reports: 2 yrs prior & 1 yr prior).

Table 13: Reports of Dreams Following Actual Threat Experiences

Total Sample	Subsequent Dream	No Subsequent Dream
Count	38	66
%	36.54%	63.46%

These Actual threats were further coded as Modern or Ancestral. TST predicts that ancestral threats in particular should activate the threat simulation mechanism. Thus it is important to investigate whether ancestral life-threatening events are more likely to be followed by dream simulations than modern threats. All the examples listed in the previous section were coded as ancestral threats. Modern life-threatening events predominantly involved car accidents. No significant difference was found in incidence of dreams subsequent to ancestral rather than modern life-threatening experiences across the entire sample ($\chi^2_{[1,N=104]} = 0.808$, $p < 0.3687$; see Table 14); or within the samples from different threat contexts (SA: $\chi^2_{[1,N=64]} = 1.96$, $p < 0.1619$; Wales: $\chi^2_{[1,N=34]} = 0.02$, $p < 0.8766$; US: Fisher's Exact Test, $p = 0.8$, 1-tailed).

Table 14: Reports of Dreams Following Modern and Ancestral Actual Threat Experiences

Threat Type	Subsequent Dream	No Subsequent Dream
Modern	19	39
	32.76%	67.24%
Ancestral	19	27
	41.30%	58.70%

TST predicts that dream simulations of actual severe threat experiences should feature an appropriate response from the dreamer. Participants who did report dreaming of the life-threatening event they had experienced were asked to provide a detailed example of such a dream. 27 of the 38 participants who reported later dreaming of actual threat experiences recorded example dreams. Raters examined these reports to ascertain whether an escape from the threat was present. Table 15 indicates that in 85% of these cases, an escape from the threat did not occur.

Table 15: Incidence of Escape in Dreams Following Actual Threat Experiences

Total Sample	Escape	No escape
Count	4	23
%	14.82%	85.18%

There were only 4 instances (15%) of escape from the threat in subsequent dreams. 1) A participant reported breaking up with an abusive boyfriend, who then came back and raped her. She reports subsequently dreaming of this, and that in some of her dreams she beats him up or 'gets away somehow'. 2) A participant reported being robbed at knifepoint by 2 men; but he managed to hit the one and run away. In his subsequent dreams he reports beating both their heads into the pavement, and kicking them until they are dead. 3) A participant reported nearly being involved in a serious car accident, having to swerve to avoid a truck. She then reports dreaming of a similar near-miss accident. 4) A participant reported experiencing severe turbulence during a flight. People fell over, someone collapsed and there was panic in the cabin. In her dream, she reports similar scenes 'like the movies', but that she somehow escapes. Note that in three out of four cases, the escape initially occurred in the real life event, and then also features in subsequent dreams.

In 85% of example dreams, an escape from the dream threat did not occur. Examples of dreams in which an escape did not occur follow: 1) A participant was harassed by a group of men wanting sex; which she refused. They became aggressive, breaking her friend's car window in an attempt to get at her. In her subsequent dream, they approach her again, but she cannot run and cannot call out for help. She is terrified of being shot. 2) A

participant reported driving too fast, being unable to brake in time, and thus having an accident. In her subsequent dreams, she cannot reach the brakes, or they do not work properly. 3) A participant reported having a head-on collision; her subsequent dream features the sound of the cars hitting and the sight of her friend's body being thrown about. 4) A participant reported being burgled, and subsequently dreams that the men will come back, particularly when she is alone and helpless. 5) A waitress reported being held up at gunpoint in an armed robbery; she reports now dreaming of the gunman's face. This image intrudes into many dreams. 6) A surfer reported nearly drowning in big surf and subsequently dreams of that situation, only the waves are 'the size of 10 storey buildings'; he dreams of the panic he experienced in real life.

The tendency not to escape the dream threat appears to be similar across the different groups. Cell sizes were extremely low for this analysis (expected frequencies < 5 in four of the six cells; see Table 16). The US sample was thus dropped, and Fisher's Exact Test shows no difference between the SA and Wales groups ($p = 0.6759$, 1-tailed).

Table 16: Escape in Dreams Following Actual Life-Threatening Experiences Across Samples

Sample	Escape	No Escape
Western Cape	3	17
	15.00%	85.00%
North Wales	1	5
	16.67%	83.33%
Tuskegee	0	1
	0.00%	100.00%

Real Life Positive Events and Subsequent Dreams:

Revonsuo states that only experiencing threat impacts on dream content in any consistent way. He hypothesizes that no other class of event will be found to impact on dream content. In order to check the veracity of this claim, participants were asked whether they had ever had an overwhelmingly positive or exhilarating life experience and to describe it. They were then asked if they had later dreamed of this event. Positive events that occurred in 2000 or later were included in this analysis. Many participants (41%) reported that they did dream of positive events after they had occurred (See Table 17).

Table 17: Reports of Dreams Following Positive Events

Total Sample	Dream	No Dream
Count	99	143
%	40.91%	59.09%

Revonsuo (2000a) has cited Hartmann (1998), claiming that positive events are dreamed of in terms of what can go wrong with them: that is, even dreams of positive events become threat simulations. Thus, in order to check whether the dreams of positive events in our sample were in fact threat simulations, the content of the reported dreams was rated as either positive or negative. Sixty-five participants provided examples of dreams of positive events. Contrary to Revonsuo and Hartmann, Table 18 indicates the overwhelming preponderance (91%) of content in these dreams was rated as positive. Only 9% of example dreams featured anxieties related to the event, or things going wrong. Examples of dreams rated as positive include: dreaming of graduating, feeling the pride and joy of accomplishment; dreaming of flying home and visiting family, 'enjoying every minute of it'; dreaming of a very positive sexual experience; and dreaming of a very successful wrestling match, of the crowd's support and of winning.

Table 18: Are Dreams of Positive Events Positive or Negative in Nature?

Total Sample	Positive	Negative
Count	59	6
%	90.77%	9.23%

Comparing reports of dreams subsequent to threat events with reports of dreams subsequent to positive events:

Even though it appears that some participants later dream of positive events, and that these dreams are positive in nature, it is still possible, as Revonsuo contends, that threat experiences are more likely to lead to simulation dreams and that only threat dreams recur. A comparison was thus conducted to check these possibilities. Once again, only events that occurred in 2000 or later were included in the analysis. No difference was found in self-report of dreams following life-threatening rather than positive life experiences ($\chi^2_{[1,N=389]} = 0.17$, $p < 0.6772$). Participants were thus as likely to report later

dreaming of positive events as they were to report dreaming of threatening events (See Table 19).

Table 19: Dreams Following Life-threatening and Positive Life Experiences.

	Real Life Threat Experience	Real Life Positive Experience
Dream of event	57	99
%	38.78%	40.91%
No Dream of event	90	143
%	61.22%	59.09%

Participants were also asked to estimate how many times they dreamed of either type of event. Dreams of both life-threatening events and positive events were reported to have recurred, and the mean estimates of recurrence were similar. The mean number of times participants estimated having dreamed of positive events after they happened was 8.94 times, while the mean number of times participants estimated having later dreamed of threatening events was 7.24. It is not likely that these estimates are highly accurate: the intention of this comparison is simply to indicate that positive events also seem to be dreamed of subsequent to their occurrence; and they seem to be dreamed of recurrently. Contrary to Revonsuo's assertions, the self-reports about dreams following from positive events are remarkably similar to those about dreams following from life-threatening events.

CHAPTER FOUR
DISCUSSION

Overview of the results

Threat in dreams of participants from different threat contexts:

The most important aspect of the present study is this: an investigation of Revonsuo's claim that the threat simulation mechanism will activate differently depending on the level of ecologically valid threat cues operational in waking life. The different levels of exposure to ecologically valid threats in the three samples were established - firstly by examining official statistics for violent crime; secondly by ascertaining the proportion of participants in each sample who reported experiencing a recent ancestral-type life-threatening event; and thirdly by obtaining an impression of the participants' subjective sense of relevant threats faced routinely. The participants' responses confirmed the pattern indicated by the crime statistics. The SA sample is exposed to a significantly higher level of threat, while the sample from Wales has a significantly lower level of threat exposure. South Africans were four times more likely to have been exposed to a recent ancestral-type life-threatening event than Welsh participants.

This data provides a firm foundation for testing Revonsuo's arguments. South Africans are exposed to ecologically valid threat cues, so the threat simulation mechanism should be activated in this context. According to his prediction of a gradient of activation, the dreams of South African participants should thus contain the most threats, with US and then Welsh dreams containing fewer. The results indicate precisely the opposite pattern to that predicted: Welsh participants had significantly more realistic physical threats in their dreams than the other groups. They were two and a half time more likely to have realistic physical threats in their dreams than South Africans. Inexplicably, in terms of TST, the group living in conditions virtually free from ancestral threat had the most threat

simulation dreams, while those living with a fairly high prevalence of ancestral threat cues, had the least.

Welsh participants also reported the most life-threats in their dreams (12.75%), followed by the US (7.41%), and with South Africans again reporting the least dream threats (7.03%). The difference between the groups was not found to be significant. There was also no difference across the SA and Wales groups in the rate of escape from dream threats. There is thus no indication of more dream life-threats or escapes occurring in the high threat exposure sample. Revonsuo's prediction of a gradient of activation in the threat simulation mechanism, dependent on the level of exposure to ecologically valid cues, is not supported.

This MRD content analysis clearly tells us that most dreams do not contain realistic physical threats to the dreamer. Although the Welsh participants' MRD reports contained significantly more realistic physical threats than the other groups, even in this sample 81% of MRD reports were threat free. In the SA sample, 91% of reports did not contain realistic physical threats. This confirms our previous finding (Malcolm-Smith & Solms, 2004) and is similar to Revonsuo & Valli's (2000) report that only 22% of dream threats were coded as physically dangerous or life-threatening. These figures all clearly indicate that most dream content does not feature physical threats. Furthermore, life-threats in MRD reports seldom occurred - between 87% and 93% of dreams did not contain life-threats. These results contradict both the impression given by Revonsuo's review of empirical evidence under Proposition 2; and the conclusions derived in Revonsuo and Valli (2000): namely, that dreams specialize in representing threats relevant to his argument.

Critically, most of the few dream threats that did occur were not followed by an escape. Between 75% and 100% of all MRD threats were not successfully resolved in the dream. This is the most critical aspect of Revonsuo's proposed function for dreams. The threat mechanism cannot provide adaptive advantage simply through rehearsal of threat experiences: successful avoidance responses must also occur. Only simulations of escape

can lead to improved performance in real life. Domhoff (2003a) also adopts this position, arguing that a having a dream reflect a problem is one thing; having it reflect a solution is another entirely. The escape figures cited here, and those indicated in our 2004 study (2.74%) seem far too low to provide support for this theory of function.

Dreams subsequent to threatening and positive life experiences:

The aim here was to explore participants' reports of dreams subsequent to positive life events, and to see if these were in any way similar to their reports of dreams subsequent to threatening events. TST states that only experiencing threat impacts on dream content; and that if it can be shown otherwise, this would constitute proof against the theory (Revonsuo, 2000a).

Only one third of participants who experienced a recent life-threatening event reported dreaming of this experience. Experiences coded as ancestral were no more likely to be followed by dream simulations than those coded as modern. Both these results contradict TST's predictions. In dreams of actual life-threatening experiences, 85% of the time the dream threat was not followed by a successful escape – the dreamers simply relived the terror of the experience. In the four instances (15%) where a dream escape did occur, three of the escapes had initially occurred in real life. In terms of TST, these dreams would thus constitute rehearsals of skills already functioning adaptively in waking life.

41% of respondents who reported experiencing an overwhelmingly positive experience said they later dreamed of this event. Of the dream examples provided, raters coded 91% as having only positive content. The participants relived the joy and exhilaration they experienced in real life. Some participants did report 'post-triumphant dreams' – entities that Revonsuo (2000b, p.1065) confidently asserts do not exist. Moreover, no difference was found in rate of reporting dreams subsequent to threatening events rather than positive events. Participants' estimates of the recurrence of both types of dreams were also remarkably similar: the mean estimate of recurrence for threat dreams was 7.24 times, and that for positive events was 8.94 times. According to these results, it appears that people do dream of intensely positive emotional events in the same way that they

dream of threatening events – sometimes dreams recreate the experience, and sometimes these dreams recur.

Clearly, retrospective self-report data is not entirely reliable, and confirmation of these findings using a prospective design would be most valuable. However, I would like to put forward two comments suggested by these results. Firstly, the idea espoused by Revonsuo that trauma is usually followed by recurrent dreams incorporating that event, may not be entirely accurate. Recent research shows that literal incorporation of the threat event in dreams is not the rule (Hartmann, 1998; Hartmann & Basile, 2003; Mellman et al., 2001; Punamaki, 1997; 1999).

I suggest this particular belief regarding the incorporation of threat events into dreams may have been based largely on data from a biased sample: namely, people in treatment for post-traumatic symptoms. Due to this, we may have subscribed to a retrospective fallacy. This type of retrospective error, which overestimates the base rate of the occurrence of a relationship, is a quite common logical error. The best known example, of course, comes from looking at prison populations in the US, where most offenders are black. This gives the relationship: most offenders → black, but not its reciprocal, i.e. it does not mean that most blacks → offenders. Similarly, in the literature on child abuse, it was initially found that parents currently abusing their children retrospectively reported having been abused themselves, and this led to the idea of the cycle of abuse. The relationship: abusers → previously abused was inverted to become: abused → abusers. Prospective studies later indicated that not all children who are abused go on to become abusers – there is no straightforward relationship of abuse → abuse (Kaufman & Zigler, 1993; Quinton & Rutter, 1988; Widom, 1989).

Perhaps a similar situation arose in the literature on trauma and dreams. People suffering from PTSD, who repeatedly dream of particular threat events, obviously tend to retrospectively report having been traumatized (i.e. threat incorporation dreams → previously traumatized). It seems this is how the relationship of trauma events being incorporated into dream content was established - the relationship was inverted (trauma

→ threat incorporation dreams). Now, looking prospectively at what happens to dreams post-trauma, we see that this relationship is not a given. Although it seems clear that dreams become more emotionally intense after trauma (Hartmann & Basile, 2003; Hartmann et al., 2001), many people who are traumatized do not experience literal simulations of the event in their dreams. Moreover, those who do tend to have poorer psychological adjustment (Levin & Basile, 2003; Mellman et al., 2001); which again suggests that the 'in-treatment' sample is likely to be biased. The base rate of trauma → incorporation dreams cannot be accurately estimated by looking primarily at this sample.

Secondly, I suggest these results indicate that we need to investigate the impact of positive events on dream content. I was unable to find a single published study on this particular subject, and G.W. Domhoff and M. Blagrove (personal communications; 17th and 18th November 2004, respectively) indicated that they were not aware of any research conducted on this topic. There are some studies that indirectly indicate that positive life events may have an impact on dream content, but they do not specifically examine dream content subsequent to positive life experiences. For example, Blagrove & Price (2000) found that happy skilled individuals tend to have happy dreams. A study by Van den Bulk (2004) found that 60% of thirteen year olds and 50% of sixteen year olds report pleasant dreams related to material seen on TV. Kelly Bulkeley (personal communication on work in prep., 18th November, 2004) has found instances of dreams reflecting a positive waking event. This gap in the literature means that Revonsuo's confident assertions concerning the unique impact of threat on dream content are based only on assumption – there is currently no basis for comparison.

What is needed is a good prospective study examining the impact of exhilarating or overwhelmingly positive events on dreams, and ideally, comparing this to the impact of trauma on dreams. The current study was unable to shed any light on exactly what kind of positive experience tends to lead to dreams. Would these be biologically relevant events? There was no clear pattern in the current data. Some people reported dreaming of wonderful experiences in nature – hikes; swims; scenery; others reported dreaming of highly meaningful events – graduations; reunions; intimacy. Others reported not

dreaming of very similar experiences. This direction of investigation needs to be pursued.

Limitations

Although the sample sizes from SA and Wales, the two most critical contexts, were large enough to be reliable, the US sample, intended to be used as a calibration point between these groups, was unfortunately too small. In two instances it had to be excluded from statistical analyses. Its small size also casts doubt on it being representative of this population. In terms of purely descriptive statistics, the percentages obtained for the US group did generally fall between those for the SA and Wales groups – it is a pity these figures cannot safely be regarded as reliable estimates. Fortunately the sample sizes for the critical contrasts between the most divergent threat contexts, SA and Wales, were sufficient.

Another area of concern is the possibility of limited power. In two of the MRD analyses, there appeared to be a difference between the groups, but this was not found to be statistically significant. 1) MRD reports from Welsh participants contained the most life-threats (12.75%), while those from SA contained the least (7.03%) – this difference was not significant. In this instance the MRD sample sizes should be sufficient (Wales: n = 102; SA: n = 185), unless the effect size is very small (Domhoff, 2003b), which would appear to be a possibility.

2) MRD reports from SA participants appeared to contain more escapes (25%) than those from Welsh participants (10.53%), and this difference was not found to be significant. In this analysis, based on the number of escapes that occurred from MRD realistic physical threats, sample sizes were extremely small (SA: n = 16; Wales: n = 19). There were two reported escapes from Welsh participants and four from South African participants. If these figures were treated as proportions of the total MRD samples, rather than as proportions of MRD realistic physical threats, there is even less difference between the groups. Obtaining a large enough sample of MRD escapes to enable statistically

satisfactory analysis of differences between groups would not be easy. Given that escapes from realistic physical threats in dreams seem to occur in around 2% or less of MRD reports (Malcolm-Smith & Solms, 2004; current results); getting a sample of only 50 escapes would require around 2 500 MRD reports, clearly a daunting task. It seems to me that the mere fact that realistic escape from realistic physical threat occurs so infrequently as to cause these problems suggests that basing a theory of function for dreaming on this rare element is somewhat questionable.

Using only students as participants is also somewhat problematic – they can hardly be regarded as representative of the broader population. Clearly this is primarily due to a pragmatic issue of access: university classes provide large numbers of potential participants, an important consideration. Obtaining large samples of completed surveys is no easy feat: many people do not recall their dreams, or simply do not have the time to participate. Note, however, that Revonsuo (2000a; 2000b) asserts that the threat mechanism should be optimally active in children and adolescents, partly because of the short life span of ancestral humans, but also because he hypothesizes that in younger humans, the conditions of modern living have had less impact, and ancestral dream scripts should be more active. In addition, Domhoff (2003b) has shown that older individuals' dream content does not differ, except that aggression and negative emotions are reduced. Student samples can thus be considered appropriate in terms of age. The most important antidote to non-random sampling is aiming for replication of results (Cook & Campbell, 1989). The current results replicate our 2004 findings; the additional areas of investigation introduced in this study require replication in the future.

Clearly, all the methodological problems inherent in the field of dream research (discussed in the literature review) apply to this study. Most importantly, we cannot be entirely certain about what dream recall biases exist, although it seems that salient, dramatic dreams tend to be remembered better. Domhoff (1996; 2003b) indicates that home reports result in more reports of aggression and misfortunes than do laboratory reports – this bias may impact on the present results. However, the possibility that these

biases have affected these results simply strengthens the argument against TST – despite biases favouring their recall, reports of threat simulation dreams are rare.

Zadra and Donderi (2000b) report that retrospective estimates of nightmare frequency are much lower than their frequency in dream diaries. This could suggest a problem for the self-report data on whether a recent actual life-threatening experience was followed by a threat simulation dream – these might be under-reported. I would, however, contend that this question constitutes a very different scenario. The participants all remember the life-threatening event in great detail; and post trauma dreams are usually considered highly emotional and memorable (Hartmann, 1998). Hence, asking about specific dreams of highly memorable events is very different from requesting an estimate of how many nightmares one might have had in a month. Nonetheless, all retrospective self-report data must be viewed with caution.

Implications for TST

As stated earlier, TST is not a theory that can be refuted by one simple test. The theory's six propositions give rise to many predictions. The predictions listed by Revonsuo (2000a) are clearly not exhaustive, but I will reflect on this data in relation to them. Proposition 6 states the theory – it rests on the validity of the preceding propositions. Proposition 1, which contends not only that dream experience is not random, but that it is a selective organized simulation of the world, seems untestable. The neural mechanisms underlying dreaming are not random, but this does not necessarily mean dreams are simulations. The current findings do have implications for the remaining propositions.

Proposition 2 asserts that dreams specialize in simulating threatening events; and predicts these should be over-represented in dreams. The results indicate that relevant threats are few: between 81% and 91% of dreams feature no physical threats. Even fewer dreams contain life-threats. Threats are thus not over-represented in terms of dream content. Revonsuo also predicts that when activated by actual threats, the mechanism should more

efficiently simulate ancestral than modern threats. This data showed no such advantage: in dreams following actual recent life-threatening events, ancestral threats were no more likely to be followed by threat simulation dreams than were modern threats. The data thus contradict two of the three predictions derived by Revonsuo from Proposition 2. As discussed in the closing section of the literature review, this study cannot address the third prediction derived from Proposition 2: that dream threats are over-represented compared with threats in waking life. As mentioned previously, this aspect will be examined in a later paper (in preparation) that examines all biologically relevant events in dreams.

Proposition 3 contends that real threatening events impact markedly on dream content. From this Revonsuo predicts that exposure to real threats will activate the mechanism, and that the frequency and recurrence of dream simulations will depend on the degree of personal threat experienced. I found no evidence that exposure to ancestral threat cues activates the mechanism: South Africans had the least MRD threats (8.65%); and the least life-threats, despite living in a high threat context. Participants who experienced recent ancestral-type life-threatening events generally did not dream of them (63.46%). Revonsuo also predicts that no other class of event impacts on dreams in a similar fashion to threat. My data indicates that self-report of dreams subsequent to positive experiences is remarkably similar to that of dreams subsequent to threat experiences. A similar proportion of participants reported dreaming of both types of events, and these dreams seemed to recur to a similar extent. All three of these predictions are thus contradicted.

Proposition 4 states that dream simulations efficiently rehearse both threat perception and avoidance responses, and from this Revonsuo predicts that in life-threatening dream events, the dreamer will be most likely to respond appropriately. My data does not support this – threat avoidance responses in dreams seem to be the exception, rather than the rule. Hardly any escapes occur in MRD reports: South Africans report no more escapes despite living in context where the threat simulation mechanism should be active; and in dream reports subsequent to actual threatening experiences, escapes are few, and predominantly initially occurred during the actual threat experience. These results also

have implications for Proposition 5, which states that simulation of skills leads to enhanced performance in real life. Escapes are most often not being simulated, so no waking improvement can be expected. This is a problem for Revonsuo's two-stage model of dream production. The second stage – the rapid selection of an avoidance response – tends not to occur. Revonsuo's analogy, likening the threat simulation mechanism to the human immune system, thus does not hold. He explicitly states that the critical factor in its selection was that it remembers the response to a particular pathogen, rendering future response far more efficient. We see little evidence for this in dreams.

Conclusion

TST's fundamental predictions are not supported by this empirical evidence. Moreover, the dearth of avoidance responses in dreams, combined with the suggestion that positive events impact markedly on dream content, constitute convincing evidence against TST's logical foundations. Revonsuo's focus on an evolutionary perspective should be acknowledged as potentially useful, but the domain of consideration must be broadened from the focus on fear/threat. Brain imaging studies (Braun et al., 1997; Maquet et al., 1996; Nofzinger, Minton, Wiseman et al., 1997) clearly indicate that our basic emotional circuitry is highly active during dreaming. Evolutionary ancient emotionally charged concerns, however, do not only involve threat – we should be examining *all* biologically significant events in dreams.

Panksepp (2000) has raised an important point: REM structures are more ancient than the waking structures of the Extended Reticulo-Thalamic Activating System (ERTAS). Panksepp hypothesizes:

> "The REM process may be the functional residue of an ancient form of waking – a simple-minded form of emotional arousal that was 'reined in' through the evolution of REM-atonia as higher 'post trigeminal' ERTAS systems prevailed over primordial pre-propositional forms of waking. This would help explain why REM still arouses basic emotional processes and infuses affect into cognitively manifested dream deliberations...REM arousal may reflect an ancient form of waking

> arousal that was devoted largely to activating genetically ingrained emotional subroutines, which guided behavioral actions in ancestral species long before the behavioral flexibility provided by higher cerebral evolution. Those ancient, value-coding processes may still provide background operations that help higher brain mechanisms sift and integrate fundamental survival concerns from the Niagara of cognitive information flowing in from newly evolved forebrain regions" (p.989).

It is remarkable to think that dream content research may perhaps shed some light on fundamental core-consciousness, now virtually inaccessible to us. This direction of investigation, focusing on all basic emotions and all biologically significant events, will be pursued in a forthcoming paper.

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APPENDIX A

Crime Statistics: Sources, Definitions and Calculations

CRIME STATISTICS FOR SOUTH AFRICA AND THE WESTERN CAPE

These statistics are based on figures released by the South African Police Services and collated/analyzed by the Institute for Security Studies. The ISS is an independent body funded by, among others, USAID; the Ford Foundation; and the British High Commission. One of its research areas is crime analysis, and it aims to provide a resource for both the public and the state. Crime Quarterly is an ISS electronic publication that presents statistics and analyses.

Criminal Justice Monitor (2004). Crime Statistics released by the South African Police 20th September 2004. www.iss.co.za/CJM/stats0904/index.htm

Western Province Provincial total 2003/04		**SA Totals 2003/04**
Murder	2839	19824
Rape	6315	52733
Attempted murder	3633	30076
Assault/GBH	36912	260082
Aggravated robbery	13855	133658
Indecent Assault	2844	9302
Culpable Homicide	1252	11096

[Note: aggravated robbery means armed robbery]

CALCULATING RATES PER 100 000 FOR THE WESTERN CAPE AND SOUTH AFRICA FROM THE SAPS STATISTICS

From Statistics SA (www.statssa.gov.sa) obtained a recent (i.e. mid 2004) population estimate for SA and for the Western Cape.

SA mid 2004 population:	46.6 million
Western Cape	4 570 696

Used these figures to calculate incidence per 100 000 on crimes that were presented only as totals in the ISS sources.

Western Province Provincial total 2003/04		**SA Totals**
Murder	2839	19824
p/100 000	62	43
Rape	6315	52733
p/100 000	138	113
Attempted murder	3633	30076
p/100 000	80	65
Assault/GBH	36912	260082
p/100 000	808	558
Aggravated robbery	13855	133658
p/100 000	303	287
Indecent Assault	2844	9302
p/100 000	62	20
Culpable Homicide	1252	11096
p/100 000	27	24

CRIME STATISTICS FOR THE UK AND NORTH WALES

These statistics were taken from the British Home Office webpage.

Dodd, T.; Nicholas, S.; Povey, D.; & Walker, A. (2004). Crime in England and Wales 2003/2004. ***Home Office Research Development Statistics***
www.statistics.gov.uk/rds/

This reports on the British Crime Survey (BCS), which combines reported crimes with interview data and analysis.

Violent Crime

Includes violence, threat of violence and simple harassment. (Includes Violence against the person; Sexual Offences and Robbery).

NNB: Neither Total violent crime nor Total violence against person can be used as indicator of violent crime – includes many categories aside from the usual murder, attempted murder, rape, assault/GBH and armed robbery.

CATEGORIES COMPRISING TOTAL VIOLENCE AGAINST THE PERSON

MORE SERIOUS OFFENCES:

Homicide (murder, manslaughter and infanticide)
Attempted murder
Threat or conspiracy to murder
Child destruction
Causing death by dangerous driving
Causing death by careless driving when under the influence of drink or drugs
Causing death by aggravated vehicle taking
More serious wounding or other act endangering life
Endangering railway passenger

LESS SERIOUS OFFENCES:

Endangering life at sea
Less serious wounding
Possession of weapons
Harassment
Racially-aggravated less serious wounding
Racially-aggravated harassment
Cruelty to or neglect of children
Abandoning a child under the age of 2 yrs
Child abduction
Procuring illegal abortion
Concealment of birth
Assault on constable
Common assault
Racially-aggravated common assault

From Dodd et al

A similar problem occurs with the Sexual Offences category – it includes an extremely broad range of crimes.

SEXUAL OFFENCES:
Buggery
Indecent assault on male/female
Gross indecency between males
Rape (male and female)
Statutory rape
Incest
Procuration
Abduction
Bigamy
Soliciting
Abuse of a position of trust
Gross indecency with a child

This means that UK crime figures cannot be directly compared with US and SA.

UK Totals for 2003/04

Homicide	853	
Attempted Murder	884	
More Serious wounding	19358	
Rape (female)	12354	
Indecent assault	26709	

North Wales

Total violent crime	11749	
Violence agst person	10979	(p/1000) 16
Sexual offences	569	(p/1000) 1
Robbery	201	(p1000) 0

CALCULATING RATES PER 100 000 FOR THE UK

Found UK population statistics at National Statistics www.statistics.gov.uk
Most recent figure for the UK population was for 2003 = 59.6 million. Used this figure to work out UK totals for violent crime (only these specific figures provided – N Wales figures only given for unusable broad categories).

UK Totals for 2003/04		**p/100 000**
Homicide	853	1.43
Attempted Murder	884	1.48
More Serious wounding	19358	33
Rape (female)	12354	21
Indecent assault	26709	45

CRIME STATISTICS FOR THE US AND ALABAMA

Mitchell, M.; Goggins, B.; & Cobert Roberts, C. (2003). 2003 Crime in Alabama.
Alabama Criminal Justice Information Center.
http://acjic.alabama.gov/SAC/cia2003.pdf

Site gives reported crime; operates under FBI standards.

Violent crime – includes homicide, rape, robbery and assault. All have high risk of injury/death to the victim. Attempted homicide is listed as assault. Rape includes only female rapes; includes attempts.

Alabama 2003

(per 100 000)	
Violent crime	413.3
Homicide	6.6
Rape	66.7
Robbery	128.4
Assault	243.7

Tuskegee Crime Statistics and Crime Data

http://tuskegee.areaconnect.com/crime1.htm

Gives Tuskegee figures as proportions per 100 000; and gives national comparison figures

Tuskegee totals for 2002		**p/100 000**	**US p/100 000**
Homicide	1	8.37	5.6
Rape	9	75.31	33
Robberies	30	251.03	145.9
Assault	43	359.8	310.1

Figures for 2003 are lower than this; Tuskegee population given on this site as 11846. Used this to calculate per 100 000 figures for 2003.

APPENDIX B

QUESTIONNAIRE

Consent form

This research is aimed at a content analysis of dreams, and a comparison of dream events with real life. Should you decide to participate, the information you provide will remain confidential. Aside from a consent signature, these questionnaires are anonymous. General, overall results of content may be published, but individual, identifiable dream accounts will not be made public.

Thinking about one's dreams or some difficult life experiences can be mildly distressing to some. Your participation in this study is entirely voluntary. There is no requirement that you participate, nor is there a requirement that you have to fill out questions that may be particularly upsetting.

I consent to participate in this study by completing the attached questionnaire about my dreams.

Signature of consent: _____

Please provide the following demographic information:

AGE: _____

GENDER: _____

ETHNICITY: _____

VERY IMPORTANT – *DO NOT* READ THROUGH THE ENTIRE QUESTIONNAIRE BEFORE FILLING IT OUT – PLEASE ANSWER THE QUESTIONS IN SEQUENCE

ONLY GO ON TO THE NEXT PAGE ONCE YOU HAVE COMPLETED FILLING IN THE CURRENT PAGE

THANK YOU FOR YOUR PARTICIPATION!

Your Most Recent Dream:

What was the date (approx) when you had this dream? _____

Please write down the last dream you remember having, whether it was last night, last week or last month. Please describe the dream exactly, and as fully as you can remember. Your report should contain, whenever possible, a description of the setting and people (or animals, objects, etc). If possible, describe your feelings during the dream. Tell exactly what happened during the dream, even if it doesn't make sense or seems bizarre. Continue on the other side of the page if necessary.

Have you ever felt that your life was in danger in real life? Yes/ No

If so, please describe the incident in as much detail as you can remember
(If you have felt that your life was in danger on more than one occasion, describe the **most serious** situation)

[If you need more space, continue on the other side of the page, or use extra paper]

When did this incident occur? (give an approximate date) _____

Have you ever dreamed about this threatening experience? Yes/ No
How often? (Try to estimate no.of times over your lifetime) _____

Did the dream(s) occur immediately after the event? _____
If the dreams recurred, how long did you continue dreaming of this event? _____
Do you still dream of it now? _____

If you can, please describe one of these dreams below. (Follow the same instructions as for the **Most Recent Dream** report).

[If you need more space, continue on the other side of the page, or use extra paper]

Try to estimate on average how many potential physical threats/risks (if any) you face on a daily basis – how many times do you feel threatened/ at risk?

(Note – we are concerned here with **physical** rather than psychological/mental or spiritual threats. These potential physical threats/risks can include anything - from traffic accidents; burning yourself in the kitchen; sports injuries; health problems; occupational hazards; etc, to direct physical aggression from other people/animals; crime etc).

Give your daily estimate _____

Give a weekly estimate _____

List the types of physical threats you encounter regularly

Have you ever had an overwhelmingly positive or exhilarating experience in real life? [Eg: Swimming/diving in the ocean; getting married, a helicopter ride – it can be anything that you felt **really excited/happy/exhilarated** by]

Yes/No

If you answered yes, please describe this event in detail

When did this incident occur? (give an approximate date) _____

Have you ever dreamed about this experience? Yes/ No
How often? (Try to estimate no.of times over your lifetime) _____

Did the dream(s) occur immediately after the event? _____
If the dreams recurred, how long did you continue dreaming of this event? _____
Do you still dream of it now? _____

If you can, please describe one of these dreams below. (Follow the same instructions as for the **Most Recent Dream** report).

[If you need more space, continue on the other side of the page, or use extra paper]

APPENDIX C

RATING SHEET AND GUIDELINES

RATING SHEET

MOST RECENT DREAM RATING

Does the dream contain a realistic physical threat to the dreamer? Yes/No

If the answer is YES, answer the following questions:
Is this threat life-threatening? Yes/No
Does the dreamer escape the threat? Yes/No
Is the escape realistic? Yes/No

Would you classify the threat as
A: Modern
B: Ancestral A B

REAL LIFE THREAT RATING

Into which of the following categories does the reported threat fall?

1: Immediate real possibility of death or severe harm; did the person have reason to believe they could be killed or severly harmed?
2: Report simply of a vague, indefinite threat
3: No description of the reported threat
4: The description indicates no external threat to the dreamer. 1 2 3 4

Would you classify the threat as
A: Modern
B: Ancestral A B

REAL LIFE THREAT DREAMS

1: Does the dreamer escape the threat? Yes/No
2: Is the escape realistic? Yes/No

REAL LIFE POSITIVE EVENT DREAMS

Is the dream content
A: positive
B: negative A B

RATING GUIDELINES

RATING THREATS IN THE MRD REPORT

NNB: All threats rated must affect the dreamer, not other characters in the dream

So watching something threatening happening to a friend etc does not count, unless the dreamer is directly threatened as well.

We are looking for realistic threats - something that could happen objectively in real life

We are looking for physical threats - not subjective sense of being threatened in other ways

'The car nearly went over the cliff' = a physical threat
'I felt really uncomfortable in that room' = not a physical threat

EGS OF REALISTIC THREATS
He was trying to hit me with a spade
Stepfather hits with stick; then stabs with knife
Enemies chasing with intent to harm or kill (some dream chases are not this clear-cut – use your judgment as to whether there is a physical threat present or not)

EG Dream where enemies want to kill dreamer but they manifest as a small furry animal chasing her through a forest –the overall scenario is clearly not realistic.

EGS OF UNREALISTIC THREATS

The witch was putting a curse on me
The house was trying to kill me
Jumping over giant waves

AMBIGUOUS CASES

A dream where there is a boy locked inside a piano – when the dreamer sits at the piano the barrel of a gun emerges and the boy teaches her to play a tune with the threat of being shot if she fails

Being threatened with a gun is realistic enough, but the other elements – the boy locked in the piano, and the threat of death for playing poorly - are not realistic. On balance, it seems that this is not something that is likely to occur in real life, so it should not be coded as a realistic physical threat. Some dreams will present difficult decisions – reason through it as best you can.

Life Threatening MRD threats

Its usually simple to decide if the realistic physical threat is in fact life-threatening or not.

ESCAPES:

To code an escape, there must be a description of it in the dream report. Waking up does not constitute an escape from a dream threat.

To decide whether the escape is realistic or not, decide whether the escape tactic would work in real life.

Egs of realistic escapes: hiding; shooting the bad guy; successfully running away

Egs of unrealistic escapes: flying away; putting stones in a certain pattern to deter pursuers; turning into something or someone else.

The MRD threats then need to be coded as either modern or ancestral types:

Modern threats:
Anything that couldn't possibly have occurred in our evolutionary history

EG: Surgery; traffic accidents; plane accidents or emergency landings; incidents involving explosives; Car-jacking;

Ancestral threats:
Anything that has been occurring since the dawn of time

EG: Assault; rape; mugging; attacks with weapons of any sort

Being shot at is coded as ancestral because threats of guns are extensions of threats with any weapon e.g. bow and arrow/spear

RATING THREATS IN REAL LIFE:

Again we are looking for real physical threats.

Category 1: Actual life-threatening event

EGS: being shot at; being attacked; being raped; being robbed at gun or knifepoint; being threatened by gangsters; finding armed burglars in your house

Category 2: Vague or indefinite threat (i.e. not immediately threatening the respondent)
Being home alone at night and fearing break-ins; walking alone in deserted/dangerous areas; being only woman in almost empty taxi or train; etc;

Category 3: No description
Person says has been threatened but doesn't describe event

Category 4: No physical threat present in description
Any reports of attempted suicide/suicidal thoughts go here; also reports of purely subjective distress - feelings of being threatened that have no reference to actual physical dangers.

EG: My boyfriend dumping me

The threats then need to be coded as either modern or ancestral types:

Modern threats:
Anything that couldn't possibly have occurred in our evolutionary history

EG: Surgery; traffic accidents; plane accidents or emergency landings; incidents involving explosives; Car-jacking;

Ancestral threats:
Anything that has been occurring since the dawn of time

EG: Assault; rape; mugging; attacks with weapons of any sort

Being shot at is coded as ancestral because threats of guns are simply extensions of threats with any weapon e.g. bow and arrow

Real life threat dreams:

Please code escapes as you did for the MRD reports:
Ie there must be a description of the escape; or a clear statement of evading the threat; and the decision as to whether the escape was realistic depends on whether it would be effective in waking life.

Real life positive dreams:

You need to decide whether the content is positive or negative if a dream is provided.

Positive content: the described dream contains only positive elements; it clearly reproduces the positive real life experience described above

Negative content: the described dream reproduces the positive event described above, but there are anxieties or fears described in relation to it; something goes wrong; the dream ends badly; etc