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Waking From a Bad Dream: A Response to Threat-Simulation Theory

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ABSTRACT
Antti Revonsuo proposed an evolutionary account for the function of dreaming, rejecting other popular theories such as activation-synthesis. Revonsuo's hypothesis, threat simulation theory, proposes that dreams: 1) are too organized and reminiscent of reality to be considered random, 2) are specialized to present humans with and simulate threatening material, 3) present threatening content following related threatening experiences, 4) are understood to be real while the dream is taking place, 5) provide rehearsals that lead to changes in behavior (conducive to survival and reproduction), and 6) are evolutionarily selected for. I argue that this theory is unfounded and may not have worked as Revonsuo explains. Dreams may not be as organized as TST supports, but the likelihood of remembering such dreams can be explained using prior well established psychological theories. Flaws are presented in data that are used by Revonsuo to support TST regarding methodology that may skew understanding of dream content overall. The remembering of certain dream content can be explained by understanding preexisting psychological workings, such as schema theory and flashbulb memories. Efficacious mental training conditions are lengthy, repetitive, and focused, whereas dreams are short, spontaneous, and scattered, and are not likely to be conducive of developing behavior or responses that increase survival. Supposing much of the supporting data is accurate of dream content, there still remain larger questions about the likelihood that TST adequately explains how dreams may work under selection pressures. Since TST fails as a generalized account for why humans dream, I introduce alternative theories and other original ideas on how dreams may influence behavior on an individual basis. Shortcomings of evolutionary psychological explanations do not suffice as empirically justified theories, as they, as well as TST are post hoc speculations that remain untestable and unscientific in nature. Though evolutionary perspectives on behavior are helpful, there are serious doubts that TST provides an accurate representation of dreams as an adaptive function.

KEYWORDS
Cognitive Dissonance, Desensitization, Dream Function, Evolutionary Psychology, Fear, Implicit Learning

UNDERSTANDING DREAMS

Dreaming is a human universal. The content of dreams is wide-ranging from terrifying to pleasant, and from mundane to exuberant. The perceived events that happen while slumbering, if remembered (or even not!), are likely to at least leave the dreamer confused, if not behaviorally altered in some way. The act of trying to make sense of or understand these stories from an unconscious state has been around since the time we had the cognitive faculties necessary to think about them. Throughout most of history, interpretation has fallen into a religious context—we travel to an alternate reality where we meet or receive messages from gods; having a good dream means that our soul was taken by a god while we slept, while an unpleasant dream meant that a demon got to it first; the soul takes in images during the day and produces them again during the night. Freudian dream analysis came later, in which dreams serve as a window to peer into the unconscious and as a means of understanding our urges and wishes. The Jungian view came just a bit later than the Freudian, claiming that we should view dreams as neglected parts of the self that are to be understood symbolically.

Evolution and Functionality

A pattern has emerged over history; that the understanding of dreams is becoming localized to our immediate contexts and less attributed to other-worldly kinds of events. Contemporarily, the theory of evolution has led to the understanding of many different functions of living beings, and is driven by the idea that living things adapt to their surroundings by means of mutation and natural selection to survive. Biology and psychology alike have used the theory of evolution to make sense of why humans work physically and mentally. One popular dream theory, known as threat simulation (TST), is an evolutionary perspective to explain why we dream. According to threat simulation, the nature of the content we dream is determined by what we perceive to threaten us. Dreams are a means of rehearsing threatening events before actually encountered, and people are thereby more effective in the course of action taken in waking life. Antti Revonsuo supports a version of this theory, but the only part that stands is the idea that dreams have the potential to alter our waking lives—not the idea that dream content is pre-selected for threatening or anxiety-provoking material (Revonsuo 2003).

Before detailing his own theory, Revonsuo includes an overview of alternatives, and explains why they've either failed or are insufficient. Specifically, functionality is what he's after. Functionality is determined by whether or not something serves as beneficial to an organism, or increases the likelihood of survival and reproduction. So, if dreams are functional, this is what's expected of them—if we dream, we survive. A distinction is made between natural and invented function, in which natural is independent of culture or convention. Natural functions are intimately related to functionality, whereas invented ones are more tied to the other examples used in the introduction.

There is a possibility that dreams are non-adaptive, or came along with adaptive functions that do have a purpose. The most popular non-adaptive theory is synthesis-activation, which is a neurological standpoint on dreaming that claims that dreams are evolutionarily epiphenomenal, and are a result of the multitude of functional purposes being performed by the brain while we sleep (such as memory consolidation). In activation-synthesis theory, dreams arise as a result of the forebrain attempting to make sense of the activities involved in other neurological processes, and are understood as a random occurrence (Hobson and McCarley 1977). David Foulkes (1985) put forth a similar theory. Likewise, he emphasizes the randomness of dream content and denies any purpose, but does grant that our dreams take place in a kind of an analog to our waking lives. Owen Flanagan (1996), again, agrees that dreams are a result of the cortex processing noise, denies biological function, and denies that the phenomenal aspect of dreaming (*p*-dreaming) was selected for. Flanagan says dreams aren't worth remembering, and that the perceived sensations in our dreams have no real correlate, but since they aren't maladaptive, they've survived. Revonsuo does look to psychology for possible intellectual and emotional benefits from dreams, but to no avail—the evidence that he's gathered doesn't support these ideas. It appears that Revonsuo wants to find a place to fit the content that more closely relates to natural function, and can be supported by evidence. I, however, will argue that the evidence and assumptions made to support TST are insufficient to conclude that dreams have been evolutionarily selected to promote survival as opposed to being a byproduct of other evolutionary selections. The studies and data used by Revonsuo are often used hastily, or without consideration of alternative explanations. I will point out methodological flaws that leave Revonsuo's interpretations in doubt. I'll also present established psychological

theories that elucidate trends and other happenings in the data, as well as contradict the assumptions made that back TST. Finally, I propose another plausible explanation for how dreams may change behavior in individuals.

THREAT SIMULATION THEORY

Organized States

Revonsuo splits his argument into six propositions and defends them accordingly. His first proposition is that dream experience is not random, but that it constitutes an organized and selective simulation of the perceptual world. I'll refer to this as the "organized state" aspect of the argument. The dreaming brain is similar to the waking brain in terms of activity according to the studies that he cites, and the content we experience while sleeping is remarkably similar to the content experienced while awake. Dream content is laden with "objects, people, and animals, participating in a multitude of events and social interactions with other dream characters" (Revonsuo 2003, 883). Revonsuo argues that dreams are too coherent to be results of random noise, as other theorists argue. He expects that neurological noise would present itself in unintelligible ways—ways that wouldn't construct narratives or familiar people and objects as dreams do. The organized structure provided in dreams make them akin to a virtual reality. He says that threatening experiences are more frequent than other kinds, and concludes this section by citing a few studies that find that particular subjects like writing or calculating are not often found within dreams.

Threatening Material

Proposition 2 is that dreams are specialized in the simulation of threatening events, in which he argues that there is a clear bias or overrepresentation of threatening content in our dreams. Let this be the "threatening material" trait. The support for this claim is heavy in dream data and empirical studies. Studies on the emotions felt in dreams that indicate that about two-thirds of dreams involved negative emotions, and cites a study of his own in which the emotions experienced appropriately correlate to the content of the dream (i.e., if a person is being attacked in their dream by an aggressor, they feel fear). Misfortune, he says, is a more common theme in dreams than good fortune, but the kinds of misfortune most often experienced are "accidents, losses of possession, injuries

or illnesses, obstacles, and threats from environment" (Revonsuo 2003, 884). Death and falling happen much less frequently. The misfortunes often convey experiences in which resources and goals are threatened. Reasons are presented to believe that aggression involving the dreamer as a victim is a common trend as well. Data show high prevalence of interaction with enemies (or aggressors) in dreams, and that these enemies are typically male. Male aggressors were recorded as being more common in both men and women, explaining that our ancestors would've likely encountered more male than female aggressors in interspecies conflict. Animals, specifically large predators, were likewise recorded often in dreams. Children's dreams are also suspect of being specialized, as studies find that they often dream about predatory animals. Recurrent dreams are examined, and according to a 1983 study, the only kind of recurring dream encountered were anxiety dreams that involved the dreamer being pursued or threatened. The aggressors in nightmares are, again, often unfamiliar males or groups of people. Last presented is neuroimaging data that indicates high emotional charge, presumably in response to dreamed threats. Again, overall, he aims to show that an overwhelming amount of dream content is threatening and that dreaming brain states emulate that of a waking one when it is emotionally distressed.

Dreaming from Experience

Proposition 3 is as follows: "Encountering real threats during waking has a powerful effect on subsequent dream content: real threats activate the threat simulation system in a qualitatively unique manner, dissimilar from the effects on dreaming of any other stimuli or experience" (Revonsuo 2003, 887). In other words, the experience of threatening events in real life leads to dreaming of that experience or experiences derived from that event. Let's call this "The transitivity of threat" principle. Dreams resulting from trauma are likely to repeat, being continually more modified to match normal surroundings as time passes. Post-traumatic nightmares occur in those who have experienced "wartime battles, natural catastrophes, terrible accidents, or assault, rape, or torture," the occurrence of the nightmares depends upon how threatening the experience was perceived to be (Revonsuo 2003, 887). The majority of children and Vietnam veterans who experienced or were exposed to traumatic events reported having related dreams. Only events or stimuli perceived to actually be threatening can

produce nightmares; stimuli used in experimental studies, such as film clips, aren't perceived as threats, and therefore do not produce these nightmares. He uses data to support the idea that real life threats lead to the activation of the threat simulation system by citing studies that show that stressful events lead to more intense REM sleep (the stage of sleep that dreaming is most frequent), and that those who suffer from post-traumatic stress disorder spend more time in REM sleep. Dream content is selected from our long-term memory. The more threatening a past event was perceived to be, and the more it pertained to physical survival and success, the more likely it is to appear in dreams.

Virtual Reality

Proposition 4 is the "virtual reality" part of his argument, so we'll refer to it as such. While dreaming, a person is unaware of dream content being anything but real. Dreams are vivid enough, thereby sufficient enough, to serve as a proper means of emulating what real threatening events would be like, because we're every bit as motivated to escape in a dream as we are in real life. This idea, of course, rests on the supposition that most of our dreams are of threatening material. Dreaming and awake brain states of individuals performing motor actions have been compared, and the motor cortex displays similar activity in both states. The reason that we don't actually move while sleeping is due to the activation of an inhibitory system that blocks the neurons' activity in the spinal cord, essentially blocking what otherwise would have been a real motor movement. A few cases are described of people who have REM Sleep Behavior Disorder, a condition in which the inhibitory function just described doesn't work. These people interact with their environment *while* dreaming, and real objects appear to correlate with dream objects. For example, there is a case of a boy who rises from his bed, grabs the butter dish from the table his parents were dining at, and hurls it through a window. He was dreaming about a bomb that was about to explode, and the butter dish, no doubt, was the dream correlate of that bomb (Oswald and Evans 1985). These aspects of dreaming are pieced together to show that dream behavior is adequate to rehearse waking behavior.

Dream Drills

Proposition 5 states that simulation of perceptual and motor skills in dreams leads to enhanced performance in real situations, and that these may be learned

implicitly. Think of this as "dream rehearsal." To conclude this, data are cited from research in mental training that finds that mental kinds of rehearsal can lead to increased strength and performance. Research done on implicit learning indicates that consciousness (or memory) isn't necessary to learn skills. So, the mental activities that we've engaged in while dreaming, though they may have even been forgotten, may be enough for learning and rehearsing skills. Assuming, again, that our dreams are filled with content of threatening situations, we would thereby be increasing our strength and performance should such events arise in real life.

Evolutionary Selection

Proposition 6 assumes his theory, and adds that the threat-simulation system was selected for through evolution. I'll refer to this later as the "evolutionary selection" conclusion. Given that dreams are specialized in simulating threats and better preparing humans for real threats, those with this system in place had increased chances of surviving and reproducing under selection pressures. Conditions were tough; the mortality rates were high and people were dying before many were even able to reproduce. Threats likely encountered then were due to being eaten by animals, being exposed to the elements, disease, famine, incidents during hunting and gathering, and conflict between groups of humans over territory or resources. Since threats were so common, threat simulation was in effect often, enhancing skills over thousands of rehearsal sessions providing people with the skills needed to survive. Since those who could dream in this way were able to survive, they were able to pass this function on genetically though generations.

Summary and Concerns

TST says that dreams:

1. Are organized states
2. Simulate threatening material
3. Present content following threatening experiences
4. Are realistic and taken seriously
5. Provide rehearsals that lead to changes in behavior
6. Are evolutionarily selected for

Overall, threat simulation theory seems convincing in light of the evidence presented, but there are some cases to be made against his claims upon inspection of data. Some of the methodology used to collect it is questionable. I'm also skeptical of certain assumptions made about the involved psychological workings, and have alternative theories to introduce that may lead to a different understanding of threatening dreams. With some critique, we see that the theory may not function as well as expected under selection pressures. I'll revisit the propositions and address some issues.

REVISITING TST

Organized Recall

The "organized state" aspect, or the organized manner in which dreams are presented does seem purposeful in some aspect. The issue brought up doesn't say that dreams are puzzling because of the sometimes inexplicable content, but because they make any sense at all. People appear to have these elaborate narratives that strikingly resemble features of their waking lives and have some sort of coherence about them, but otherwise, how might dreams be remembered? It may be difficult verbally presenting dream content to another, or even accessing it ourselves it were presented to us in a bundle of seemingly random images and sounds as a result of brain activity, as the activation-synthesis account of dreaming might suggest (Hobson and McCarley 1977). Revonsuo claims that the narrative fashion in which dreams are presented remains unexplained, (or not well explained enough by previous theories), but it seems that a classic work (as well as contemporary work) in schema theory might make sense of why dreams are as they're *remembered*.

Frederic Bartlett introduced schema theory to psychology with his first book *Remembering*, and in it, he proposes that people hold different organized clusters of information (or schemata) in memory. New information is made through relationships with the existing schemata (Bartlett 1932). Bartlett's 1932 work contained the classic "War of the Ghosts" experiment in which English participants read a Canadian Indian folklore piece. The story contained culturally foreign folk-phenomena which participants understood as ambiguous bits of information. Subjects were asked to recall the story several times at extended intervals. The parts of the story that did not match or identify with the readers'

previous schemata were either omitted or distorted to match previous information and beliefs. The more time that passed from the time the story was presented, the more bits were forgotten or altered.

This theory provides insight as to why dreams are recalled in such a coherent way. The more salient thoughts and events that tend to construct much of dream content, according to the activation-synthesis view, may be due to recent activation of schemata, thereby making a sort of mental filter that makes sense of the random firings. Dreamers may be presented with lots of odd and abstruse stimuli, and when their minds are trying to encode what they've been exposed to, then pieces of the dreams are discarded and altered in ways to easier make sense of them. It may be especially difficult to make sense of a dream as it's presented, but we do encode them in helpful ways which at least allow for coherent recall.

Medley of Material

The "threatening material" trait emphasizes the amount of research that suggests dream content is overwhelmingly negative, or that dream content usually involves aggressive or threatening interactions with others and environments. There are reasons why this might be the case as well. The kinds of studies used to support Revonsuo's theory are mostly done though self-reports made by the participants. The participants were asked to keep track of a dream journal over a period of time, and they filled them out when they were able to recall a dream at some point after waking. Gathering results in this way may skew the kinds of dreams being reported. More contemporary and controlled methods of gathering dream content data take place in sleep labs, where participants are woken when there is good reason to suspect that they were dreaming. Allan Hobson finds, according to his sleep lab studies, that more positive emotions are reported, and that this is so because negative dreams may wake people more often in home environments, making them more readily available to report (Hobson 2003). When not woken in a sleep lab study, the positive dreams would've been slept through, making them more difficult to recall later on.

These conclusions suggest that more recent findings conducted in sleep labs, or otherwise using equipment to wake a participant during REM sleep, would show more balance in the emotions reported, and this is indeed the case. Some studies show that the emotions associated with dreaming are mostly positive and accompany joy and elation (Fosse, Stickgold, and Hobson 2001). Others are still

conclude that the majority of dreams are negative (Merritt, Stickgold, Pace-Schott, Williams and Hobson 2001). Some studies are mixed with strong emotions, between positive and negative (Yu 2007). There isn't yet enough information to warrant a strong consensus, but it is evident that new methods of collecting data put Revonsuo's position on dream content being overpoweringly negative into question.

Aside from possibly being outdated and unable to provide accurate data of dreams by participants who wake naturally, some have raised the objection that the data that Revonsuo presents is in question because of how the dream content was coded (Malcolm-Smith and Solms 2004). Much of the dream data put forth by Revonsuo was determined to have aggressive features through use of the Hall and Van de Castle system, which has eight codes for aggression. Only four of them involve physical aggression. Of the four that involve physical aggression, not all of them involve dire consequences and may not even elicit a negative emotion. Something like stepping on a bug would qualify as an act of aggression (Domhoff 1996).

Another possible explanation for the excessive report of threatening content in dreams may be related to people's tendency to remember high amounts of detail about traumatic events, a phenomena widely accepted and reported in psychology (Kensinger 2007; Christianson and Loftus 1990). Specifically, studies have found that subjects report central details about these events clearly, but are less detailed in their accounts of peripheral content. This feature of the brain has clear evolutionary advantages on its own. Having the ability to remember crucial information about the environment, or using the memories of an event of a close mortal error vividly leads to different subsequent behavior patterns that boost survivability. This function may simply be working within the perceived dream events that have threatening content, making the recall of these particular dreams much higher.

Dreaming from Observation

There isn't much to contest about the evidence in support of "The transitivity of threat" principle, as listed symptoms of those with post-traumatic stress disorder include nightmares and night terrors, but there are doubts that this is so because of a threat simulation system. As victims of trauma are often met with their past through other mental associations (like flashbacks), then this may be

another example of salient content making its way into dreams. Revonsuo does put forth a claim within this section that appears problematic, though. He suggests that fictional stimuli isn't able to induce a sense of genuine threat to a person's life, and therefore doesn't function as a cue to be used as threatening content in dreams. This claim is made following a quote from a researcher who was unable to find a relationship between external stimuli and dream content, but the claim itself didn't cite any more research. I found this odd, given how people cringe and shriek while watching a horror movie, and that there are plenty more who report having nightmares, for instance, about movie characters trying to kill them. Much data indicates that people have strong emotional reactions after watching horror movies, and the phrase "cinematic neurosis" has been coined in light of this common reaction (Bozzuto 1975). Other studies actually use cinematic stimuli to induce anxiety to find an effective method of calming the patient (Mathai 1983). The content that makes it into our dreams isn't as specific as he makes it out to be in this section. It's clear that most people can discriminate between real threats and fictional threats, but the physiological responses still follow, and the content still meets us in our dreams (Van 2004).

Another claim made in this section is that nightmares occurring from traumatic events have a recurrent pattern in which they start as intense, but eventually become watered-down versions of them. He then suggests that all dream content may be seen as a result of threat simulation. Even if the most accurate and invasive means of viewing people's dreams were available, this claim is blatantly unfalsifiable, as this leaves dreams open to loose, adaptive interpretations.

Dream Demonstrations

The simulation of reality, or the inability to distinguish between dreaming and real life, and the inhibited motor movements discussed in the "virtual reality" part are widely accepted ideas. Lucid dreaming, which Revonsuo does mention, could be problematic, but it's agreed that this is a rare phenomenon that requires training and practice to do with any consistency. The conclusion about the rehearsal of motor movements and implicit learning in "dream rehearsal" though, does seem like a stretch. Again, he cites the efficacy of kinds of mental training—in this case, kinds of training that don't require motor movement that elicits progression in a motor skill. He suggests that this kind of training leads to benefits, so there's every reason to believe that the mental activities undergone in

our brains while we sleep will lead to survival benefits. There are components of mental training, at least of the kind cited in his work, that are probably missing in dreams. In experiments which found motor improvement from mental training, there's a decent amount of repetition involved before any benefit is seen. A particular study uses sixty trials of mental exercise before measuring benefits, and mostly saw improvements if the participant was young, healthy, and was given a short bout of physical practice before engaging in the training (Gentili, Han, Schweighofer, and Papaxanthis 2010). One of the studies cited by Revonsuo, in reference to improved performance in sports skills and measuring table tennis improvement, had their mental training condition relax (which wouldn't correlate with the negative emotions or threatening content that are suggested in dreams) as well as perform the physical task (Lejeune, Decker, and Sanchez 1994). The mental training group in this study rehearsed a specific counterattack return for 40 minutes; they were asked to imagine themselves practicing the technique backhand and forehand, as well as to feel minimal muscular tensions related to it. Other studies show zero to marginal improvement after mental training (Lamirand and Rainey 1994).

It's easy to imagine, with these findings, that teaching amnesiac patients any lasting, effective skills would involve similar concentration. The findings on implicit learning are largely on cognitive, frontal cortex kinds of tasks, which presents another problem for Revonsuo (Reber 1989). There is little to suggest that dreams are as repetitive, focused, or involve such long periods of mental training. The proposed relationship he presents is easy to understand, but difficult to imagine given experimental conditions that only sometimes provide any benefit. Dreams likely do not include the rigorous standards required for motor improvement.

Survival Trait Survival

The "evolutionary selection" conclusion, of course, makes the case for why this theory works well within an evolutionary context. This, too, merits investigation. Due to the heavy correlation of REM sleep in the process of dreaming, there are some minor concerns. There are some noted benefits of REM sleep, such as memory consolidation, and there are some noted effects of REM sleep deprivation, such as hallucinations. One common property of nightmares is that they have the ability to wake the dreamer, and in more extreme cases, can lead to insomnia. Since the content of nightmares is threatening or anxiety

provoking, the kind of content understood to be dominant by Revonsuo in the threat simulation system, it seems unlikely that these two functions would compete, in a manner, to maintain functionality. Do the dreams Revonsuo anticipates to work within his theory also maintain themselves under an excitation threshold in order not to wake the sleeper? Also, it has been reported that waking an individual from REM sleep often leaves them confused and disoriented (Zadra and Nielsen 1998). It was stated in Revonsuo's work that real threats may intensify REM sleep, and that those who had recently experienced a threatening event may spend more time sleeping in REM sleep. This seems to be another instance in which there is a conflict between an aspect of REM sleep and having to face a real threatening event, as it doesn't seem adaptive that one who had recently experienced a traumatic event should wake in a muddled stupor, or in a state that would leave them less able to defend themself more often.

An issue was presented with the particular kind of learning that occurs in dreams, and even within the context of Revonsuo's work, it's challenging to identify how, exactly, the points put forth will lead to survivability. The idea appears to be that since people are exposed to threatening content via dreams, that they should be better prepared to face them in waking life, but why is this the case? It's unclear that a dreamer should come across the correct answers, or somehow learn the correct answers, to perform the best adapted course of action. People may come into contact with aggressors or other kinds of disaster within a dream, and he's established that they likely feel fear, which is an emotion that is felt in creatures in dire situations whether they're about to live or die. What isn't precisely established is how simulated threats are going to help. One could easily be suppose that the physical response associated with fear or aversion on its own is the wrong course of action. Throughout an ancestral human's life, suppose they've had many dreams about a lurking saber-toothed tiger; they feel fear and anxiety, as they know they have little chance of killing it, even with a weapon. Let's suppose that their learned response that they've even rehearsed numerous times via dreams has been to run in the opposite direction, but what if in waking life, the human spots the predator first? The natural reaction, through simulation, may be to run in the opposite direction, but maybe this was the wrong move. In all the grass and brush, the human makes enough noise to direct the beast's attention. The human isn't faster than the tiger, so the human gets chased down and eaten. Maybe the right move in this situation was to keep cool and stay

still, going against what the dream would've prepared the human for. It could be argued that more often than not, running in the opposite direction would have been the correct move, still making threat-simulation selected for, but this invites another question: is that actually what all of those threatening dreams would prime an ancestral human to do?

Desensitization is a psychological concept that refers to a diminished emotional response to a negative or anxiety provoking stimulus after repeated exposure to that stimulus, or when an aversive stimulus elicits an action that is proves to be unhelpful or superfluous. It was originally developed and understood as a means of treating anxieties and phobias, and remains to be the most efficacious method of doing so. More recently, interest has been sparked in the concept due to the rising popularity of violent forms of media such as television and video games.

Exposure anxiety treatments, or treatments that physically or mentally expose a client to an aversive stimulus, have classically done in hierarchal manners. In other words, a therapist or practitioner collaborates with a client to determine a list of related fears, starting with the least aversive and ending with the most aversive. The client works through these starting from the beginning, and progresses to the next step when anxiety levels have diminished. This repeats until the end goal is met and anxiety is manageable or no longer present. Alternatively, an immersive, computer simulated virtual reality treatment is used in substitution of in-vivo treatment, and has proven to be similarly effective (Rothbaum et al. 1995; Garcia-Palacios, Hoffman, Carlin, Furness, and Botella 2002). A similar, but less effective version of exposure treatment is flooding, which doesn't involve the graduated, hierarchal process explained above.

Other studies in desensitization involve the media aspect, and they commonly find that exposure to violent media decreases responsiveness to otherwise sensitive (control group) participants; these results are consistent with long and short term effects (Bushman and Huesmann 2006). To illustrate this effect, one study found that after 20 minutes of playing a violent video game, responsiveness was decreased to come to the aid of an injured fight victim compared to the control group subjects, who played a non-violent video game (Bushman and Anderson 2009). Another study in this paper found the same effect with subjects who watched violent movies—they took longer to help an injured woman who had dropped her crutches than the control group.

With the effects of exposure to violence and anxiety provoking material well understood, it seems unlikely that repeated exposure through dreams would make dreamers more sensitive to the threatening content of their dreams, and if anything, it may even lend to them a more lax, inhibited response in the face of selective pressures. Also, the misery accompanied with a dream threat may become well-associated with another common non-threatening experience—waking up. Under Revonsuo's theory, people are essentially wearing a virtual reality desensitizer that runs about four times every night while they sleep. Threats may need to be related to novelty to some degree, and the innate fight or flight system humans developed at a much earlier stage in evolution probably works fine, if not better, without the assistance from dreams.

OTHER POSSIBILITIES AND EXPLANATIONS

Revonsuo considered and introduced other theories as he set out to prove his own. Activation-synthesis theory and the rest of the neurological theories were unsatisfactory to him because they didn't introduce a biological function of the phenomenal aspect of dreaming. Something was unsatisfactory about the previous answers to explain why people are able to sleep but feel so alive. Because dreams are so fascinating, people are driven to look for better explanations, but maybe there aren't, and maybe there doesn't need to be. If there is a better answer, I have doubts that threat simulation is the one due to of the problems that I've presented.

I side with the neurological, biologically epiphenomenal accounts, but with one distinction or emphasis. There's a term that's been used for dreams in the evolutionary sphere. The ability to dream is a spandrel—it came along with the rest of humans' adaptive structures, and it hasn't caused extinction, so it stayed (Internet Encyclopedia of Philosophy n.d.). The ability rests between the mapping of the brain and the need to sleep. So, as a species, dreams by themselves haven't killed us or provided any great advantages, but maybe the scope here is too vast. This conclusion has come about as a result of averages. As a whole, dreams don't perform a specialized role, but maybe there are more remarkable interactions that take place at an individual level.

Dreams have a rather unknown place in history, but if it weren't for these phenomena, life in some ways could be radically different. For instance, it's been said that Einstein's theory of relativity was inspired by a dream about a group of

cows huddled together touching an electric fence. A farmer came and turned on the fence, shocking the cows. Einstein was watching from a different place than the farmer and saw them all jump at once, while the farmer reported seeing them all move individually. The structure of DNA came to James Watson after he dreamt about two snakes. The sewing machine was invented after Elias Howe dreamt of seeing warriors who had spears with holes in the heads while being executed by a king for not inventing a sewing machine on time.

Dreams are idea mutations, if you will. While the ideas produced by dreams require context, the brain activities that happen during sleep lead to some unexpected results—the content produced in dreams could be considered the most creative. Our dreams aren't under any obvious control or direction. We get a random mess of scattered signals and our frontal cortexes pick up the pieces, and the results could lead to nothing or something huge. If not an idea, it could be just the little nudges in our mental states that lead to big changes. Maybe a nice dream occurs between the dreamer and a classmate, and who is then is inspired to ask them out, marries them, and starts a family. Perhaps a dream just puts someone in a good mood for unknown reasons and the mood helps determine an action. But, again, there's a chance that a wild dream warranting an interpretation results in a scientific revolution. Dreams may, as well, lead to unfavorable outcomes. What conclusions are to be made after a person does something deplorable in a dream, such as murder? What about out-of-character promiscuity? (Issues of dream actions being immoral character continuity between dreams and waking life are part of another debate, but speculating outcomes is of interest within this context.) The dreamer may be left in a conflicted state of self-reflection, trying to make sense of which part of their character would produce such an outcome, even in a dream state. They might wonder if their dream actions more closely reflect some deep, unconscious desire (as Freud supposed), and anxiety stems. Another outcome may be that the dreamer is compelled to reconcile cognitive dissonance resulting from dream content. They may do so by concluding that the poor dream actions are a more accurate representation of their self, thereby adopting the dissolute dream behavior. A separate possibility is that dreams do prime fight or flight systems, but in a way that causes strife between a dreamer and their otherwise close friend. A terrible nightmare about an otherwise docile environment or object may trigger anxiety when experienced

thereafter. These are, of course, speculations, but the nature their conception isn't entirely different from that of Revonsuo's theory.

Evolutionary Narratives

Revonsuo states that all six of his propositions are empirically testable (Revonsuo 2003, 878). What this means, though, is he can present some intuitive speculations on the nature of dreams, information on dream content, neurological activity, psychology theory, imply some cause and effect relationships, and then tie it all together to make a plausible story on how dreams came to be. In other words, he started with an idea about dreams that might explain their presence—people dream because they contribute to survival and the likelihood of genes being passed on. From there, he thought about how he could support that idea, and started investigating other ideas and empirical data that lend to it, asking himself if it fit or made sense looking through an evolutionary lens. If it fits, he considers it empirical evidence. If not, or at least not at first, it may be disregarded or reinterpreted to make sense in another way. I found that a reinterpretation took place between his original paper and a response to a related critique of mine. The original states, "…stimuli…, such as films, never induce anything like a sense of real threat…," and thereby "…do not function as…valid cues for the dream-production mechanisms" (Revonsuo 2003, 887). Later, a different tone appears when presented with dream data that indicates higher prevalence of fictional content. Though content does involve much "fantasy and fiction," this doesn't imply that "the threat simulations in themselves are unrealistic and therefore inefficient. Even fantasy-based threats can be taken seriously within the dream…" and "thus…can activate threat perception and avoidance mechanisms in a relevant manner, just as effectively as reality-based simulations" (Valli and Revonsuo 2006, 467). This is a fluid process. There was an explanation to begin with, but he was presented with conflicting evidence and then found another way out. Giving post hoc explanations is even impervious to contradiction. Just change the story a little bit.

Further developments have been made in supporting TST by Revonsuo, but they're susceptible to the same criticisms I've presented (Valli et al. 2005; Valli and Revonsuo 2009). Additional evidence was found to make the story just-so, but the last proposition will always remain empirically problematic. There won't be a time when early human populations can be controlled for and compared to others who

don't dream, nor will researchers be able to measure a number of dreams our ancestors had and find a survival length correlation. The best explanations for why we dream will be guesses, but they'll only be guesses. Some guesses will be better than others, and others will fall behind. This one is falling behind. It's time to look for other answers—it's time to wake up.

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