Dreaming in Relation to Reward Processing and Motivational Aspects of Personality

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Abstract

Current literature relating to the neurophysiological underpinnings of the dream process provides evidence for a central role of mesolimbic-mesocortical activity in the genesis of dreaming. It is also evident that the mesolimbic-mesocortical dopaminergic system is the basis of motivational aspects of personality and reward processing. This study aimed to investigate the relationship between dreaming and the mesolimbic-mesocortical dopamine system by modelling aspects of dreaming on personality and reward processing measures. It was predicted that dream frequency and vividness would be positively associated with motivational or appetitive traits and reward processing in a healthy population. To test this hypothesis a correlational study was conducted on a sample of 207 undergraduate psychology students from the University of Cape Town. Personality was measured using the Behavioural Approach System (BAS) scale and the Sensation Seeking subscale of the Zuckerman-Kuhlman Personality Questionnaire. The results were that the Reward Responsiveness subscale of the BAS significantly predicted variation in dream frequency. None of the personality variables were found to significantly predict variation in dream vividness. These results are discussed in relation to the obstacles faced in using psychometric measures as proxies of neurophysiological activity. In light of this, the significant result of this study is particularly germane. This study has thus provided the first empirical evidence for a relationship between reward processing, motivational aspects of personality and dreaming. This hopefully will provide the impetus for future research to further explicate this relationship.

Keywords: dreaming, reward processing, dream frequency, dopamine, SEEKING

Introduction

A substantial amount of literature has been devoted to dreaming, with the view that it provides a unique line of insight into consciousness and cognition (Aserinsky & Kleitman, 1953; Freud, 1953; Hobson, Pace-Schott & Strickgold, 2000). A commonly agreed upon function of dreaming, however, has yet to be established (Malcom-Smith, Koopowitz, Pantelis, Solms, 2012). A less ambitious undertaking may be in understanding how dreams are generated at a neurophysiological level, as this may elucidate how dreaming affects cognition (Hobson, Pace-Schott & Strickgold, 2000). Early theories pointed to cholinergic brainstem mechanisms as being the impetus for dream generation (Hobson & McCarley, 1977). However, these theories have subsequently been revised in light of new evidence that shows dreaming to involve dopaminergic forebrain mechanisms (Solms, 2000; Perogamvros & Schwartz 2012). It is also evident that these same dopaminergic mechanisms are implicated in reward processing, motivation and other appetitive behaviours (Haber & Knutson, 2010). Though it is not unreasonable to think that a link may exist between appetitive behaviours and dreaming, research into this relationship remains scant. This study therefore aimed to respond to this deficit and empirically investigate dreaming in relation to reward processing and motivational aspects of behaviour.

Dream Generation

Early theories regarding dream generation dealt primarily with the notion that dreams were a concomitant of rapid-eye-movement (REM) sleep (Hobson & McCarley, 1977). Initially this was due to there being a higher frequency of dream recall during REM sleep in healthy individuals than during Non-REM (NREM) sleep stages (Dement & Kleitman, 1957). A second line of evidence came from the view that heightened cortical arousal is necessary for dream representation (Hobson, Pace-Schott & Stickgold, 2000). Heightened cortical arousal is a distinct feature of REM sleep, where levels of activation are equivalent to waking (Aserinsky & Kleitman. 1953). This is particularly surprising as during this period the body is in a state of atonia, marked by a loss of muscle tone akin to paralysis. These findings influenced the belief that dreaming and REM sleep are isomorphic processes. This provided the catalyst for a focus on understanding the neurophysiology of REM sleep in order to understand the neurological correlates of dreaming. Studies initially indicated that the REM sleep stage is controlled by pontine brain mechanisms (Jouvet, 1962). This finding influenced the *reciprocal interaction model* posited by Hobson and McCarley (1977). Explicit to the model was that REM sleep was induced by the activation of cholinergic cells and inhibited by

aminergic cells localised primarily in the pons (Hobson & McCarley, 1977). As REM sleep and dreaming were hypothesised to be isomorphic processes, it was concluded that these cholinergic brainstem mechanisms were the cause of dreaming.

A competing theory of dream generation has since challenged this account (Solms, 2000). Implicit to the assumption that REM sleep is a result of cholinergic pontine mechanisms is that damage to the brainstem should result in total dream cessation. However, brainstem lesions that abolish REM sleep do not result in dream loss. Conversely, instances of total dream cessation have arisen from patients without lesions to the brainstem (Solms, 1997). Total dream cessation has been found to occur with parietal lobe and deep bifrontal lobe lesions (Domhoff, 2001). Two extensive reviews of dream cessation after focal brain injury have been conducted. The first included 104 cases (Doricchi & Violani, 1992), the second included 111 (Solms, 1997). Both of these reviews found total dream cessation without damage to pontine mechanisms (Dumont, Claude & Guimond, 2007). Furthermore, patients with focal lesions but a spared brainstem continued to experience normal REM sleep with the cessation of dreaming. This led Solms (2000) to hypothesise that REM sleep and dreaming, though highly correlated, are doubly dissociable states.

Dreaming as a dopaminergic process

The cortical pathology associated with dream cessation was localised to either the parieto-temporo-occipital junction or in the white matter under the frontal horns of the lateral ventricles (Solms, 2000). Studies utilising positron emission tomography (PET) scans have further supported the localisation of dream cessation to these areas (Domhoff, 2001). This is conducted by the mapping of a radioactive isotope that is inserted into the bloodstream and highlights areas of metabolic activity.

The loss of dreaming due to parieto-temporo-occipital damage is in some sense to be expected, as this region subserves the various cognitive processes required for mental imagery (Solms, 2000). Therefore, the ability for the perceptual construction of dreaming is lost with damage to this area (Dumont et al., 2007).Of greater interest, however, is the fact that damage to ventromesial frontal white matter causes dream cessation. These frontal and limbic circuits begin in the ventral tegmental area and innervate through the lateral hypothalamus, nucleus accumbens and other basal forebrain areas, before terminating in the frontal cortex (Perogamvros & Schwartz, 2012). Collectively this circuit forms the mesolimbic-mesocortical dopamine system (ML-MC). Thus, it seems reasonable to assume

that this circuit is involved in the dreaming process. Indeed, this system has been found to play a critical role in dream genesis (Domhoff, 2001; Solms, 2000)

Evidence for the role of the ML-MC dopamine circuit in dream generation can be found in the following: Firstly, dream cessation occurs with damage to this circuit, such as bilateral lesions in the ventromesial frontal white matter (Domhoff, 2001). Secondly, drugs (for example L-Dopa) that increase levels of dopamine in this region produce excessive and unusually vivid dreaming (De Gennaro, Marzano, Cipolli & Ferrara, 2012). Thirdly, drugs that inhibit this circuit likewise inhibit dream frequency (Sacks, 1985). The fourth line of evidence is supplied by two in-vivo studies conducted on rats. Single-cell recordings of the activity of dopaminergic cells in the ML-MC showed increased neuronal firing during the REM sleep stage (Dahan et al, 2007). Similarly, studies utilising microdialysis (a semi-invasive procedure that collects extracellular fluid via a probe) also iterated a substantial increase in dopamine release during REM sleep (Léna et al., 2005). Finally, equivalent increases in dopamine during REM have been found in humans (Gottesmann, 2004). Thus, a confluence of clinicoanantomical, neuropharmalogical and neurophysiological evidence points to the dopaminergic ML-MC system as essential for dream generation.

The ML-MC and Reward Processing

Along with dream genesis another major function of the ML-MC system concerns reward processing (Perogamvros & Schwartz, 2012). This serves one half of two basic behavioural tendencies that are generally accepted as being found in all animals (Alcaro & Panksepp, 2011). These are *approach* and *withdrawal*. These two opposite tendencies are often accompanied by the respective affective states of reward and punishment. Rewards are conceptualised as the central component to "driving incentive-based learning, appropriate responses to stimuli, and the development of goal-directed behaviours" (Haber & Knutson, 2010, p. 4). Examples of primary rewards are stimuli such as food and water. However, rewards can be broadly construed as anything that positively reinforces behaviour. Understandably then, rewards usually induce a hedonic response such as pleasure (Schultz, 2006). Approach behaviours are either manifested by phasic or tonic dopamine activity. The former involves episodically directing attention to salient environmental cues. While the latter regulates stable motivational states (Perogamvros & Schwartz, 2012).

These motivational behaviours are primarily associated with dopaminergic signalling in the ML-MC circuit (Panksepp, 1998). The motivational component of the circuit switches behaviour and attention to reward-related stimuli or novel cues in the environment

(Perogamvros & Schwartz, 2012). The psychological-behavioural state of reward processing and motivation can be thought to have an evolutionary basis (Panksepp, 1998). Incentive-based brain reward systems motivate an individual to seek out in the environment that which is necessary for survival.

The SEEKING system

The ML-MC circuit is best conceptualised as the SEEKING system (Panksepp, 2005). The SEEKING system is an archetypal "psycho-behavioural emotional and motivational system of the mammalian brain" (Perogamvros & Schwartz, 2012, p. 1936). This system is driven by homeostatic imbalances and is manifested in consequent appetitive behaviours. These are differentiated from consummatory behaviours which inhibit these appetitive drives when a particular reward is attained (Panksepp, 2005). SEEKING is thus understood as the system that activates reward processing traits such as curiosity, interest and expectancy.

The personality dimensions most readily associated with the SEEKING system are positive emotionality and sensation seeking (Panksepp, 2005). Psychometric measures have a long-standing history of attempting to measure seeking behaviours (Gray, 1981). One such instrument, the Behavioural Inhibition System/ Behavioural Approach System (BIS/BAS) scale, measures certain appetitive elements of the SEEKING system (Carver & White, 1994). Examples of which include craving novel sensations or challenges. Research indicates that hyper-excitability of the dopaminergic ML-MC circuit predisposes individuals to be highly responsive to exogenous stimuli (Alcaro & Panksepp, 2011). Subsequently, a link between addiction and the SEEKING system using the BIS/BAS scale has been found (Krmpotich et. al., 2013). Imaging studies show that substance abusers score higher on the "fun seeking" BIS/BAS subscale compared to controls; whilst presenting with greater ML-MC activity during reward processing (Krmpotich et. al., 2013). Thus, an apparent link between ML-MC activity and psychometric measures of SEEKING exists.

Novelty Seeking scores acquired via the Temperament and Character Inventory have also been correlated with activity in the SEEKING system. An example of a Novelty Seeking item is "I often try new things, just for the fun or for the challenge…" (Cloninger, 1992). The use of functional magnetic resonance imaging (fMRI) found increased ML-MC activity in individuals with high Novelty Seeking scores (Krebs, Schott & Druzel, 2009). This technique measures brain activity by detecting changes in blood oxygenation levels in the brain. The Zuckerman-Kuhlman Personality Questionnaire has also been reliably used to differentiate high and low sensation seekers across various formats (Aluja, et. al., 2006). Imaging studies

again emphasise that ML-MC activation is differentially associated with high and low sensation seeking scores. A recent fMRI study indicated that high sensation seeking individuals show significant ML-MC activity differences between reward receipt and reward absence conditions, whilst this difference is absent in low sensation seeking individuals (Cservenska, Herting, Seghete, Hudson & Nagel, 2013). Therefore, these personality scales appear to measure both the neurological and affective facets of the SEEKING system.

The SEEKING system, sleep and dreaming

As the ML-MC SEEKING system is both the site of dream genesis and involved in reward processing, it is likely that a relationship exists between the two. This may manifest in both quantitative and qualitative aspects of dreaming. The dopaminergic ML-MC has already been explicated as being necessary for dream generation. However, it may also account for the frequency with which dreams occur during REM sleep. As has already been mentioned, dreaming is reported disproportionately more during REM than NREM sleep. A review of 62 awakening studies found that, on average, dreams were recalled 40% more frequently during REM than NREM sleep (Nielsen, 1999). Extracellular levels of dopamine in the ML-MC areas have also been found to be significantly higher during REM compared to NREM sleep (Gottesmann, 2004). It is therefore plausible that the ML-MC system, activated due to reward processing, may lead to an increase in both REM sleep and dreaming. Evidence for this may be found in the effect that increased ML-MC activity has on both the frequency and phenomenological aspects of dreaming. This may be indirectly illustrated in how ML-MC activity is linked to REM elevation and memory processing.

The ventral tegmental area constitutes the core of the reward circuit and bursting activity in this area is strongly related to reward processing (Yun, Wakabayashi, Fields & Nicola, 2004). Burst firing of dopamine neurons has been shown to result in maximum levels of dopamine accumulation in the synapse (Léna et al, 2005). The ventral tegmental area has also been found to play an essential role in the generation of REM sleep (Perogamvros & Schwartz, 2012). Dopaminergic activity in this area is increased during REM sleep onset and marks the end of NREM sleep stages. Furthermore, burst firing of neurons in this area in rats during REM sleep has also been found to be of comparable duration to firing during motivational behaviours, such as sex (Dahan et al., 2007). It is evident then that the ventral tegmental area subserves functions of both REM and reward processing.

The link between dopamine and REM sleep is further corroborated in individuals who have Parkinson's disease. This disease is characterised by an altered ML-MC

dopaminergic system with dramatic effects on REM sleep latency (Dzirasa et al., 2006). Along with sleep disturbances, Parkinson's Disease patients suffer from apathy and show impairments on stimulus-reward learning tasks (Czernecki et al, 2002). Treatment with L-Dopa (a dopamine agonist) has been found to alleviate both the motivational and sleep deficits of this disease. A subtype of Parkison's Disease includes frequent and vivid hallucinations due to abnormalities in the ML-MC system. Dreaming has been reported more frequently by patients in the hallucinatory subtype (Mehler-Wex, Riederer & Gerlach, 2006). Accordingly it is plausible that the SEEKING system mediates both facets of the REM sleep stage, dream frequency and motivational aspects of behaviour.

Not all dreaming occurs during REM sleep however and neither are these dreams necessarily different. At least 10 - 30% of NREM dreams are reported to be indistinguishable from those during REM (Rechtschaffen, 1973). Thus, dream generation during NREM may similarly be linked to activation in ML-MC structures (Perogamvros & Shcwartz, 2012). Further evidence for this can be found in the role of reward processing in memory consolidation during sleep (Alcaro & Panksepp, 2011; Wamsley & Stickgold, 2010).

The spontaneous activation of emotional memories in ML-MC areas occurs during NREM dreaming (Alcaro & Panksepp, 2011). Recently encoded memories are thought to be reactivated in the hippocampus (which forms part of the ML-MC SEEKING system) during sleep. Evidence for this is found in studies that show increased memory recall after such activation (Zhang, 2009). Furthermore, episodic/declarative memory formation utilises some of the same neurophysiological mechanisms as reward processing in both sleep and waking states (De Gennaro et al., 2012). Tonic dopamine release in the ventral tegmental area during NREM sleep has been suggested to aid in this consolidation (Floresco, West, Ash, Moore & Grace, 2003; Perogamvros & Schwartz, 2012). Other ML-MC areas are likewise activated during NREM sleep such as the amygdala and ventral striatum (Maquet et al., 1993).

The question then is this: what impetus could there be for ML-MC activation across sleep stages? One theory is that this facilitates sleep-dependent memory consolidation (Wamsley & Stickgold, 2010). As the SEEKING system is involved in dream genesis, it may be that dreaming is induced by the activation of reward components by passive memory processes during sleep (Perogamvros & Schwarz, 2012). This line of thinking is further corroborated by evidence showing that dream content tends to be more strongly associated with SEEKING activities, such as pursuing a goal, than avoidance behaviours (Malcom-Smith et al., 2012). Dream content also often includes or is made up of memories with strong valences (De Gennaro et al., 2012). Furthermore, PET studies have shown that limbic areas

are reactivated during REM sleep in accordance with the recall of emotional content and reported vivid dreams on awakening (Maquet et al., 1993). These results suggest that limbic activation is a major determinant of vivid imagery in dreams. Dreams during REM also tend to be more vivid and bizarre (Nielsen, 1999) Thus, it is plausible that dopaminergic limbic activity influences the affective content and vivacity of dreams. The strongest evidence for this is from diffusion tensor imaging studies (DTI). This technique measures grey matter volume and allows for microstructural comparisons. A recent study using DTI found that inter-individual differences in hippocampus and amygdala brain tissue were directly related to the vividness of dream content (De Gennaro et al., 2011). It is evident then that the ML-MC SEEKING system may mediate a variety of aspects of dreaming, including vividness and frequency.

Rationale for Present Study

While empirical evidence suggests that the SEEKING system plays a central role in dream genesis, there is significant lack of literature regarding dreaming, motivational aspects of personality and habitual reward processing traits in the waking personality (Pergoamvros & Schwartz, 2012). Empirical evidence suggests that motivational personality traits are related to activation in the ML-MC reward processing system (Cservenka et. al., 2013). Therefore, it is reasonable to predict that there may be a link between dream generation, motivational behaviour and personality traits; however, this hypothesis is yet to be tested empirically. Should such a relationship be established, it would provide further evidence for the central role of the ML-MC system in dreaming, as well as contribute to our understanding of dream processes during sleep. Furthermore, the evidence of a link between increased ML-MC system activity (as it relates to personality factors and motivated behaviours) and dream frequency may help to explain individual differences in memory processing during sleep.

Aims and Hypotheses

This study aimed to examine the relationship between dreaming and motivational aspects of personality and reward processing. An abundance of evidence in the literature links mechanisms of dreaming to activity in the ML-MC dopamine system. However, various elements of the dream process have yet to be investigated in relation to motivational aspects of personality in a healthy population. It is plausible that dreaming may be reflective of waking exploratory behaviours as the ML-MC is critical to both. Psychometric measures of these behaviours have been found to similarly measure ML-MC activation. Thus, the scores on these measures were used as proxies for ML-MC activity.

The hypothesis of this study were that dream frequency will be associated with increased activity in the ML-MC dopamine system. As dopamine has also been found to induce intense and vivid dreams, it may be that ML-MC activation is also positively associated with dream vividness.

Specific Hypotheses

H1**:** Psychometric proxies of ML-MC dopamine activation will significantly predict dream recall frequency.

H2: Psychometric proxies of ML-MC dopamine activation will significantly predict dream vividness.

Methods

Design

A between-subjects correlational design was used in this study to test the a priori hypothesis that a relationship exists between dreaming, motivational aspects of personality and reward processing. The dependent variables under study were dream quantity and dream vividness. Quantity was defined as scores on the DIS Dream Quantity subscale and the Schredl Recall Scale. Vividness was defined as scores on the DIS Dream Vividness subscale. The independent variables were the scores on the various psychometric measures of motivation and reward processing. The target sample was healthy undergraduate students exhibiting typical sleeping patterns.

Participants

The undifferentiated sample included 639 undergraduate psychology students enrolled at the University of Cape Town. Participants were drawn from the Department of Psychology's online course portal (Vula). A convenience sampling approach was used whereby students were offered course credits points for their participation. These credits are a requisite requirement for completion of undergraduate psychology courses at the university.

The initial sample completed an online questionnaire (comprising a number of scales and subscales), including questions related to their medical history. To be eligible to receive 2 course credits, all participants were required to complete the questionnaire in its entirety.

A target sample size was set of between 350 – 500 participants. This best suits the nature of this study, being the analyses of naturalistic relationships between variables. The final sample included 207 participants. This is above the minimum sample size of between 100 – 125 participants stipulated as necessary for the collection of representative dream report data (Domhoff & Schneider, 2008). These participants did not meet the exclusion criteria and so formed part of a healthy student population with typical sleeping patterns. The exclusion criteria included:

Psychiatric and sleep disorders. Participants were excluded if they had been previously diagnosed with any chronic psychiatric disorder, as assessed by the medical history items on the online questionnaire. They were also excluded if they currently had a sleep disorder, as assed by the Pittsburgh Sleep Quality Index (PSQI; Buysse, Reynolds, Monk, Berman & Kupfer, 1989). This was warranted as both psychiatric and sleep disorders have been found to affect sleep architecture and dream recall (Benca, Obermeyer, Thisted, & Gillin, 1992;

Nofzinger, 2005). The PSQI was also used to establish typical sleeping patterns and subjective sleep quality. Good subjective sleep quality is defined as a score of < 5 on the PSQI. This cut-off score has been established to reliably differentiate between healthy and unhealthy sleepers in both general and student populations (Buysse, et al. 1989; Lund, Reider, Whiting & Prichard, 2010).

Depressive disorders. Participants were further asked if they had ever been diagnosed with a depressive disorder. Depression has been found to affect the motivational aspects of personality that are of focus in this study (Foley, Ancoli-Israel, Britz, & Walsh, 2004). Depression has also been found to drastically affect sleep architecture and dream recall (Lam, 2006). The Beck Depression Inventory (BDI; Beck, Steer & Carbin, 1988) was used to further screen for depression. Typically scores < 10 are considered to be indicative of a lack of clinical depression (Beck et al., 1988). However, the originators of the BDI urge that the appropriateness of such cut-off ranges are contingent on aspects of the sample and purpose of the instruments used. Others have also cautioned that high scores on the BDI are not indicative of depression in samples of university students (Tanaka-Matsumi & Kameoka, 1986). In order then to minimise the inclusion of false-positives, participants were excluded if they scored < 18 on the BDI. This still falls within the category assigned as 'mild depression' as stipulated in the original cut-offs (Beck et al., 1988).

Chronic medical conditions and medication. Each participant was required to give a general medical history. Participants who had asthma, diabetes, or epilepsy were excluded. These conditions have been found to affect sleep quality and dream recall (Bazil & Marlow, 2005). Participants were also excluded if they were taking any psychoactive medication (e.g tricyclic antidepressants, benzodiazepines and/or stimulants) as these have been found to affect sleep architecture and dream recall (Ahman, Waltonen, Theye, Olson & van Erem, 1993; Kupfer et al., 1994).

Participants were excluded if they reported the use of certain chronic medications. These included: chronic pain medication, opioid therapy and the use of sleep-inducing medications. These have been found to affect sleep architecture and dream recall (Chapman, Lehman, Elliott & Clark, 2006; Webster, Choi, Desai, Webster & Grant, 2008).

Substance use. In addition to the above mentioned exclusion criteria, participants who reported the use of psychoactive drugs were excluded from the study, as narcotics have been found to alter natural sleeping patterns (Brooks, 2005).

Materials

Online questionnaire. The online questionnaire comprised a number of scales and questions intended to address the aims of the study.

Psychiatric conditions and sleep disorders. Participants were asked to report whether they had ever been diagnosed with any sleep disorder or psychiatric condition.

The BDI was used to attain normative data on participants' levels of clinical depression. The BDI is a widely used measure of depression and has been found to correlate strongly with both clinical ratings and other depression scales (e.g. the Hamilton Psychiatric Rating Scale for Depression), with $r = 0.72$ and 0.73 respectively (Beck et al., 1988). The Beck Depression inventory was also found to retain its psychometric properties across pencil-and-paper and online formats (Hollandare, Andersson & Engstrom, 2010). This made it particularly useful given the online format of data collection in this study.

The PSQI (see Appendix A) was used to formally assess subjective sleep quality. A global PSQI score of > 5 was found to yield a diagnostic sensitivity of 89.6% in distinguishing between good and poor sleepers (Buysse et al., 1989).

Chronic medical conditions and medications. Each participant was required to answer questions relating to their general medical history and their use of chronic medications (see Appendix B).

Reward functioning and motivational aspects of personality. The Behavioural Inhibition System/ Behavioural Approach System (BIS/BAS) questionnaire was used to assess individual differences in approach and avoidance behaviours (Carver & White, 1994; see Appendix C.). The BIS/BAS comprises four subscales, namely Behavioural Inhibition System (BIS), BAS Reward Responsiveness, BAS Drive and BAS Fun Seeking. The Cronbach Alpha values for each subscale were moderate to strong with, $\alpha = 0.82$, 0.54, 0.75 and 0.55 respectively (Smits & Boeck, 2006). Convergent validity with the Extraversion dimension of the Big-Five was found for both Reward Responsiveness and Fun Seeking, with a significant correlation of $r = 0.36$ and 0.69 respectively ($p < 0.001$; Smits & Boeck, 2006).

Scores on the BIS/BAS are also significantly predicted by theoretically associated scales on the Temperament and Character Inventory (TCI; Cloninger, Svarkic & Przybeck, 1994). The TCI is a 240-item questionnaire that measures trait and character dimensions that are associated with responses to environmental events involving reward and punishers (Farmer & Goldberg, 2004). Specifically the Novelty Seeking subscale of the TCI was found to significantly predict BAS scores, with $\beta = 0.29$, $p < 0.05$ (Mardaga & Hansenne, 2007). This is promising as high Novelty Seeking scores have been associated with increased ML-

MC dopaminergic activity (Stuettgen, Hennig, Reuter & Netter, 2005). Finally, fMRI studies have found the BIS/BAS to successfully measure ML-MC cortical activation and subsequent motivational aspects of personality (Krmpotich et al., 2013).

The Sensation Seeking Scale Form V (SSS-V) of the Zuckerman-Kuhlman Personality Questionnaire assesses personality traits of Thrill and Adventure seeking (TAS), Disinhibition (DIS), Experience Seeking (ES), and Boredom Susceptibility (BS; Zuckerman 2002). These traits have previously been shown to correlate with the neurophysiological underpinnings of dopaminergic motivational and reward systems (Beaver et al., 2006; Netter et al., 1996). Strong test-retest reliability has been established for the SSSV with $r = .80$, N = 153 (Zuckerman, 2002). Cronbach's Alpha values have also been established cross-culturally in male American, Spanish, Chinese and Japanese samples ($\alpha = .77, .76, .83$ and $.77$ respectively); with similar values found in equivalent female samples (Zuckerman, 2002). Score distribution on the SSS-V has also been found to be comparable in different samples of high risk-taking adolescents, indicating good reliability (Cservenka et al. 2013). A shortened ten-item form of the SSS-V was used in this study (see Appendix D). This was found to have an equivalent factor structure as the original, across four languages (Aluja et al., 2006). Similar alpha reliability coefficients were found between the original and shortened version. Furthermore, a high correlation was found between scores on the original and shortened form of the SSS-V with $r = 0.87$, N = 4621 (Aluja et al., 2006). The shortened form of the SSSV has also been found to be equivalent across pencil-and-paper and online test formats (Aluja, et al., 2006).

Dream recall frequency. Schredl's (2004) dream recall scale (see Appendix F) was used to assess dream frequency. Pearson correlation scores for test-retest reliability on this scale were high, $r = .85$, $p < .0001$ (N = 198). There was also no significant difference between the means in the test and retest conditions, t_1: $M = 1.67$, t_2: $M = 1.62$. Additionally, the time interval between the first and second test did not impact the test-retest correlation scores significantly, indicating that dream recall is a fairly stable trait. However, single-probe measures of dreaming are less sensitive to variations in personality traits than scales that include broader phenomenological aspects of dreaming (Yu, 2012).

Dream vividness. The Dream Intensity Scale (DIS; Yu, 2010) was used to further measure the subjective experience of dream frequency, while also accounting for dream intensity. The DIS consists of four primary subscales: Dream Quantity, Dream Vividness, Diffusion and Altered Dream Episodes (see Appendix E). The subscales of Dream Quantity and Vividness were used in this study. The DIS was shown to have good internal consistency

for both dream Quantity and Vividness (α = .73 and .81). Dreaming has been proposed to influence affect regulation (Kramer, 1993). Emotional instability, such as neuroticism, has been strongly associated with aspects of dreaming (Cohen & Cox, 1975). Accordingly the Dream Quantity subscale was found to positively correlate with Neuroticism on the Eysenck Personality Questionnaire Revised-Short Form (Eysenck, Eysenck, & Barrett, 1985; Yu, 2010). While the Dream Vividness scale was found to positively correlate with extraversion on the Eysenck Personality Questionnaire Revised-Short Form (Yu, 2010). Thus, the DIS has good concurrent convergent validity.

Procedure

Normative data relating to the variables under study was collected via an online survey platform. This was distributed to the undergraduate students in the Department of Psychology at UCT by placing an advertisement on the University's online administrative platform Vula. The aim of the study was revealed in the advertisement to students (Appendix G), however, the importance of dreaming was not emphasized. Research has shown that this often produces a bias in post-hoc reporting of dream frequency (Schredl, Ciric, Gotz & Wittman, 2003). Consequently, it was stressed that the focus of the study is sleep and personality, rather than dreaming and personality. Likewise, to avoid additional bias, it was not revealed that the personality variables under study were of a motivational and reward-seeking nature. All instructions, including details pertaining to informed consent, were part of the questionnaire itself.

Participants in the final sample were contacted via email four months after their initial participation and asked to again complete the Schredl Recall Scale test. This was to validate the test-retest reliability found by Schredl (2002). This was completed in an online survey identical to the one previously used. Participants agreed to be contacted, via email or telephone, for further assessment on the initial survey. They were not obligated to participate and were awarded course credits for completing the follow up questionnaire.

Ethical considerations

Ethics approval was granted for this study by the Psychology Department's Research ethics committee at UCT on 10 April 2013, reference number PSY2013 - 005 (see Appendix I). In order to ensure that informed consent was obtained, participants were not allowed past the informed consent page without first having given consent to participate in the study. Participants were free to withdraw from the study at any time; however, participants were not

eligible to receive course credits for incomplete questionnaires. Respondents were able to complete the survey at their convenience, and participation in the study was voluntary (see Appendices G and H).

There are no risks associated with the administration of questionnaires. Any student who was identified as having either undiagnosed depression or a potential undiagnosed sleep disorder (PSQI > 5) was contacted via email and referred to the UCT Student Wellness Centre. Participants benefited from the study by gaining course credits. They were also advised to contact the researcher after completion of the project if they wanted to know more about the aims of the study.

Data Analysis

Data management and scoring. The data was compiled using an online survey platform. It was then exported into an MSExcel database. The raw scores from this file were coded into IBM SPSS Statistics software package (Version 21) for statistical analysis.

Statistical Analysis. Hypothesis testing was used to test whether a relationship exists between mesolimbic-mesocortical activity and aspects of dreaming. Two hypotheses were specifically tested. Firstly, that motivational aspects of personality and reward processing significantly predict variation in dream frequency. Secondly, that motivational aspects of personality and reward processing significantly predict variation in dream vividness.

A multivariate analysis best suited the aim of determining the extent of a naturalistic relationship between the variables. Next, a hierarchical linear multiple regression analysis (MRA) was conducted. A hierarchical regression was chosen on the basis that it allowed differences in sex on the predictor and outcome variables to be assessed.

Predictor and Outcome Variables. For both hypotheses the predictor variables were as follows: (1) scores on BAS - Fun Seeking subscale, (2) Scores on BAS – Reward Responsiveness subscale, (3) scores on BAS – Drive subscale, and (4) Scores on the SSS-V. These were selected due to their association with ML-MC activity.

The outcome variables were as follows: (1) Dream Frequency and (2) Dream Vividness. Dream Frequencyy was determined by combing the individual scores on the Schredl Dream Recall Scale and the DIS Dream Quantity subscale. Z-tests were used to transform individual scores on each scale into Z-scores (Z_{calc}). These were averaged to ensure that the different metrics of each scale was accounted for. The Z_{calc} scores where then added together to form the composite Dream Frequency variable. Dream Vividness was determined by the scores on the DIS Dream Vividness subscale.

The scales underpinning dream frequency and vividness were determined from the results of a Principle Component Analysis (PCA). The PCA included the Schredl Dream Recall Scale, the DIS Dream Quantity subscale and the DIS Dream Vividness subscale. This was conducted to ensure that the theoretically associated scales of recall and quantity loaded on one component. To warrant testing the second hypothesis it was also necessary to determine that vividness differentiated from frequency and loaded on a second factor.

Sex was also used as a predictor variable for both outcome variables. Sex differences have been found to significantly influence aspects of dreaming as measured by questionnaires (Schredl & Reinhard, 2008). Women have been reported to significantly recall more dreams than men, $z = 2.5$ $p < .001$ (Schredl, 2002). Women were also found to rate their dreams as significantly more intense, $z = 3.0$, $p < .001$. A meta-anlaysis of sex differences showed small-to-moderate effect sizes, with the range for ages > 18 being 0.242 and 0.270 (Schredl & Reinhard, 2008; Grissom & Kim, 2005). Given that sex differences have previously been explained as being due to measurement technique (e.g. Schredl, 2002); it was necessary to use sex as a predictor to ascertain whether sex differences might influence the study's results.

Descriptive statistics. Descriptive statistics were compiled on both the predictor and outcome variables. This included the mean and standard deviation of the data. This was to check for non-zero variance. It also allowed for meaningful interpretation of the inferential statistics.

Inferential statistics. A principle component analysis (PCA) with Varimax rotation was run using the following variables: Schredl Dream Recall Scale, DIS Dream Quantity and DIS Dream Vividness. This was conducted to verify two assumptions: (1) That the Schredl scale and the DIS Dream Quantity scale are similarly measuring dream frequency, and (2) that DIS Dream Vividness is measuring an aspect of dreaming other than frequency. These assumptions arose from the literature. Dream frequency and vividness are posited as two different aspects of dreaming (Schredl, 2002; Yu, 2010). The PCA was set to extract components with an eigenvalue > 1 as prescribed (Field, 2009).

Two separate MRAs were run using the predictor variables and each of the outcome variables. Sex was also included in the model as a first step. The remaining predictors were all entered together in a second step. The MRA was then run again with only the significant predictors remaining ($p < .05$). This was for parsimony and to maximise power.

To test the first hypothesis, a MRA was run using the predictor variables and the outcome variable of Dream Frequency. Only one of the predictors in the model significantly

predicted Dream Frequency. This resulted in the MRA being run a second time with only the predictor BAS – Reward Responsiveness entered.

To test the second hypothesis, a MRA was run using all the predictors and the outcome variable of Dream Vividness. Following the aforementioned reasoning, the MRA was run until only significant predictors remained in the model.

Analysis of residuals was conducted for both models. This was to check for non-normality or heteroscedasticity. Diagnostics were also run on any outliers using Cook's and Mahalanobis distances. Outliers were determined as lying 2 standard deviations outside of the mean.

To determine the test-retest reliability of the Schredl Recall Scale, a two-tailed Pearson correlation was run on scores collected four months apart. A paired-samples t-test was also run on time 1 and time 2 scores. This was to validate that the scale had similar reliability to that found by Schredl (2002).

Results

Sample Characteristics

The descriptive statistics for the sample are seen in Table 1. The initial sample size was N=639. Of this 68% met the exclusion criteria (N=432). After exclusion, the final sample included healthy participants with good sleep quality, N=207. There were disproportionately more females N=161 (77.8%) than males N=46 (22.2%). Age ranged from 16 to 39 years old (M = 19, SD = 2.37).

Principle component analysis to validate outcome variables

The correlation matrix indicated that Dream Vividness had correlations of r = .14 and .36 with the Schredl and Dream Quantity scale respectively. Whilst the Schredl and the Dream Quantity Scale had a correlation of r = .53. Diagnostics revealed that the sample was of adequate size and suitable for a Principle Components Analysis (PCA). The Kaiser-Meyer-Olkin measure was .527. Bartlett's Test of Sphericity was significant, $p < .0001$. The anti-image correlations were above the recommend minimum of .5, indicating the matrix was psychometrically sound (Dziuban & Shirkey, 1974)

Initially, the PCA extracted a single component. This component explained 57.1% of the overall variance. I chose to run a second PCA extracting 2 components for three reasons: 1) the scree plot indicated that a two component solution may be viable; 2) the second

component explained an additional 28.9% of variance, 3) dream vividness only loaded .35 on the first component.

The two component solution collectively explained 86.03% of the overall variance. Dream Quantity and Dream Recall loaded .92 and .79 on Component 1, respectively, and Dream Vividness loaded .97 on Component 2. This verifies the assumptions stated above. Namely that the Schredl scale and the DIS Dream Quantity scale are both measuring dream frequency, and that DIS Dream Vividness is measuring an aspect of dreaming other than frequency .The first component was termed *Dream Frequency*. The second component was termed *Dream Vividness*.

Hypothesis 1

The hypothesis that Dream Frequency is significantly predicted by the variables BAS–Reward Responsiveness, BAS – Fun Seeking, BAS–Drive and SSS-V was partially supported. Table 2 shows correlations between all of these predictor variables and the Dream Frequency composite measure. The largest significant correlation found between Dream Frequency and the predictor variables was for BAS-Reward Responsiveness ($p = .009$). The first hierarchical regression analysis using all the predictor variables was not significant, $F(5,201) = 1.526$, $p = .183$. The coefficients are seen in Table 3.

A second model was run with Reward Responsiveness as the only predictor. Reward Responsiveness was retained as it was the only significant predictor, as seen from inspection of the B values in Table 3. The second model was significant $F(1,205) = 5.609$, $p = .019$. The effect for Reward Responsiveness was small with $R^2 = .027$. Model diagnostics showed no problems with heteroscedascity, undue influence of outliers or issues of multicollinearity (see Appendix I).

Table 1
Descriptive Statistics: Psychometric Measures of MC-ML Activity

	Minimum	Maximum	Mean	SD
Dream Frequency	-4.42	4.27	0.0	1.75
Dream Vividness	1.00	20.00	10.64	3.67
BAS-Drive	4.00	16.00	11.02	2.22
BAS-Fun Seeking	6.00	16.00	12.10	2.09
BAS-Reward Responsiveness	13.00	20.00	17.79	1.70
SSS-V	0.00	9.00	4.31	2.24

Table 2
Bivariate Correlations Between Predictor Variables and Dream Frequency(N= 207)

	1	2	3	4	5	6
Dream Frequency	-					
Sex	.081	-				
BAS-Drive	.040	-.101	-			
BAS-Fun Seeking	-.007	-.016	.376***	-		
BAS Reward-Responsiveness	.163**	-.039	.399***	.192**	-	
SSS-V	-.030	.117*	.251***	.659***	.045	-

*$p < .05$. **$p < .01$. ***$p < .001$.

Table 3
Dream Frequency: First Hierarchical Regression Model Testing Hypothesis 1 (N = 207)

					95% C.I		
	B	*β*	*t*	*p*	Lower	Upper	Semi-partial
Step 1							
Constant	-0.41 (.378)		-1.095	.275	-1.158	0.331	
Sex	0.34 (.292)	0.08	1.157	.249	-0.238	0.915	0.81
Step 2							
Constant	-3.33 (1.433)		-2.326	.021*	-6.160	-0.508	
Sex	0.38 (.297)	0.09	1.292	.198	-0.202	0.969	0.089
BAS-Drive	0.00 (.47)	-0.01	-3.20	.949	-0.129	0.121	-0.004
BAS-Fun Seeking	-0.01 (.09)	-0.01	-4.08	.922	-0.168	0.152	-0.007
BAS-Reward Responsiveness	0.18 (.32)	0.17	2.87	.025*	0.023	0.330	0.157
SSS-V	-0.03 (.073)	-0.04	-0.041	.665	-0.177	0.113	-0030

Note. R^2 for step 1 = .006; ΔR^2 for step 2 = .030 (p = .184); overall R^2 = .037; overall adjusted R^2 =.13; Standard deviations are shown in parenthesis.
*p < .05. **p < .01. ***p < .001.

Table 4
Dream Frequency: Second Hierarchical Regression Model Testing Hypothesis 1 (N = 207)

					95% C.I		
	B	*β*	*t*	*p*	Lower	Upper	Semi-partial
Step 1							
Constant	-2.975 (1.262)		-2.358	.019*	-5.464	-0.487	
BAS-Reward Responsiveness	0.167 (.071)	0.163	2.368	.019*	0.28	0.9306	0.163

Note. R^2 = .027; adjusted R^2 =.022; Standard deviations are shown in parenthesis.
*p < .05. **p < .01. ***p < .001.

Hypothesis 2

The hypothesis that Dream Vividness is significantly predicted by the variables BAS–Reward Responsiveness, BAS – Fun Seeking, BAS – Drive and SSSV was not confirmed. The overall model was not significant, $F(5,201) = 1.138$, $p = .239$. None of the predictors were significant, as seen in Table 5. SSS-V had the largest β value and was nearly significant at the 10% level.

Model diagnostics showed no problems with heteroscedascity, undue influence of outliers or issues of multicollinearity (see Appendix J).

Table 5
Dream Vividness: Hierarchical Regression Model Testing Hypothesis 2 (N = 207)

					95% C.I		
	B	*β*	*t*	*p*	Lower	Upper	Semi-partial
Step 1							
Constant	9.842 (.793)		12.409	.000*	8.278	11.405	
Sex	0.655 (.614)	0.074	1.067	.287	-0.556	1.867	0.074
Step 2							
Constant	6.546 (3.016)		2.171	.031*	0.599	12.492	
Sex	0.496 (.625)	0.056	0.795	.428	-0.735	1.728	0.055
BAS-Drive	-0.057 (.133)	-0.034	-0.425	.671	-0.320	0.206	-0.029
BAS-Fun Seeking	0.016 (.171)	0.009	0.096	.924	-0.320	0.353	0.007
BAS-Reward Responsiveness	0.160 (.164)	0.75	0.978	.329	0.163	0.484	0.068
SSS-V	0.246 (.154)	0.150	1.594	.113	-0.058	0.551	0.111

Note. R^2 for step 1 = .006; ΔR^2 for step 2 = .027 (p = .228); overall R^2 = .033; overall adjusted R^2 =.009; Standard deviations are shown in parenthesis.
*p < .05. **p < .01. ***p < .001.

Schredl Recall scale reliability

Test-Retest reliability was conducted on the Schredl Recall scale (N=46). The mean scores for Time 1 and Time 2 were M= 3.76 and M = 3.50 respectively. The Pearson two-tailed correlation between scores on t_1 and scores on t_2 was r= .41, p = .005. The paired-samples t-test revealed no significant change between the means, t(45) = 1.089, p = .282.

Discussion

This study aimed to ascertain whether a link exists between reward processing, motivational aspects of behaviour and dreaming. Dream genesis has been closely linked to activation in the dopaminergic ML-MC system. This system is also conceptualised as the SEEKING system and accordingly mediates reward processing and appetitive aspects of behaviour. With this in mind it was hypothesised that SEEKING behaviours may influence dream frequency and vivacity. The results of this study support the first hypothesis. BAS-Reward Responsiveness was found to be a significant predictor of Dream Frequency. However, none of the personality variables under study were found to predict Dream Vividness. To account for the disparity between these results a thorough exposition is necessary regarding how these findings fit within the overall literature. Thus, this discussion will focus predominantly on two areas. The first concerns how one can make meaning out of the significant result of this study. The second will focus on how the non-significant results of this study can be accounted for and tolerated within the general ambit of this research project.

Reward Responsiveness Predicts Dream Frequency

The Reward Responsiveness subscale of the BIS/BAS was found to be a significant predictor of Dream Frequency. An example of an item on this scale is: ‘when I get something I want I feel excited and energised’ (Carver & White, 1994). Due to the novel aim of this study, comparative studies with which to place this finding are scarce. However, this result does corroborate with theoretically related results found by Yu (2012), in which scores on the DIS Dream Quantity subscale were positively correlated with scores on the Openness scale of the NEO-Five Factor Inventory (NEO-FFI). This correlation was similarly small, r = .096, p < .01 (N = 611), to that found in the present study between BAS-Reward Responsiveness and Dream Frequency. The Openness scale of the Neo–FFI is said to represent six facets, five of which are internal types of experience seeking (Aluja, Garcia & Garcia., 2003). The remaining facet, termed Action, is said to represent an external type of experience seeking. Evidence for which is that Openness has been found to be highly correlated with the

Sensation Seeking scale (SSS-V) of the ZKPQ used in this study (Zuckerman, 2004). Scores on the SSS-V were used in this study as an index of ML-MC SEEKING activity. With that in mind this study found that SSS-V was not a significant predictor of Dream Frequency. However, this is not surprising given the weak correlation between Openness and the DIS Dream Quantity subscale reported by Yu (2012).

How then might one understand the significant finding in this study? One possibility is that reward processing during sleep is implicated in dream genesis. This may primarily be a result of differences between tonic and phasic dopamine signalling across sleep stages. Whilst phasic activity is related to burst firing and a brief increase (up to two seconds) of dopamine, tonic activity is defined as a relatively slow charge lasting up to 10 seconds (Ikemoto, 2007). These differences in dopaminergic signalling have behavioural implications. Phasic activity is primarily involved in reward processing (Schultz, 2010). On the other hand, tonic signalling in the ML-MC system supports relatively stable traits such as motivation and affect regulation (Ikemoto, 2007). The argument can be made that if there is a distinction between phasic/tonic activity across the sleep stages, then this may explicate why reward processing and not motivation predicted dream frequency.

An initial line of support for this is that dreaming predominantly occurs during REM (Rechtschaffen, 1973). In addition to this, reward related regions in the ML-MC system (such as the ventral tegmental area and nucleus accumbens) are highly active during REM sleep (Perogamvros & Schwarz, 2012). As burst firing takes place in these reward critical areas during REM sleep and that dopamine is involved in dream genesis, it stands to reason that there is a link between phasic activity and dream frequency. This is additionally supported by the role of phasic activity in the generation and maintenance of REM sleep. Increased dopaminergic activity has been found to initiate longer and more dream prolific REM sleep (Perogamvros & Schwartz, 2012). Recent findings have also linked increased dopaminergic activity with reward sensitivity (Cservenska et al., 2013). As a result, this study may tentatively support the related link between reward sensitivity and dream frequency.

The corollary of this may explain why motivational aspects of personality are not predictive of dream frequency. Activity in the ML-MC system during Non-REM (NREM) sleep has been linked to tonic dopamine release (Floresco et al., 2012). As tonic activity is linked to motivational and stable affective traits, it may be that NREM sleep is more reflective of motivational processes. This may explain why BAS-Reward Responsiveness was found to be significant, whilst motivational predictors such as BAS-Drive were not. This is supported in the following: Firstly, dopaminergic activity is greater during REM than

NREM periods (Gottessman, 2005); and secondly, dreaming is more frequent during REM (Schredl, 2002). Thus, individual motivational differences may not produce the requisite neurophysiological changes to significantly influence dream frequency. However, this still leaves it open as to why neither reward processing nor motivational aspects of personality were found to be predictive of Dream Vividness.

SEEKING as Indeterminate of Vividness

This study found that neither the BAS scale nor the SSS-V significantly predicted Dream Vividness. One explanation for this could be that vivacity utilises different neurological structures than those involved in dream frequency. Research shows that the hippocampus and amygdala are directly related to the qualitative aspects of dreaming (De Gennaro et al., 2012). Between-subject studies of microstructural differences in these areas found qualitative effects on dreaming, with no relationship to quantitative aspects (such as frequency) of dreaming (Maquet et al, 1996). Similarly, inter-individual differences of activity in the hippocampal-amygdala complex found using PET had no correlation to the frequency of dream recall (De Gennaro et al., 2012). This finding is further substantiated by the results of another study that found no volumetric or structural differences in these two areas between high and low frequency dreamers (De Gennaro et al., 2011).

The positive relationship between the amygdala and the phenomenological aspects of dreaming is not surprising. The amygdala has been found to be critically involved in the processing of the emotional sources of dreaming (Hobson et al., 2000). These affective components are thought to form a large part of dream content (Perogamvros and Schwartz, 2012). Thus, as it is apparent that there are different neurophysiological correlates influencing the quantitative and qualitative aspects of dreaming. It may also be that these areas process avoidance and not SEEKING behaviours. This is in accordance with one proposed function of dreaming put forward by Revonsuo (2000). This is termed the *Threat Simulation Theory* (TST) and posits that dreaming serves the biological function of simulating threats. According to the TST, dreaming provides a safe environment for the rehearsal of threat recognition and avoidance.

It is important to note that this theory first-and-foremost conceptualises dreaming as serving an evolutionary function. Evolution privileged dreaming as it provided an adaptive advantage which endowed certain individuals with a greater capacity for harm appreciation and avoidance. Concerning TST the results of this study are not untenable. If dreaming fulfils a functional role of threat avoidance it stands to reason that the conditioning of aversive

stimuli is part of this process. This is supported by the aforementioned role of the amygdala and hippocampus in memory consolidation and learning (De Gennaro et al., 2013). Furthermore, the amygdala has been found to play a critical role in fear conditioning and avoidance behaviours (LeDoux, Cicchetti, Xagoraris & Romanski, 1990). Thus, this may account for why SEEKING behaviours measured in this study do not significantly predict Dream Vividness. As TST emanates from an evolutionary perspective it is likely that an archetypal psycho-behavioural system akin to SEEKING is involved. The FEAR circuit posited by Panksepp (1998) suitably fits what may be the neurophysiological basis of TST. This circuit predominantly involves connection between the amygdala and periaqueductal grey. Other areas of involvement include the anterior and medial hypothalamus. As such, FEAR activation is congruent with both the evolutionary perspective of TST and the neurophysiological sites involved in the qualitative aspects of dreaming. The FEAR system is also primarily involved with avoidance behaviours that lie anathema to the personality traits under focus in this study. It is plausible then that the FEAR and not SEEKING system is implicated in mediating the vivacity of dreams. Whilst this explanation may be alluring in describing the non-significant results of this study that pertain to Dream Vividness, it is inherently flawed. This is evident from two findings. The first pertains to the incoherence of the TST, whilst the second deals with the inextricable link between dopaminergic activity and dream vividness.

The TST rests primarily on two premises. The first is that it is an evolutionary theory positing an adaptive function of dreaming. The second is that dream content predominantly involves threatening situations and negative emotions (Renvonsuo, 2000). Both of these premises however lack empirical support. Currently there is no evidence that the rehearsal of threats during dreaming improves threat avoidance or appreciation in waking life (Malcom-Smith, Solms, Turnbull & Tredoux, 2008). Furthermore, in some instances the opposite appears to be true. Increases in threatening dreams have been associated with elevated anxiety symptoms and reduced coping strategies (Delorme, Lortie-Lussier & Konnick, 2002; Punamaki, 1997). Thus, dream rehearsal appears not to mitigate any of the psychological consequences of threatening situations. Empirical evidence likewise is lacking for the prevalence of threatening themes in everyday dreams (Malcom-Smith & Solms, 2004). As already mentioned, amygdala-hippocampal activation occurs during NREM sleep as a result of tonic dopamingergic activity (Floresco et al., 2003). This overrides sustained activation of FEAR circuitry which involves excitatory amino acids not related to dream genesis (Panksepp, 1998; 2005).

Furthermore, reward-related components of the ML-MC, which include the hippocampal formation, elicit sustained activation across the sleep stages (Smith et al., 2004). It also is clear that increased dopamine does lead to more intense, bizarre and vivid dreams. Evidence for which is found in a study conducted by Hartmann et al. (1980). This involved 13 subjects who were awakened and administered either L-dopa or a placebo before going back to sleep. The L-dopa group reported significantly more vivid and emotional dream reports compared to the placebo group ($p < .01$). Therefore, even though activity is neurophysiologically differentiated within the ML-MC system in relation to qualitative aspects of dreaming, these aspects are still dopamine driven. A more probable explanation then for why no significant predictors of vividness were found may be due to methodological and not theoretical issues. This intimates a key limitation of this study: the use of pencil-and-paper surveys as a proxy for ML-MC activity.

Indirect Inference: Both Limiting and Encouraging

This study utilised scores on personality measures as an index of activity in the ML-MC system. Though these measures have been reported to correlate with high density imaging studies (such as fMRI and PET) they are still only an indirect assessment of neurophysiological activity. This in of itself is problematic. This is further compounded by the ambiguity throughout the literature concerning the definition of the traits these scales purport to measure. Common agreement is found at a neurochemical level, with dopamine being primarily involved with reward processing and motivation (Berridge, 2006; Panksepp 1998). However, whether dopamine plays a causal role in these behaviours has for some time been met with confusion. This study adopted an affective neuroscience perspective to dopaminergic activity, positing that dopamine provides the psychical impetus for appetitive behaviours. This position has enjoyed a large amount of support in both human and non-human animal studies (Haber & Knutson, 2010; Leyton, Casey, Delaney, Kolivakis & Benkelfat, 2005; Panksepp, 1998). However, an important distinction is still not appreciated when discussing dopamine and reward processing. This being that ML-MC dopaminergic activation is associated with ‘wanting’ and not ‘liking’.

Liking vs. Wanting

This distinction can be best understood when phrased as a question of dopamine functioning. Is it that dopamine mediates the hedonic impact of rewards (liking)? Or does dopamine drive goal directed behaviours by attributing incentive salience to reward-related

stimuli (wanting)? This phraseology was first used by Robinson & Berridge (1993) in discussing the neural basis of drug craving. A number of theories have since attempted to provide evidence for either of these questions. However, it appears that the empirical evidence overwhelming supports the notion of ML-MC dopaminergic activity being implicated in wanting (for a review see Berridge, 2007).

Two lines of evidence support this view. The first involves a study of Parkinson's disease (PD) patients. As previously stated, PD involves severe ML-MC system abnormalities (Dzirasa eta l., 2006). If dopamine is involved with mediating hedonic responses then the opposite should also be true; that deficits should lead to an inability to experience pleasure (anhedonia). However, PD patients do not experience anehdonia and have been found not to significantly rate pleasurable experiences differently from controls (Sienkiewicz-Jarosz et al., 2005). Furthermore, PD patients have also been known to request extra medication without cause even if the drugs induce unpleasant side effects (Berridge, 2007). The second line of evidence comes from a study in which dopamine depletion and the self-administration of cocaine (a ML-MC stimulant) were used (Leyton et al, 2005). This yielded interesting results, where dopamine depletion was found to supress subjective ratings of wanting to take more cocaine whilst having no effect on ratings of pleasure elicited by the narcotic. While there is a lack of evidence for ML-MC activity being related to liking, there is empirical support for the role of mediating 'wanting'.

Studies conducted on rats have further linked ML-MC activity to wanting. When provided with the means to stimulate this area, rats will self-stimulate for prolonged periods until physically exhausted or incapacitated (Panksepp, 1998). The behaviour elicited is one where the rat appears to want something behind the self-stimulation apparatus, and is differentiated from behaviour elicited during reward consumption. In conjunction with the previous studies on dopamine depletion these findings iterate that ML-MC activity is both necessary and sufficient for wanting (or SEEKING) and not 'liking'.

This bares significant consequence on the interpretation of the psychometric measures (such as the BIS/BAS) in this study. This may help elucidate the non-significant results of this study in light of such a strong theoretical link between ML-MC activation, SEEKING behaviours and dreaming.

Limitations of the BIS/BAS in assessing liking

Though this study found that BAS-Reward Responsiveness was a significant predictor of dream frequency, an important caveat may already be apparent to the reader. This is the

fact that ML-MC SEEKING activity and not 'liking' is the impetus for dream generation (Perogamvros & Schwartz, 2012). Another consideration is that opioid and not dopamine activation has been found in the ML-MC circuit, specifically the nucleus accumbens, to amplify 'liking' reactions (Peciña & Berridge, 2005). It is important then to discern the link between BAS-Reward Responsiveness, ML-MC activation and the 'liking'/'wanting' distinction. The BAS-Reward Responsiveness was originally conceptualised to 'focus on positive responses to the occurrence or anticipation of reward' (Carver & White, 1994, p. 32). This conception bares an ostensible similarity to that of 'liking'.

This is unfortunate in light of this study's findings, as it contradicts the notion that dopaminergic SEEKING activity stimulates dreaming. However, an alternate explanation may be that BAS-Reward Responsiveness in fact measures 'wanting'. Evidence for this can be seen in the items themselves such as, 'it would excite me to win a contest' (see Appendix C). Though this item represents a rewarding situation it is not implausible that it can be interpreted as 'I would want to win a contest'. Whether this item is interpreted in a 'liking' or 'wanting' sense could be contingent on the level of introspection the participant takes at the time of responding (Woodside, 2004). If the participant places themselves in the first-person, at the receiving end of winning the contest, then a 'liking' response may be evoked. However, if a third-person perspective is taken, such as thinking that it would be exciting to win a contest generally, then a 'wanting' response may be evoked.

The introspective capabilities of participants may thus influence whether a SEEKING or liking response is generated. The significant result may be due to items being interpreted without adequate introspection and thus favouring the SEEKING interpretation. This is supported by research indicating that university students fail to exercise adequate self-awareness in survey responses (Woodside, 2004). It also may explain why the test-retest reliability of the Schredl Recall Scale found in this study was lower than that originally found by Schredl (2002). Participants may have at one time engage sufficiently with the questionnaire, while not at another. This is made more plausible in so far as participation is somewhat coerced in this study. Though participation was voluntary, it was still required to accrue university course credits and so this may result in flippant or inconsistent responses.

Another limitation facing the BIS/BAS (and other psychometric measures) is that the 'liking'/'wanting' distinction may not be accounted for in item selection. Carver & White (1994) admittedly state that item selection for the BAS was liberal due to the lack of consensus "about how exactly BAS sensitivity is likely to manifest" (p. 322). Thus, while three subscales were originally posited, items specific to 'wanting' may be spread across

them. Evidence for this can be seen in a recent study that found a two factor solution to be preferred (Simon et al., 2010). This study specifically looked at 'liking' vs. 'wanting' tasks. Significant activity in the ML-MC circuit was linked to BAS scores on 'wanting' tasks using fMRI. It is evident then that the BAS scale does generally tap SEEKING activity, though this may be weakened by the lack of a distinction between SEEKING and 'liking'. While this may be a limitation, it may also be encouraging with regard to the significant result found in this study.

Encouraging aspects of indirect inference

The drawbacks of using psychometric measures to index ML-MC activity also have an implicit advantage. This is due in part to the complexity inherent in measuring personality traits and the nature of indirect inference. Dream research also involves a number of obstacles, particularly when it is undertaken from a nomothetic perspective. This is due to it being a subjective state occurring at a specific time and under certain conditions. With regard to this study, one obstacle was the complexity of the variables under investigation. Furthermore, the relationship between the independent and dependent variable was assessed indirectly using psychometric scores of waking behaviour. A considerable amount of noise is to be expected between these instruments and the SEEKING construct central to this study. In addition to this, there is the possibility of an inverse relationship between affective states and aspects of dreaming. One example is sleep deprivation (SD). Healthy subjects after SD have been found to have reduced negative affect in response to loss (Venkatraman, Chuah, Huettal & Chee, 2007). This inverse relationship runs counter to the general expectation that SD results in worse cognitive and affective functioning (Pilcher & Walters, 1997)

With this in mind, the result of a significant relationship between BAS-Reward Processing and dream frequency is not negligible. This may also explain why such a small effect size was found even though the relationship was definitively significant. The result of a non-random link between a measure of SEEKING behaviour and dream frequency is particularly interesting. Currently there is no a priori reason, apart for the one provided in this study, to account for this relationship.

Conclusion

This study is the first empirical investigation of dreaming in relation to reward processing and motivational aspects of behaviour. The results of which substantiate the claim that ML-MC SEEKING activity is involved in dreaming. Scores on the BAS-Reward

Responsiveness subscale were found to significantly predict variation in dream frequency. Whilst only a small effect size was found for this relationship, this finding is still pertinent as ML-MC activation was indirectly measured using psychometric measures as proxies. Furthermore, the non-significant results of this study can be ameliorated in light of these methodological issues. The implications of this finding are similarly germane. To date, research has focussed on the role of dopamine in dreaming and SEEKING. However, though these two areas are theoretically linked, there has been no attempt to converge these two research areas. The finding of a significant relationship between SEEKING behaviours and dreaming is thus both novel and in line with current theories of dream genesis. In providing a fledgling empirical basis for this relationship, this study will hopefully generate the impetus for further research into ML-MC SEEKING activity and dreaming.

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APPENDIX A

The Pittsburgh Sleep Quality Index

The following questions relate to your usual sleep habits during the past month *only*. Your answers should indicate the most accurate reply for the *majority* of days and nights in the past month.

Please answer all questions

1. During the past month, when have you usually gone to bed at night?

USUAL BED TIME _____

2. During the past month, how long (in minutes) has it usually take you to fall asleep each night

NUMBER OF MINUTES _____

3. During the past month, when have you usually gotten up in the morning?

USUAL GETTING UP TIME _____

4. During the past month, how many hours of actual sleep did you get at night (This may be different than the number of hours you spend in bed.)

HOURS OF SLEEP PER NIGHT _____

For each of the remaining questions, check the one best response. Please answer *all* questions.

5. During the past month, how often have you had trouble sleeping because you...

(a) Cannot get to sleep within 30 minutes

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(b) Wake up in the middle of the night or early morning

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(c) Have to get up to use the bathroom

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(d) Cannot breathe comfortably

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(e) Cough or snore loudly

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(f) Feel too cold

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(g) Feel too hot

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(h) Had bad dreams

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(i) Have pain

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(j) Other reason(s), please describe

_____

_____

_____

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

6. During the past month, how would you rate your sleep quality overall?

Very good_____
Fairly good_____
Fairly bad _____
Very bad_____

7. During the past month, how often have you take medicine (prescribed or "over the counter") to help you sleep?

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?

No problem at all _____
Only a slight problem ____
Somewhat of a problem ____
A very big problem ____

10. Do you have a bed partner or roommate

No bed partner or roommate ____
Partner/roommate in other room ____
Partner in same room, but not same bed ____

Partner in same bed ____

If you have a roommate or bed partner, ask him/her how often in the past month you have had...

(a) Loud snoring

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(b) long pauses between breaths while asleep

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(c) Legs twitching or jerking while you sleep

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(d) Episodes of disorientation or confusion during sleep

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

(e) Other restlessness while you sleep; please describe_____
_____
_____

Not during the past month ___	Less than once a week ___	Once or twice a week ___	Three or more times a week ___

APPENDIX B

General Medical Questionnaire

1) Are you right-handed?
- Yes
- No
2) Do you take any kind of medication on a regular basis?
- Yes
- No
3) If so, please specify what kind.

_____

4) Do you smoke cigarettes?
- Yes
- No
5) If no, do you ever smoke occasionally?

_____

6) Have you ever had a head injury?
- Yes
- No

7) If yes, describe the most sever one

_____

8) Any surgery/hospitalisation as a result of your head injury?
- Yes
- No

9) If yes, please specify

_____

10) Have you ever been diagnosed with asthma?
- Yes
- No

11) Have you ever had seizrues or an epileptic fit?
- Yes
- No

12) Has anyone in your immediate family (siblings, parents) ever been diagnosed with epilepsy?

13) If yes, please specify who.

_____

14) Have you ever been diagnosed with a psychiatric illness?

- Yes
- No

15) If yes, please specify.

_____

16) Have you ever had any neurological condition?

- Yes
- No

17) If yes, please specify.

_____

18) Have you ever been diagnosed with a sleep disorder?

- Yes
- No

19) If there are any other details about your medical history, that you have not mentioned yet, please add them here.

_____

20) Do you acknowledge that all of the details (e.g. age & medical details) given to the researcher by you are correct?

- Yes
- No

APPENDIX C

The Behavioural Inhibition System/ Behavioural Approach System questionnaire

Each item in this questionnaire is a statement that a person may either agree or disagree with. For each item, indicate how much you agree or disagree with what the item says. Please respond to all the items; do not leave any blank. Choose only one response to each statement. Please be as accurate and honest as you can be. Respond to each item as if it were the only item. That is, don't worry about being "consistent" in your responses. Choose from the following four response options:

1 = very true for me
2 = somewhat true for me
3 = somewhat false for me
4 = very false for me

1. A person's family is the most important thing in life.
2. Even if something bad is about to happen to me, I rarely experience fear or nervousness.
3. I go out of my way to get things I want.
4. When I'm doing well at something I love to keep at it.
5. I'm always willing to try something new if I think it will be fun.
6. How I dress is important to me.
7. When I get something I want, I feel excited and energized.
8. Criticism or scolding hurts me quite a bit.
9. When I want something I usually go all-out to get it.
10. I will often do things for no other reason than that they might be fun.
11. It's hard for me to find the time to do things such as get a haircut.
12. If I see a chance to get something I want I move on it right away.
13. I feel pretty worried or upset when I think or know somebody is angry at me.
14. When I see an opportunity for something I like I get excited right away.
15. I often act on the spur of the moment.
16. If I think something unpleasant is going to happen I usually get pretty "worked up."
17. I often wonder why people act the way they do.
18. When good things happen to me, it affects me strongly.
19. I feel worried when I think I have done poorly at something important.
20. I crave excitement and new sensations.
21. When I go after something I use a "no holds barred" approach.
22. I have very few fears compared to my friends.
23. It would excite me to win a contest.
24. I worry about making mistakes.

APPENDIX D

Zuckerman–Kuhlman Personality Questionnaire (ZKPQ)

Sensation Seeking Scale Form V (SSS-V)

DIRECTIONS:

On the following pages you will find a series of statements that persons might use to describe themselves. Read each statement and decide whether or not it describes you. If you agree with a statement or decide that it describes you answer TRUE by crossing in T. If you disagree with a statement or feel that it is not descriptive of you, answer FALSE by crossing in F. Follow the next sample:

Items

1. I often feel nervous T F
2. I would like to go to the cinema T F

In marking your answers, be sure that the number of statements you have just read is the same as your number of answers. Please, try to answer every statement either True or False, and dont' think too much before answering. There are no good or bad answers, so any option is correct.

PLEASE, TRY TO ANSWER ALL THE STATEMENTS

I often do things on impulse.

I would like to take off on a trip with no preplanned or definite routes or timetables

I enjoy getting into new situations where you can´t predict how things will turn out

I sometimes like to do things that are a little frightening

I´ll try anything once

I like to wear myself out with hard work or exercise

I sometimes do "crazy" things just for fun

I prefer friends who are excitingly unpredictable

I often get so carried away by new and exciting things and ideas that I never think of possible complications

I like "wild" uninhibited parties

APPENDIX E

Dream Intensity Scale
In the following items, please circle the number that best applies.

1. Although some people may forget the details of their dreams after waking from sleep, they still retain a notion that they have dreamed. How often have you dreamed over the past year on average, irrespective of whether you remember the actual content of your dreams?
0. . . . . Never
1. . . . . Less than once a month
2. . . . . About once a month
3. . . . . Two to three times a month
4. . . . . About once a week
5. . . . . Several times a week
6. . . . . Almost every night

2. On average, how often have you been able to remember the main content of your dreams immediately after waking from sleep in the morning?
0. . . . . Never remember any main dream content
1. . . . . Remember main dream content less than once a month
2. . . . . Remember main dream content about once a month
3. . . . . Remember main dream content two to three times a month
4. . . . . Remember main dream content about once a week
5. . . . . Remember main dream content several times a week
6. . . . . Remember main dream content almost every morning

3. How often do you experience nightmares that are so frightening that they wake you up?
0. . . . . Never
1. . . . . Less than once a year
2. . . . . About once a year
3. . . . . About two to four times a year
4. . . . . About once a month
5. . . . . About two to three times a month
6. . . . . About once a week
7. . . . . Several times a week
8. . . . . Almost every night

4. Have you ever had two dreams or more in a single night?
0. . . . . Never
1. . . . . Less than once a year
2. . . . . About once a year
3. . . . . About two to four times a year
4. . . . . About once a month
5. . . . . About two to three times a month
6. . . . . About once a week
7. . . . . Several times a week
8. . . . . Almost every night

5. How often do you know during a dream that you are dreaming?

0. . . . . Never
1. . . . . Less than once a year
2. . . . . About once a year
3. . . . . About two to four times a year
4. . . . . About once a month
5. . . . . About two to three times a month
6. . . . . About once a week
7. . . . . Several times a week
8. . . . . Almost every night

6. Have you ever been able to control the contents of your dreams and make things happen in them at will?
0. . . . . Never
1. . . . . Less than once a year
2. . . . . About once a year
3. . . . . About two to four times a year
4. . . . . About once a month
5. . . . . About two to three times a month
6. . . . . About once a week
7. . . . . Several times a week
8. . . . . Almost every night

7. Have you ever experienced the following situation: Upon awakening from a dreaming sleep, you have the feeling that you "want to continue and reconnect with the dream." After attempting to return to the dreaming state, you actually, as you wished, reconnect with the dream.
0. . . . . Never
1. . . . . Less than once a year
2. . . . . About once a year
3. . . . . About two to four times a year
4. . . . . About once a month
5. . . . . About two to three times a month
6. . . . . About once a week
7. . . . . Several times a week
8. . . . . Almost every night

8. Have you ever experienced the following situation: You have had some dreams that make you "wish to dream them once again." Some days later, these dreams actually turn up again.
0. . . . . Never
1. . . . . Less than once a year
2. . . . . About once a year
3. . . . . About two to four times a year
4. . . . . About once a month
5. . . . . About two to three times a month
6. . . . . About once a week
7. . . . . Several times a week
8. . . . . Almost every night

9. Do you see colours in dreams?
0. . . . . Almost every dream of mine is colourless.

1. . . . . The majority of my dreams are colourless.
2. . . . . Both appear with similar frequency.
3. . . . . The majority of my dreams have colours.
4. . . . . Almost every dream of mine has colours.

10. Do you hear sounds in dreams?
0. . . . . Almost every dream of mine is soundless.
1. . . . . The majority of my dreams are soundless.
2. . . . . Both appear with similar frequency.
3. . . . . The majority of my dreams have sounds.
4. . . . . Almost every dream of mine has sounds.

11. Do you smell anything in dreams?
0. . . . . Almost every dream of mine is odourless.
1. . . . . The majority of my dreams are odourless.
2. . . . . Both appear with similar frequency.
3. . . . . The majority of my dreams have odours in them.
4. . . . . Almost every dream of mine has odours in it.

12. Do you taste anything in dreams?
0. . . . . Almost every dream of mine is tasteless.
1. . . . . The majority of my dreams are tasteless.
2. . . . . Both appear with similar frequency.
3. . . . . The majority of my dreams have tastes in them.
4. . . . . Almost every dream of mine has tastes in it.

13. Do you feel emotions in dreams?
0. . . . . I do not feel emotions in almost every one of my dreams.
1. . . . . I do not feel emotions in the majority of my dreams.
2. . . . . Both appear with similar frequency.
3. . . . . I feel emotions in the majority of my dreams.
4. . . . . I feel emotions in almost every one of my dreams.

14. Do you have in general more pleasant dreams, more unpleasant dreams, or do pleasant and unpleasant dreams appear with similar frequency?
0. . . . . Almost every one of my dreams is unpleasant.
1. . . . . The majority of my dreams are unpleasant.
2. . . . . Both appear with similar frequency.
3. . . . . The majority of my dreams are pleasant.
4. . . . . Almost every one of my dreams is pleasant.

15. In general, are your experiences in dreams coherent or narrative (for example, dream experiences similar to a fiction or a series of shows)?
0. . . . . It is untrue for almost every one of my dreams.
1. . . . . It is untrue for the majority of my dreams.
2. . . . . Both appear with similar frequency.
3. . . . . It is true for the majority of my dreams.
4. . . . . It is true for almost every one of my dreams.

16. Have several characters in the real world ever combined into a single one in your dreams?
0. . . . . This situation has almost never happened.
1. . . . . This situation has not happened in the majority of my dreams.
2. . . . . Both have occurred with similar frequency.
3. . . . . This situation has happened in the majority of my dreams.
4. . . . . This situation has happened in almost every one of my dreams.

17. Has a certain person in the real world ever been represented by another character in your dreams?
0. . . . . This situation has almost never happened.
1. . . . . This situation has not happened in the majority of my dreams.
2. . . . . Both have occurred with similar frequency.
3. . . . . This situation has happened in the majority of my dreams.
4. . . . . This situation has happened in almost every one of my dreams.

18. Has a certain person in the real world ever been represented by an animal in your dreams?
0. . . . . This situation has almost never happened.
1. . . . . This situation has not happened in the majority of my dreams.
2. . . . . Both have occurred with similar frequency.
3. . . . . This situation has happened in the majority of my dreams.
4. . . . . This situation has happened in almost every one of my dreams.

19. Have you experienced the following situation: You have memories that, upon reflection, feel as if they were of events that had actually happened in real life but you truly know that merely happened in dreams?
0. . . . . Never
1. . . . . Rarely
2. . . . . Sometimes
3. . . . . Frequently
4. . . . . Very Frequently

20. Have you ever experienced the following situation: You have memories that, upon reflection, you simply do not know whether they are of events that actually happened or were part of dreams?
0. . . . . Never
1. . . . . Rarely
2. . . . . Sometimes
3. . . . . Frequently
4. . . . . Very Frequently

APPENDIX F

Dream Recall Frequency Scale

How often have you recalled our dreams recently (in the past several months)?

Almost every morning

Several times a week

About once a week

Two or three times a month

About once a month

Less than once a month

Never

APPENDIX G

Student Consent and Information Form – Phase 1

Phase 1: Online Survey

Dear student: You are being invited to participate in a research study being conducted by researchers from the University of Cape Town. The purpose of this study is to investigate the potential relationships between different personality types/ traits and sleep. Questions regarding medical conditions, previous neurological injury and details of substance use are for control purposes only. This study forms part of an Honours degree being undertaken in the Department of Psychology, University of Cape Town, by Liam Minné (supervisor: Prof. Mark Solms).

Study Procedures:

If you decide to participate in this study, you will be asked to fill in some questionnaires. If you would like to see the questionnaires before deciding to take part, please inform the researcher of this.

Possible Risks:

It will take about 45-60 minutes of your time to answer the questionnaires. There are some questions of a personal nature that may make you feel uncomfortable, or cause some discomfort. If you feel that you would like to consult with someone about these feelings, or if you feel, after answering the questionnaires, that you are concerned about something, please contact the Student Wellness Centre on 021 650 101. It is also required that all questions be answered in this study for you to receive your SRPP points. If you would like to look at the questions asked beforehand, please contact Liam Minné. All information is kept strictly confidential (as will be explained shortly).

Possible Benefits:

If you choose to take part in this study, you will be awarded 2 SRPP points, which will help you to fulfil your DP (Duly Performed) requirement for the semester. Although there are no other direct benefits to you, we hope that information gained from this study will help us answer important questions about sleep and personality.

Alternatives:

You may choose not to participate in this study, and to participate in another study in order to fulfill your SRPP requirement.

Voluntary Participation:

Participation in this study is completely voluntary. If you decide to participate, you are free to change your mind and stop taking part at any time without any effect on your relationship

with the Department of Psychology, University of Cape Town, or any staff member in this Department or at the University. If you at first decide to take part, and then later decide you would like not to, you can end participation at any time without prejudice

Confidentiality:

Information about you obtained for this study will be kept strictly confidential. All the questionnaires and all other written records will be kept in a locked filing cabinet, accessible only to the primary researcher (Liam Minné). Once collected, the information will be transferred to a Microsoft Excel spreadsheet and then to a spreadsheet on a program for statistical data analysis. Both spreadsheets will be kept in a password-protected folder on the Liam Minné's personal computer, which is also password protected. The information obtained will not become a part of your academic record in any way, nor will it be made available to anyone else. Any reports or publications about the study will not identify you or any other study participant.

Reporting of the research results and disclosure of information:

The results of this research will be reported in n Honours dissertation, written by the primary researcher (Liam Minné). The results may also be published in a journal article in a peer-reviewed academic journal. Every step will be taken to ensure your confidentiality in the reporting of these results, however, there no guarantee of absolute confidentiality as there is always a *theoretical possibility* of an accidental breach. Please also note that researchers have a legal obligation to disclose any information gathered during the research about things such as child physical or sexual abuse, deliberate neglect, family violence, notifiable diseases such as tuberculosis, or any information sought under a warrant or subpoena.

Questions and information relating to results:

Any study-related questions, problems or emergencies should be directed to the individuals listed below. If you would like to be informed of the research results, in terms of your individual results or the results as a whole, please contact Mr. Liam Minné on the contact details below:

Mr. Liam Minné 0828394991 (available 24 hours, 7 days a week) liamminne@gmail.com

Professor Mark Solms 021-650-3437, email: Mark.solms@uct.ac.za

Rosalind Adams (Psychology secretary, UCT) 021-650-3417,

email: Rosalind.adams@uct.ac.za

Questions about your rights as a study participant, comments or complaints about the study also may be presented to the Research Ethics Committee, Department of Psychology,

University of Cape Town, Rondebosch, 7701, or by telephone to 021 650 4608, or by email to Johan.Louw@uct.ac.za.

I have read the above and am satisfied with my understanding of the study, its possible benefits, risks and alternatives. My questions about the study have been answered. I hereby voluntarily consent to participation in the research study as described.

1. I give my informed consent to participate in this research

(Participant will be required to answer "yes" here before they continue to answer the questions)

APPENDIX H

Participant Consent and Information Form – Phase 2

Informed Consent to Participate in Research and Authorization for Collection, Use, and Disclosure of Dream Recall Reports and Other Personal Information

You are being asked to take part in a research study. This form provides you with information about the study and seeks your authorization for the collection, use and disclosure of your dream recall reports, as well as other information necessary for the study. The Principal Investigator (the person in charge of this research) or a representative of the Principal Investigator will also describe this study to you and answer all of your questions. Your participation is entirely voluntary. Before you decide whether or not to take part, read the information below and ask questions about anything you do not understand. For your information – this study is covered by UCT's No Fault Insurance Policy.

1. Name of Participant ("Study Subject")

_____

2. Principal Investigator and Telephone Number(s)

Liam Minné
University of Cape Town
0828394991
Liamsleepresearch@gmail.com

3. What is the purpose of this research study?

This research aims to investigate sleep and dreaming in relation to personality.

4. What will be done if you take part in this research study?

In this experiment you will be required to maintain a dream diary for a specified number of days (between 7-14). The dream diary portion of the study will entail writing down your any dream recall every morning for the specified period of time. If you do not recall a dream upon waking, you will be required to record this as well.

Upon completing the dream diary portion of the study, you will be required to come to the department for a one hour session, where you will fill in the Temperament and Character Inventory (TCI). The TCI assess various aspects of personality and traits, and takes approximately 45 minutes to complete.

After completing both portions of this study, you will be informed in detail about the design of the study and the research questions we hope to address with this study. You will also have the opportunity to ask questions and thus learn more about psychological research. If you have any

questions now or at any time during the study, you may contact the Principal Investigator listed in #3 of this form.

5. If you choose to participate in this study, how long will you be expected to participate in the research?

Dream Diary: approximately 1-2 weeks (however, over this time you will only be required to record your dream recall from your home environment). TCI: 1 hour session in the Psychology Department.

6. How many people are expected to participate in the research?

60

7. What are the possible discomforts and risks?

There are no risks to the study. The only possible discomfort will be having to record your dreams (or lack of dreaming) on a daily basis for a specified period of time. However, we hope that this discomfort will be minimised by you being able to do this from the comfort of your home environment.

8. What are the possible benefits to you?

You will receive SRPP points for participation (2-4 points for the dream diary portion of the study) and 1 more SRPP point for the questionnaire.
Furthermore, the TCI is an extensive personality questionnaire, and you will have a chance to be given the feedback of this assessment, which will allow you to find out more about yourself. It will also allow you the opportunity to be exposed to professional psychometric testing, which is a good experience to have as a psychology student.

10. If you choose to take part in this research study, will it cost you anything?

No, there will be no costs to yourself.

11a. Can you withdraw from this research study?

Participation in this study is completely voluntary. If you decide to participate, you are free to change your mind and stop taking part at any time without any effect on your relationship with the Department of Psychology, University of Cape Town, or any staff member in this Department or at the University.
If you have any questions regarding your rights as a research subject, you may phone the Psychology Department offices at 021-650-3430.

11b. If you withdraw, can information about you still be used and/or collected?

Information already collected may be used.

12. Once personal and performance information is collected, how will it be kept secret (confidential) in order to protect your privacy?

Information collected will be stored in locked filing cabinets or in computers with security passwords. Only certain people have the right to review these research records. These people include the researchers for this study and certain University of Cape Town officials. Your research records will not be released without your permission unless required by law or a court order.

13. What information about you may be collected, used and shared with others?
The information gathered from you will be: (1) certain personality questionnaire data (2) your dream recall reports. If you agree to be in this research study it is possible that some of the information collected might be copied into a "limited data set" to be used for other research purposes. If so, the limited data set may only include information that does not directly identify you. For example, the limited data set **cannot** include your name, address, telephone number, ID number, or any other photographs, numbers, codes, or so forth that link you to the information in the limited data set.

14. How will the researcher(s) benefit from your being in the study?
In general, presenting research results helps the career of a scientist. Therefore, the Principal Investigator and others attached to this research project may benefit if the results of this study are presented at scientific meetings or in scientific journals. This study is being undertaken for the Principal Investigator's honours degree.

15. Signatures
As a representative of this study, I have explained to the participant the purpose, the procedures, the possible benefits, and the risks of this research study; and how the participant's performance and other data will be collected, used, and shared with others:

Signature of Person Obtaining Consent and Authorization Date

_____ _____

You have been informed about this study's purpose, procedures, possible benefits, and risks; and how your performance and other data will be collected, used and shared with others. You have received a copy of this form. You have been given the opportunity to ask questions before you sign, and you have been told that you can ask other questions at any time.

You voluntarily agree to participate in this study. You hereby authorize the collection, use and sharing of your performance and other data. By signing this form, you are not waiving any of your legal rights.

Signature of Person Consenting and Authorizing Date

_____ _____

Please indicate below if you would like to be notified of future research projects conducted by our research group:

_____ (initial) Yes, I would like to be added to your research participation pool and be notified of research projects in which I might participate in the future.

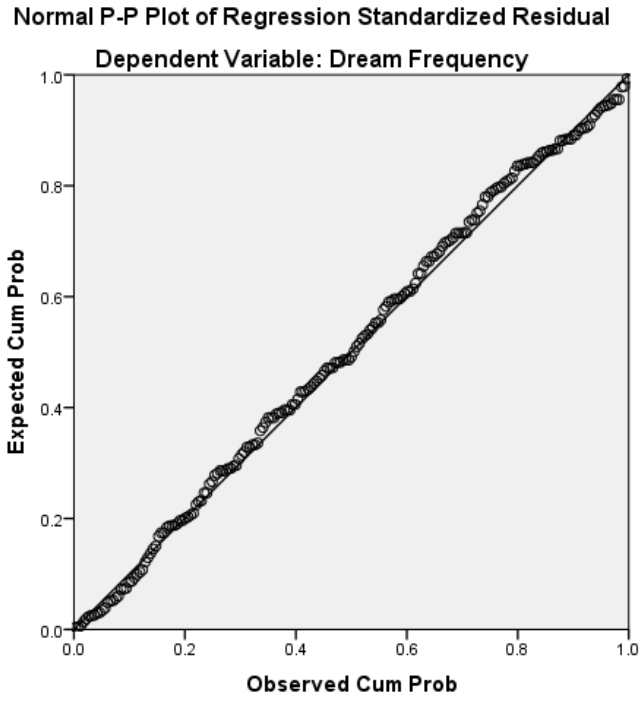
Method of contact:

Phone number: _____
E-mail address: _____
Mailing address: _____
_____
_____

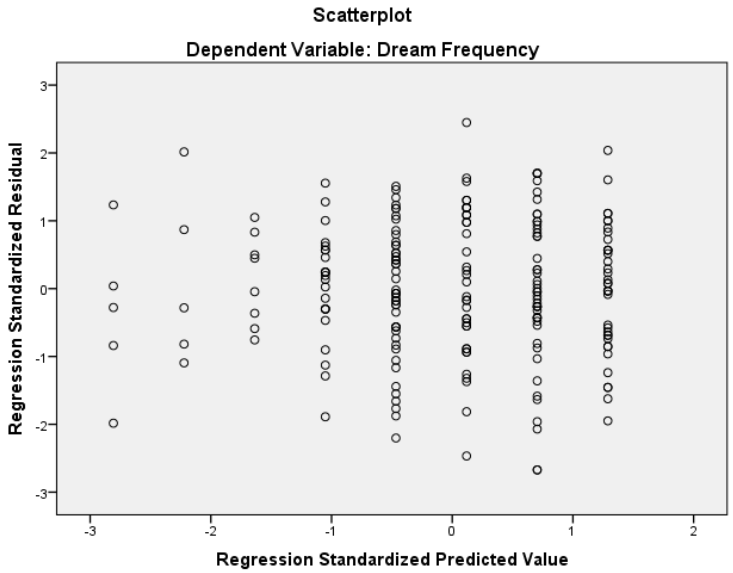
APPENDIX I

Assumptions for linear model testing hypothesis 1

Normality.



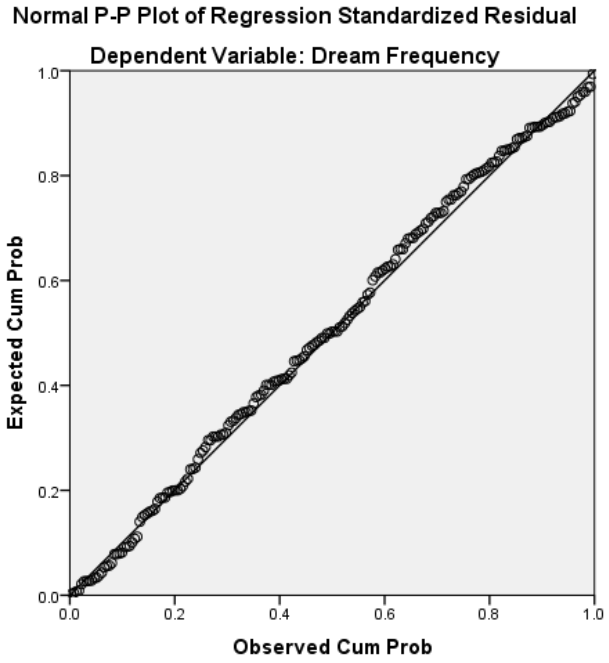
Non- heteroscedastic



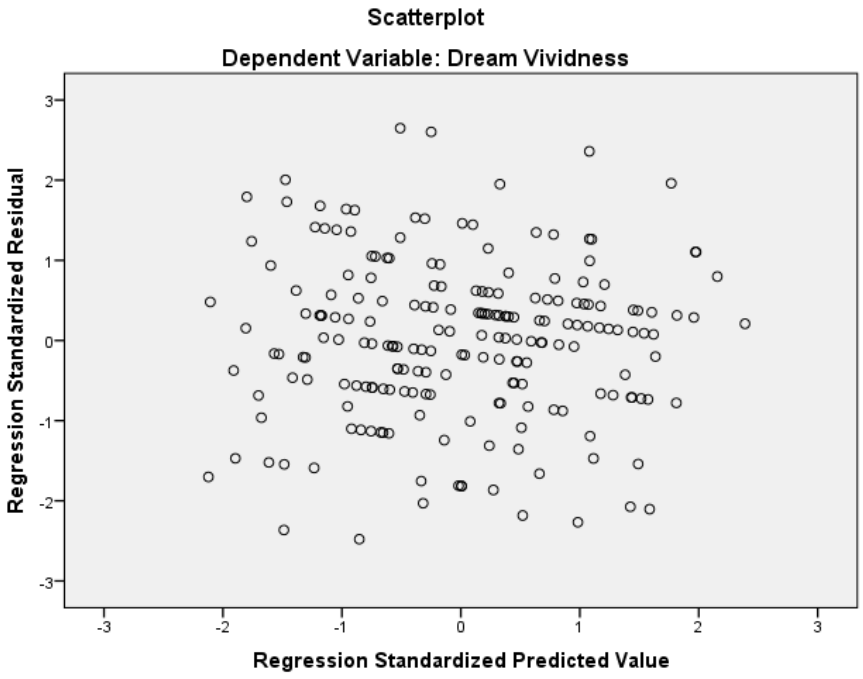
APPENDIX J

Assumptions for linear model testing hypothesis 2

Normality.



Non-heteroscedastic.



PLAGIARISM DECLARATION

1. I know that plagiarism is wrong. Plagiarism is using another's work and to pretend that it is ones own.

2. I have used the American Psychological Association (APA) as the convention for citation and referencing. Each significant contribution to, and quotation in, this essay/report/project/… from the work, or works of other people has been attributed and

   has cited and referenced.

3. This essay/report/project… is my own work.

4. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.

5. I acknowledge that copying someone else's assignment or essay, or part of it, is wrong, and declare that this is my own work

SIGNATURE: _____

DATE: _____