The Role of the Amygdala in Dreaming

Yvonne Blake
Department of Psychology
University of Cape Town

Supervisor: Mark Solms
Word Count:
Abstract: 248
Main Body: 9992

PLAGIARISM DECLARATION

1. I know that plagiarism is wrong. Plagiarism is to use another's work and to pretend that it is one's 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 been 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:

Abstract

Numerous neuroimaging studies have strongly implicated the amygdala in dreaming. Various neuropsychological dream theories propose roles for the amygdala in dreaming (particularly in the generation of dream affect), however little empirical research on its function in dreaming exists. Urbach Wiethe Disease is a very rare genetic condition which leads to calcification of the amygdala over time. Analyzing the dream reports of patients with Urbach Wiethe Disease (UWD) provides a unique opportunity to assess the role of the amygdala in dreaming. The threat simulation theory (TST) suggests that the biological function of dreams is to allow humans to practice effectively escaping from threatening situations in safety. The amygdala, which is pivotal to fear conditioning, is thought to play a central role in this process. This study assessed the dream reports of eight adult UWD patients with fully calcified amygdala bilaterally in order to examine dream affect and various other qualities of dreaming, as well as certain hypotheses specifically based on the TST. It was also necessary to refine and develop certain quantitative dream coding techniques. Results indicate only small differences between the dreams of the UWD group and a control group on various measures, including intensity of negative and positive affect and the prevalence of nightmares. These findings echo the results of the one existing study examining dream affect in UWD patients and begin to contradict the view that the amygdala has a principal role in the generation of dream affect. The results particularly seem to undermine the TST.

Keywords: amygdala; dreaming; Urbach Wiethe Disease; affect; Threat Simulation Theory; quantitative dream coding.

Introduction

A large body of research and theory relating to dreaming exists within the field of neuropsychology. Nevertheless, there is no globally accepted, definitive or complete neuropsychological dream theory, and many unanswered questions remain regarding the nature and functioning of the brain mechanisms that underpin human dreaming. One such question concerns the role the amygdala plays in dreaming. This study aims to begin to answer this question.

The Amygdala in Dreaming

The amygdala has been strongly implicated in dreaming by numerous neuroimaging studies which show that it is active during dreaming (Braun et al., 1997; Dang-Vu et al., 2005; Maquet et al., 1996; Mancia, 2005; Palagini & Rosenlicht, 2011; Nofzinger, Mintun, Wiseman, Kupfer, & Moore, 1997). However, the actual function of the amygdala during dreaming is rather poorly understood, and this confusion is increased by the existence of various contrasting theories of dreaming. Although these dream theories all suggest a role for the amygdala, little empirical research on its actual function in dreaming exists. However, it has been reported that a higher mean diffusivity of the left amygdala can be linked to shorter dream reports and lower emotional load in dream reports (De Gennaro et al., 2011). De Gennaro et al. (2011) also found that lower amygdala density was correlated to reduced bizarreness in dream reports.

It may be that the amygdala plays a similar role in dreaming to its role in the waking state. There is a vast literature covering the function of the amygdala, and a full review is neither possible nor useful here. It is, however, salient to mention the major functions that are echoed in ideas regarding amygdala involvement in dreaming.

The amygdala is involved in emotional responses to visual imagery – especially when the imagery portrays fear or anger (Adams, Gordon, Baird, Ambady, & Kleck, 2003; Adolphs & Tranel, 2004; Costafreda, Brammer, David, & Fu, 2008; Drevets, 2003; Irwin et al., 1996; Morris et al., 1996; Phillips & Young, 1997; Sergerie, Chocol, & Armony, 2008; Whalen et al., 2001). Increased amygdala activation is also evident in the experience of threat-related emotions in general (Dang-Vu et al., 2005; LaBar, Gatenby, Gour, LeDoux, & Phelps, 1998; LeDoux, 2003; Maren, 2001; Willensky, Schafe, Kristensen, & LeDoux, 2006). The amygdala has also been implicated in the processing of some positive emotions (Yang et al., 2002). Additionally, the

amygdala is involved in emotional memory (Adolphs, 2003; Adolphs, Tranel, & Buchanan, 2005; Adolphs, Tranel, Damasio, & Damasio, 1995). Pessoa and Adolphs (2010) suggest that the amygdala coordinates the functioning of cortical networks during the processing of affective stimuli. Dream theories draw on these findings in their hypotheses concerning the amygdala's role in dreaming.

Theories of Dreaming

Activation, Input source, and Mode of processing (AIM) model. The precursor to the AIM model, the activation-synthesis hypothesis, was first proposed by Hobson and McCarley in 1977. This hypothesis suggested that brain activation during dreaming is generated by random endogenous stimulation by the pons (while sensory stimulation is blocked), and that this input is projected to the forebrain and the limbic system where it is interpreted with reference to sensory-motor memories in order to synthesize dreams. The activation-synthesis hypothesis was further developed into the three-dimensional AIM model to describe different states of consciousness (Hobson, Pace-Schott, & Stickgold, 2000).

Within this theory, Hobson et al. (2000) propose a central role for the amygdala in reacting to emotionally significant stimuli and modulating emotional memories and reactions (especially anxious reactions). To support this claim, Hobson et al. (2000) cite evidence of the high level of amygdala activation in rapid eye movement (REM) sleep (Maquet et al., 1996). Although the amygdala is not necessarily crucial to this theory of dreaming, the limbic system is nevertheless a central part of the theory, and the amygdala plays an important role in this system. Hobson et al. (2000) attribute the intense emotion in dreams (especially anxiety, elation, and anger) to the amygdala, and suggest that it plays a role in producing and recalling the emotional significance of dream imagery.

The continuity hypothesis of dreaming. It has also been proposed that emotional content in dreaming mirrors an individual's prevalent mood state. This moves away from the AIM concept of dreaming being driven physiologically as opposed to psychologically (Palagini & Rosenlicht, 2011). This idea of emotional continuity from waking to dreaming is at the centre of the continuity hypothesis of dreaming, which postulates that waking feelings and concerns are reflected in dreams (Domhoff, 2001).

There is some support for this theory; for example, it has been shown that lower self-report measures of well-being can be correlated with higher incidence of unpleasant content and emotions in dreams (Pesant & Zadra, 2006). Various studies have shown that patients who suffer from post-traumatic stress disorder (PTSD) experience significantly elevated levels of nightmare prevalence and severity (Levin & Nielsen, 2007). In addition, such patients present with increased activity in the limbic system and decreased activity prefrontally during both dream and waking states (Levin, Fireman, & Nielsen, 2010). It could be that the disturbed dreaming in these individuals is due to disruptions of a neural network that controls fear processes and the production of nightmares and centres on the amygdala (Levin & Nielsen, 2009; Nielsen & Levin, 2007). Therefore, within this theory, the amygdala continues to play a similar role to its waking role: controlling and modulating emotional experiences, especially those involving fear and anger (Domhoff, 2001).

Threat Simulation Theory (TST). Evidence from studies examining PTSD has also been interpreted as lending support to the threat simulation theory (TST) developed by Revonsuo (2000). This theory argues for an evolutionary perspective suggesting that dreams constitute opportunities for the human mind to practice (in safety) how to react to threatening situations quickly and effectively. In this theory, dreaming centres around threat simulation, which is based in what Panksepp (1998) referred to as the FEAR system. The amygdala is believed to play a crucial role in this conceptualisation as it is the critical part of the fear-conditioning system. The purpose of dreaming is thought to be the priming of this amygdalocortical network (Revonsuo, 2000; Zadra, Desjardins & Marcotte, 2006).This theory, therefore, relies more heavily on the amygdala than others. Without the amygdala, it seems the whole purpose of dreaming loses its foundation. Revonsuo (2000) interprets the high activation of the amygdala in REM sleep as strong support of the TST.

Not only is the amygdala deemed necessary for effectively responding to the dream threats, it is also considered important in the generation of the threats, due to its role in emotional memory. Threat simulation theory hypothesises that chronic and severe exposure to threats in waking life results in higher levels of threat simulation in dreams, as this would be an adaptive response in learning to cope with these dangers. The triggering and assembling of threat simulations are therefore modulated by negative emotional memories. The amygdala has been implicated in emotional episodic memory systems, especially when the memories are paired with

threatening and aversive stimuli (Adolphs, 2003; Adolphs et al., 2005; Adolphs et al., 1995). Valli and Revonsuo (2009) therefore interpret amygdala activation during dreaming as indicative of the activation and processing of aversive and threatening memory traces during dreaming, which in turn is seen as evidence of waking life threats triggering the threat simulation mechanism during dreaming. The evidence that PTSD patients experience greater levels of threat in their dreams is also thought to support this hypothesis, although in this case the evolutionary remnants are no longer necessarily helpful to the dreamers (Valli & Revonsuo, 2009).

The mesocortical/mesolimbic dopamine pathways. This hypothesis, advanced by Solms (2000), stands in stark contrast to Revonsuo's TST, in that the SEEKING system is implicated as the centrally active system in dreaming, not the FEAR system. The SEEKING system is responsible for the generation of goal-seeking and appetitive behaviours (Panksepp, 1998). Solms outlines different dreaming pathways, namely the mesocortical and mesolimbic pathways, which project from the ventral tegmental area of the brain to the frontal areas to the nucleus accumbens. These dopamine pathways constitute what Panksepp (1998) labelled the SEEKING system. Research suggests that these pathways are highly active during REM sleep (Braun et al., 1997; Dahan et al., 2007; Lena et al., 2005; Maquet et al., 1996; Nofzinger et al., 1997). The activation of this system in dreaming suggests that behaviour in dreaming will be instinctual, biologically adaptive behaviour of a mostly goal-directed, exploratory nature (Malcolm-Smith, Koopowitz, Pantelis, & Solms, 2012).

The amygdala is implicated in the mesocorticolimbic pathway, as it is one of the structures to which the SEEKING system projects. It may be that the amygdala is involved in internal generation of emotion and motivation arising from this system (Alcaro, Huber & Panksepp, 2007). Curiosity driven, goal-seeking behaviours are believed to be carried out in a state of constant vigilance, which could explain why the amygdala is active during these behaviours (Malcolm-Smith et al., 2012).

Solms and Turnbull (2007) have also suggested that the implication of these dopaminergic pathways in dreaming warrant a re-examination of Freud's 'wish-fulfilment' theory of dreams. Freud (1900/1954) proposed that the latent content of all dreams constitutes the fulfilment of a wish, and that some dreams, usually short and uncomplicated dreams of a kind most often experienced by children, are in fact nothing but simple wish fulfilments. Freud (1900/1954) argued that bizarreness and complexity in dreams are caused by the distortion of the

wish fulfilment theme due to some quality of the wish that is undesirable or disturbing to the dreamer and which they therefore defend themselves from. The disturbing nature of dream wishes leads to anxiety in dreams. Although Freud (1900/1954) did not propose a role for the amygdala in these anxious reactions, it is possible, given modern ideas about the amygdala's role in anxiety, to speculate that the amygdala might be involved in these anxious processes.

The debate. The debate between these (and other) theories of dreaming continues. The findings of Solms (2000) contradict the activation-synthesis hypothesis, in that it they show that patients with lesions in the pontine area of the brain *do* still dream, thereby casting doubt on Hobson's claim that this is where dreams are generated. Hobson (2007) has argued that the theory outlined in Solms (2000) does not account for the high levels of negative emotion in dreams – a phenomenon that he attributes to the involvement of the amygdala.

Threat simulation theory is called into question by evidence that experiences of actual realistic life-threatening threats in dreams are rare, and that the successful avoidance of these threats is even rarer (Malcolm-Smith & Solms, 2004; Malcolm-Smith, Solms, Turnbull & Tredoux, 2008; Zadra et al., 2006). On the contrary, it has been reported that incidence of approach dreams are more common than avoidance dreams in populations living in both low- and high-threat environments (Malcolm-Smith et al., 2012).However, Valli, Strandholm, Sillanmäki and Revonsuo (2008) found that threat is more common in dreams than it is in waking life.

This debate lies at the heart of our understanding of the role of the amygdala in dreaming, as different theories postulate different roles for this structure. All theories agree that the amygdala must play some role in the production of emotions in dreams. However, its specific function, and the extent to which it is necessary for functional dreaming, is still very much under debate. A clearer understanding the amygdala's role in dreaming may provide critical evidence for the broader debate regarding the function of dreaming, as this structure plays a different role in each of the various theories.

Urbach-Wiethe Disease

Urbach-Wiethe Disease (UWD), also known as lipoid proteinosis or hyalinosis cutis et mucosae, is caused by a mutation of ECMI gene (Claeys et al., 2007). It is an extremely rare condition, with between 250 and 300 cases being reported in the world literature since Urbach and Wiethe first described it in 1929 (Cote, 1998). The largest population of UWD patients to be

studied live in a small community in the Northern Cape Province of South Africa (Van Hougenhouck-Tulleken et al., 2004). Because this genetic mutation has been mapped out, UWD is diagnosed by a genetic test that searches for this mutation. Symptoms of UWD include a number of dermatological problems, a hoarse voice and bilateral calcifications of the amygdala (Appenzaller et al., 2006; Claeys et al., 2007).

Research with UWD patients. Symmetrical bilateral damage to the amygdala exists in more than half of all patients with UWD. Amygdala calcification develops over time and is therefore only fully evident in adult patients (Siebert, Markowitsch, & Bartell, 2003). Consequently, investigating the functioning of adult UWD patients provides a unique opportunity to answer questions regarding amygdala function. Many researchers have done exactly this, and have generally found similar results to other amygdala research – i.e., the amygdala is involved in emotional processing and emotional memory, specifically when it comes to fear and anger (Adolphs, 2003; Adolphs, Tranel, Damasio, & Damasio, 1994; Tranel, Gullickson, Koch, & Adolphs, 2006). However, some studies have reported confusing and contradictory claims, for example, that UWD patients are not impaired with respect to the recognition of fearful or angry visual stimuli (Siebert et al., 2003). These inconsistencies are probably due, at least in part, to the heavy reliance on case studies and small sample sizes, as well as varying degrees of amygdala damage between patients.

To date, there is no published literature on any aspect of the dreams of patients with UWD. Yet studying these patients will potentially shed much light on the role of the amygdala in dreaming. Domhoff (2000) recommended studying the dreams of patients with amygdala damage. Due to evidence suggesting that UWD patients show impaired fear responses in waking life (Adolphs & Damasio, 1998; Damasio, 1999), Domhoff (2000) suggested that amygdala damage might lead to significantly lower levels of negative emotions in dreams than found in normal populations. One recent unpublished study attempted to investigate dreaming in UWD patients, but found no significant differences between the dream reports of UWD patients and the dream reports of controls (Denny, 2011). This may reflect a true lack of significant differences, and it is probably at least partly due to a small sample size, but it may also be to do with problems in the measurement tools used.

Measurement concerns. The above-mentioned thesis found little evidence to support the idea that amygdala damage results in decreased negative emotion in dreams (Denny, 2011). In

addition, a current study is experiencing similar problems (M. Solms, personal communication, May 16, 2012). It is of course possible that there are indeed no significant differences between UWD patients and controls in terms of levels of emotion. However, in order to be more confident about the differences or similarities between the dream reports of UWD patients and the dream reports of healthy controls, further assessment is necessary. It may be that statistical significance was not found due to the measurement scales used.

Specifically, both studies used the Affective Neuroscience Dream Scale (ANDS) developed by Denny (2011). This scale aimed to measure the intensity of the seven emotional systems identified by Panksepp (1998). These emotional systems include SEEKING, FEAR, RAGE, LUST, CARE, PANIC and PLAY (Panksepp, 2004). The ANDS divided PANIC into its two subtypes; grief and panic. Panksepp (1998)'s conceptualisation of affect was deemed more useful than other conceptualisations as it links each emotion to specific neurological systems. However, because the ANDS is newly developed, its reliability and validity is insufficiently accounted for. Furthermore, a key suggestion of multiple dream theories is that the amygdala plays a role in negative affect. The ANDS contains no specific measure of negative affect, which may account for its failure to pick up significant differences between the dream reports of UWD patients and controls.

The currently ongoing study also utilised the Hall and Van de Castle (HVdC) coding system for the content analysis of dreams, which is the most widely used content analysis method in dream research (Domhoff, 1999; 2005; Schredl, 2010). However, it does not put much emphasis on the measurement of emotion. Schredl (2010) has shown that this scale tends to be biased towards picking up negative emotions and that it generally underestimates the level of emotion in dreams. Therefore, the HVdC coding system seems inappropriate for the process of assessing emotion in UWD patients. A measure that focuses specifically on assessing the incidence of positive and negative affect in dream reports would arguably be better suited to this task than either the ANDS or the HVdC coding system.

Aims and Hypotheses

Little empirical research exists regarding the amygdala's role in dreaming. The presence of a relatively large community of UWD patients living in the Northern Cape provides a unique opportunity to address this knowledge gap. Furthermore, the results of the one study that has

examined affect in UWD patients' dream reports were somewhat surprising. A subsequent qualitative examination of the UWD and control dream reports used in the previous study suggested that there may be differences between the groups that the previous study was not sensitive to. The chief aims of this study were to re-address previous questions concerning the amygdala's role in dream affect, and to assess the role of the amygdala in dreaming more broadly. This study also aimed to develop appropriate quantitative measurement systems and to utilise the unique opportunity to test some of the hypotheses central to the TST.

This study investigated two hypotheses:

(1) Patients with UWD will differ significantly from healthy controls in the intensity of positive and negative dream affect expressed in their dream reports.

(2) Patients with UWD will differ significantly from healthy controls on a variety of other qualities of dreaming, including: wish-fulfilment, bizarreness, and dream-like quality, as well as on the prevalence of nightmares, threats, escape attempts, and approach and avoidance behaviour.

Design and Methods

Design and Setting

This was an exploratory, quasi-experimental study, examining the relationship between amygdala damage (the independent variable) and abnormal dreaming (the dependent variable) as measured by a variety of different instruments. Dream reports of patients with UWD were compared with those of healthy controls. Dream reports gathered approximately10 months prior to the initiation of the present study were analysed, along with new dream reports that were collected solely for the present study. The 10-month old dream reports were included in order to utilise as much data as possible from a clinical population that is very difficult to access. The data were collected in the Northern Cape, in the subjects' homes. The comparison between the dream reports of the two groups was made on the basis of dream-coding undertaken by research assistants in the University of Cape Town (UCT) Psychology Department.

Participants

The participants comprised two subsets: the old participants (interviewed before the commencement of the present study, who the present study attempted to interview a second time) and new control participants who were interviewed only as part of this study.

The pre-existing group comprised 8 UWD patients, and a matched healthy control group ($n = 8$). In an attempt to maximise the amount of data available, the aim was to gather one more dream report from each of the original UWD patients and controls, as well as one dream each from eight additional control group members. However, one of the original UWD patients and two of the original controls could not be accessed for a second interview. Although it was not possible to recruit an extra UWD patient to make up for the one who could not be accessed (a third dream report was collected from one member of the existing UWD group instead), two extra control participants were recruited. This meant that a total of ten new control participants (as well as seven of the original UWD patients and six of the original controls) were interviewed during the course of the study. Therefore, the complete UWD group was totalled at $n = 8$ and the complete control group at $n = 18$.

Inclusion criteria for the patient group were a diagnosis of UWD (based on genetic tests and the presence of standard symptoms of UWD), and the presence of bilateral amygdala damage confirmed by MRI (see Appendix A). Due to geographical isolation all the participants come from the same community in the Northern Cape, and were of low socioeconomic status. All the participants were Afrikaans-speaking, female, and between the ages of 23 and 69.

Exclusion criteria included being less than 18 years old, and a history of alcoholism. Children were excluded because the amygdala lesions associated with UWD are only fully developed in adulthood (Siebert, Markowitsch, & Bartell, 2003). Furthermore, dreaming probably depends at least in part on forebrain structures that are not yet fully developed in childhood, and children's dreams have been shown to be significantly different to the dreams of adults (Domhoff, 2001). Alcohol abuse was used as an exclusion criterion as alcohol can significantly damage various brain structures, especially the frontal lobes and the diencephalon, which leads to various functional impairments, perhaps most notably to memory processes. (Moselhy, Georgiou, & Kahn, 2001). On this basis, two male UWD participants who were originally recruited were excluded from the study.

The initial control group comprised healthy individuals living in the same community in the Northern Cape as the UWD patients and were matched on all measures. The additional 10 participants were recruited to the control group using the same method.

Materials

The Most Recent Dream (MRD) method. The MRD method was used to collect all the dream reports. This method has been shown to be at least as effective and reliable as any other method of dream collection (Domhoff, 2000). It has been demonstrated, cross-culturally and across socio-economic groups, to yield dream reports indistinguishable from those collected in a laboratory. Due to the geographical isolation and sensitive nature of the UWD patients, collecting dream reports in a laboratory was not an option.

The MRD method asks the participants to recall, in as much detail as possible, the most recent dream they can remember having, no matter how long ago that dream actually occurred (Avila-White, Schneider, & Domhoff, 1999). Participants are asked to pay attention to details such as setting, characters, and emotions (See Appendix B).

Procedure

The original dream reports were collected by structured clinical interview in the participants' homes. The participants were first asked a number of questions to determine whether they understood what was meant by dreaming, and whether they were currently dreaming. Normally participants fill out a MRD report form, but for the purpose of this study the MRD reports were collected orally in Afrikaans. This was due to the limited literacy of some of the participants. The interviews were conducted by a nurse who was familiar to these UWD patients. This same nurse collected the dreams from the control group, using the same approach. These interviews were collected about 10 months prior to the commencement of the present study. This nurse collected the dream reports from both the UWD and control group in the second subset of interviews, with the procedure being the same as in the first subset of interviews.

Analysis

Coding. Dreams were coded by three first language Afrikaans-speaking research assistants who were blind to the study's purpose. These research assistants were Honours students in the Department of Psychology at UCT; this ensured that they had some knowledge regarding the process of psychological coding. The assistants coded the dream reports using various measures (some developed by the author and some from the existing literature) that are based on the hypotheses outlined above. The full coding instructions given to participants are included in Appendix C. The order in which the dreams were rated was randomised. A difference in word count is a potential confounding factor in dream reports. For this reason, none of the judgements made in the measures required a frequency rating of any sort. Instead, the judgements assessed the global qualities of each dream report.

For each measure, the assistants were trained to ensure that they were all coding in the same manner. They were given a set of 10 practice dreams to code. These practice dreams were taken from other sources and were also collected using the MRD method. Coding on most of the measures was done individually, although two measures were coded by consensus.

For measures that were coded individually, inter-rater reliability was calculated using Domhoff (1996)'s percentage of perfect agreement. Domhoff (1996) recommends the use of this stringent absolute agreement measure of inter-rater reliability for dream coding. For each coding measure perfect agreement was calculated to be at least 80%.

The Affective Dream Scale and the Bizarreness Scale were coded by consensus due to the complicated nature of the judgements that needed to be made. Here the desired 80% perfect agreement between the researcher assistants could not be achieved. Prior to the main coding, raters still coded ten practice dreams for these two measures. It was ensured that the raters were, through discussion, able to agree on 100% of the decisions.

Positive and Negative Affect. The assistants were first asked to rate the general intensity of the positive affect shown in each dream as a whole on a 0-3 scale, where 0 = these emotions were absent, 1 = very little of these emotions were present, 2 = a moderate amount of these emotions were present, and 3 = these emotions were very intense. They were then asked to rate the general intensity of the negative affect shown in each dream as a whole on the same scale.

Eight basic emotions. The Affective Dream Scale (ADS, D. Wainstein, personal communication, August 31, 2012), which has been successfully used to assess basic emotions in

dreams in a currently on-going Master's thesis, was utilised. This scale is similar to the ANDS used by Denny (2011). However, DOMINANCE was included in the ADS as it has been proposed as a possible eighth basic emotion (Panksepp, 1992; Panksepp, 2007). The Affective Dream Scale is a refined version of the ANDS that appears to have greater validity. The scale requires an intensity rating of each of the emotions, on the same 0-3 scale described above.

Wish-fulfilment. For this measure, the assistants judged to what extent each dream constituted the fulfilment of a wish. Assistants used a 0-3 scale, where 3 = this dream is completely wish-fulfilling, 2 = this dream includes a clear wish-fulfilment but also includes other aspects, 1 = this dream has some elements of wish fulfilment but is predominantly not a wish fulfilling dream, and 0=this dream includes no wish-fulfilling elements. Whether an outcome is desirable (and therefore wish-fulfilling) was determined by the common-sense of the assistants, as well as any responses or attitudes shown to the outcome by the dreamer in the dream.

Nightmares. The assistants were asked to make a simple 'yes' or 'no' judgement as to whether they considered the dream a nightmare. There is a general failure in the nightmare literature to agree on a definition of a nightmare, although one popular criterion for deciding what does and does not constitute a nightmare is whether the disturbing dream caused the dreamer to wake up (Schredl & Reinhard, 2011; Zadra & Donderi, 2000). However, the MRD method does not provide information about whether the dreams caused the dreamers to wake up. Therefore, the assistants were asked to make the judgement based on their common-sense understanding of what a nightmare is. This approach has frequently been taken in nightmare studies (Schredl & Reinhard, 2011).

Dream-like quality. The dream-like quality (DLQ) scale developed by Brown and Cartwright (1978) was used to assess the dream-likeness of the experiences recounted in the dream reports. This is a five-point scale, with 1 = no recall, 2 = non-perceptual report, 3 = single visual image, 4 = two or more images with a story connecting them, 5 = two or more images with elaborate detail and a well-developed narrative. This simple scale has been effectively used by many studies to assess dream-like quality (Agurgun & Cartwright, 2003; Cartwright & Lloyd, 1993; Nielsen, 2004).

Bizarreness. Bizarreness was measured using Revonsuo and Salmivalli (1995)'s method for the content analysis of bizarre elements in dreams. The scale has been shown to have high

inter-rater reliability and is more thorough than previous scales in its identification of various types of bizarreness in dreams (Revonsuo & Salmivalli, 1995; Revonsuo & Tarko, 2002).

Threat. This was assessed using the same method that was effectively used in Malcolm-Smith and Solms (2004) and Malcolm-Smith et al. (2008). Raters were asked a series of five questions about each dream, assessing the presence and nature of threats and escape attempts in the dreams (see Appendix C).

Approach versus avoidance behaviour. Contrasting the incidence of threat-avoidance to the incidence of a comparable instinctual-emotional behaviour provides a manner of assessing the level of representation of threat-avoidance behaviours. Approach behaviour, which is associated with the SEEKING system, provides a good contrast to threat-avoidance behaviour, which is associated with the FEAR system (Malcolm-Smith et al., 2012). The assistants were required to decide whether the main activity in each dream involved 'avoidance' or 'approach' behaviour. 'Avoidance' behaviour was defined as, "the main activity of the subject of the dream is an attempt to avoid something through fleeing, freezing, hiding or the like" and approach behaviour was defined as, "the main action of the subject of the dream is an attempt to approach something through engagement, exploration, curiosity or the like" (Malcolm-Smith et al., 2012, p. 409).

Inferential analysis. Although the statistical analyses for each of these hypotheses requires the comparison either of means or frequencies between two groups, the use of one simple *t*-test or chi-square test per hypothesis proved to be inappropriate due to the fact that two dreams were collected from some of the participants. Therefore, some of the data was repeated measures data, which violates the assumption of independence of data that is central to these two tests. Furthermore, small sample sizes such as the one in this study can also present a problem for parametric tests (Hoyle, Georgesen, & Webster, 2001; Kenny, Manneti, Piero, Livi & Kashy, 2002). Complex statistical tests which perform similar comparisons while allowing repeated measures data and small sample sizes (such as general estimating equations) do exist (e.g. Burton, Gurrin & Sly, 1998; Hoyle et al., 2001; Fitzmauice, Laird & Ware, 2004; Manneti et al., 2002) However, these tests were considered to be outside the scope of this project. Instead, the problem was addressed in the following ways:

Continuous data. The methods described here were used for the analysis of all the data collected using scales (the affect, wish-fulfilment and dream-like quality data).

To assess all of the hypotheses without violating the assumption of independence two separate one-tailed independent *t*-tests were conducted. The first *t*-test included data from all the participants who only provided one dream report, as well the first dream from all the participants who provided two dream reports. The second *t*-test was run only on the second dream reports of those participants from whom two dream reports were collected. In this manner it was ensured that neither *t*-test included repeated measures data.

Although this lead to the sample sizes for the UWD group (n = 8 for the first *t*-test and n = 7 for the second) and the control group (n = 18 for the first *t*-test and n = 6 for the second) being unequal, the variance for all tests except the dream-like quality test was still equal. However, the data was not normally distributed for many of the eight emotions assessed by the Affective Dream Scale. Therefore, Man-Whitney U tests were performed on the dream-like quality data (which was also not normally distributed) and the problematic emotions data.

In some cases, where the results of these two separate *t*-tests were unclear, a third *t*-test was attempted. The correlations between the first and second batch of dream reports were calculated. In the event of there being no significant correlation between the two batches of dream reports it is possible that, despite the repeated-measures nature of the data, the two batches of dream reports were not actually that related to one another. A very liberal test of alpha equal to .25 was used to assess the significance of the correlations, as this has been recommended for assessing whether data shows evidence of nonindependence (Kenny et al., 2002). If (for some or all of these measures) there was a lack of significant positive correlation a third one-tailed independent *t*-test including all dream reports was conducted. The lack of correlation, taken in conjunction with theory that postulates that two dreams from one individual may be quite different (Domhoff & Schneider, 2008; Hobson & Kahn, 2007), suggests that although such a *t*-test violates the assumption of independence, it may not be entirely without value. Nevertheless, results obtained from such a *t*-test were interpreted with caution.

A final possible approach to attempt to clear up any confusing results was to run a mixed-design ANOVA on the data provided by those participants who gave two dreams. It was therefore possible to assess the difference between groups while simultaneously picking up any interactions generated by within-group differences (i.e. differences between the first and second dream reports).

Categorical data. The categorical data included the nightmare, bizarreness, threat and the approach/avoidance data.

To assess this data without violating the assumption of independence, two separate chi-square tests were conducted for each hypothesis. The first chi-square test included data from all the participants who only provided one dream report, as well the first dream from all the participants who provided two dream reports. The second chi-square test was run only on the second dream reports of those participants from whom there were two dream reports. In this manner it was ensured that neither chi-square test included repeated measures data.

Ethical Considerations

Ethical approval was already granted prior to the commencement of this study, as it forms part of a continuing research project. The original ethical approval was obtained by Dr. Barak Morgan from Stellenbosch University (Appendix D).

During data collection, each participant was read a copy of a participant information sheet (which doubled as an informed consent form) that explained the study's purpose, highlighted that their participation was entirely voluntary, and explained that they could withdraw at any time and that any information they provided was entirely confidential. An English translation of the Afrikaans sheet is attached (Appendix E).

Taking part in this study had no foreseeable harmful consequences. Debriefing and counselling were also made available to anyone who required it. Given that each interview was conducted by a nurse familiar with the patients, she was able to help them with any issues that came up during the interview. Furthermore, she was available should any of the participants have required debriefing at a later stage.

Results

Intensity of Positive and Negative Affect

Positive affect. In the first set of dream reports the mean positive affect score was higher for the UWD group, whereas in the second set of dream reports it was higher for the control group (See table 1). Both *t*-tests were non-significant ($t_{(24)} = 1.03$, $p = .156$ and $t_{(11)} = -.45$, $p = .331$).

Given these contradicting results, a mixed design ANOVA was also run. It was first necessary to perform a log transformation on the data to improve the normal distribution and to correct for unequal error variances. The subsequent ANOVA that the intensity of positive affect was not significantly higher in the UWD dream reports than in the control dream reports ($F_{(1)}$ = 1.56, p = .237, η^2 = .12). In addition, there was no significant main effect between the first and second dream reports, nor was there a significant interaction effect.

Table 1.
Descriptive statistics: positive affect

Test	UWD	Control
t-test 1	1.29 (1.18)	0.83 (0.99)
t-test 2	1.33 (1.29)	1.67 (1.37)
ANOVA	1.41	1.00

Note. Means are presented with standard deviations in parentheses.

Negative affect. Examining only the first dream report from each participant, it was found that the UWD dream reports had significantly lower intensity of negative affect than the control dream reports ($t_{(24)}$ = -2.582, p = .008, r = .47). For the second dream reports, the UWD group showed slightly higher levels of negative affect (M = 1.90) than the control group (M = 1.36). However, this effect was not significant ($t_{(11)}$ = .89, p = .197).

In an attempt to understand the contradiction presented by the second *t*-test a third *t*-test including all the data was run. This was possible as the positive correlation between the first and second dream reports was very small and not significant (r = .006, p = .984). The final *t*-test revealed that the mean for all control scores (M = 1.84) was higher than the mean for all UWD scores (M = 1.25), and, although not significant, it seemed there might be a trend towards significance ($t_{(38)}$ = -1.62, p = .057, r = .25).

Panksepp's Seven Basic Emotions and Dominance

For a number of the analyses the assumption of normality was severely violated, in these case Mann-Whitney U tests were run. Neither independent *t*-tests nor Mann-Whitney U tests

found any significant differences between the controls' dream reports and the UWD patients' dream reports on any of the emotions in the first or second set of dream reports. The descriptive statistics are reported in Table 2. Neither group showed any instances of LUST, so this was omitted from the analyses.

Table 2.
Descriptive statistics for results obtained by the Affective Dream Scale

Emotion	1st set of dream reports		2nd set of dream reports	
	UWD (n = 8)	Control (n = 18)	UWD (n = 7)	Control (n = 6)
RAGE	0.00 (0.00) 0 (0)	0.67 (1.03) 0 (3)	0.43 (1.13) 0 (3)	0.17 (0.41) 0 (1)
FEAR	0.75 (0.89) 0.5 (2)	1.17 (1.38) 0 (3)	1.57 (1.51) 2 (3)	1.17 (1.17) 1 (3)
SADNESS	0.13 (0.35) 0 (1)	0.94 (1.39) 0 (3)	0.43 (1.13) 0 (3)	0.83 (1.33) 0 (3)
SEEKING	1.13 (1.13) 1 (3)	1.61 (1.33) 2 (3)	1.14 (1.21) 1 (3)	1.50 (1.38) 1.5 (3)
PLAY	0.75 (1.16) 0 (3)	0.33 (0.77) 0 (3)	1.14 (1.21) 1 (3)	1.67 (1.51) 2 (3)
NURTURANCE	0.75 (1.16) 0 (3)	1.39 (1.33) 1 (3)	1.00 (1.41) 0 (3)	1.33 (1.51) 1 (3)
DOMINANCE	0.00 (0.00) 0 (0)	0.33 (0.84) 0 (3)	0.00 (0.00) 0 (0)	0.50 (0.84) 0 (2)

Note. Means are presented with standard deviations in parentheses. Medians with range in parentheses are reported below as non-parametric tests were performed on much of the data due to non-normal distributions.

Wish Fulfilment

A *t*-test examining the first set of dream reports was not significant ($t_{(24)} = .794$, $p = .218$), although the descriptive statistics revealed that the UWD group contained slightly higher levels

of wish-fulfilment (M = 1.21) than the control group (M = .83). The t-test examining the second set of dream reports was also not significant ($t_{(11)}$ = -1.07, p = .153), although the descriptive statistics for this test showed that the control dream reports had slightly higher levels of wish fulfilment (M = 1.64) than the UWD dream reports (M = 1.00).

A mixed-design ANOVA was run in an attempt to address this contradiction. A square root transformation was performed on the data in order to correct for unequal error variance observed for the first group of dream reports. Descriptive statistics indicated that there were slightly higher levels of wish-fulfilment in the UWD group (M = .89) than in the control group (M = .77). However, this difference was not significant ($F_{(1)}$ = .234, p = .319, η^2 = .02). There was also no significant main effect between the first and second dream reports, nor was there a significant interaction effect.

Nightmares

In the first set of dream reports, none of the UWD patients' dream reports involved nightmares, but 38.9% of the controls' dream reports involved nightmares (see Figure 1). A chi-square test of contingency was significant ($\chi^2_{(1)}$ = 4.26, p = 0.048, V = 0.41). However, in the second set of dream reports, 28.6% of the UWD dream reports were nightmares whereas 16.7% of the control dream reports were nightmares. This effect was not significant ($\chi^2_{(1)}$ = 0.26, p = 0.563, V = 0.141).

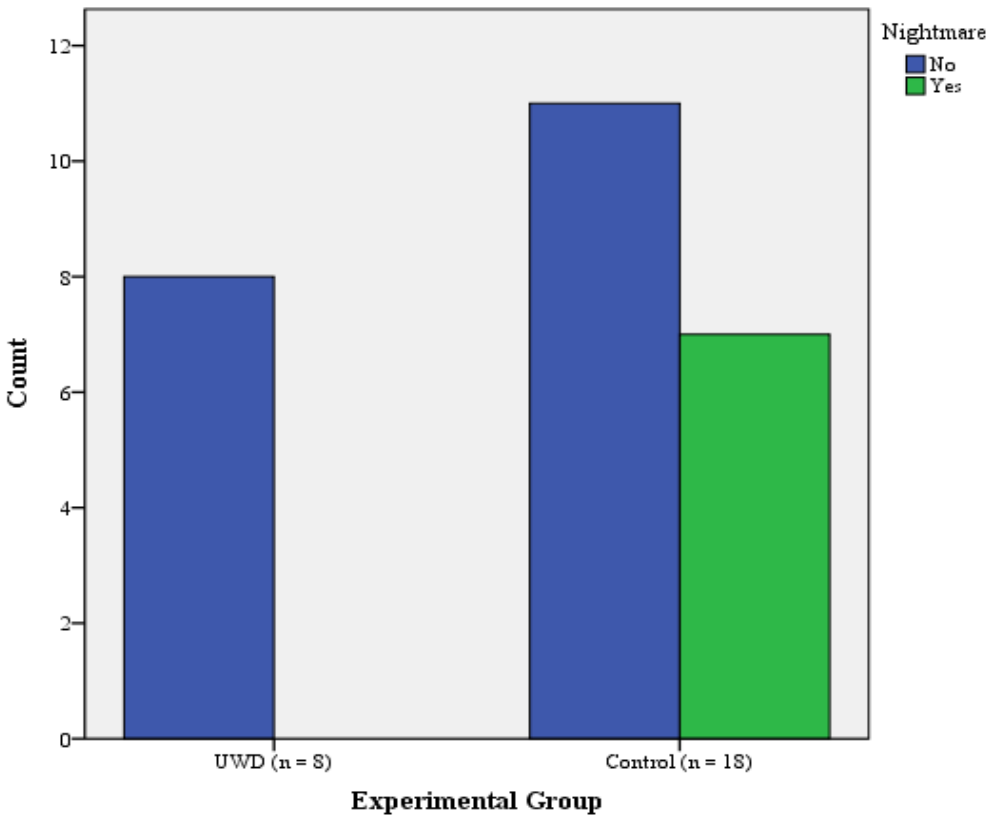


Figure 1. Nightmares in UWD and control group for the first set of dream reports

Dream-Like Quality

The descriptive statistics for the first set of dream reports suggested that the control group showed higher levels of dream-like quality (*Mdn* = 4.67) than the UWD group (*Mdn* = 3.67). A Man-Whitney U test was not significant, although the effect was still of a medium size ($U = 45$, $Z = -1.53$, $p = .067$, $r = -0.30$). The descriptive statistics for the second set of dream reports showed a similar, but smaller difference, and this test suggested no significance ($U = 13.00$, $Z = 1.17$, $p = .148$).

Bizarreness

The percentages of non-bizarre and bizarre elements were similar across both groups and both sets of dream reports, with the control group consistently showing a slightly higher percentage of bizarre elements than the UWD group (see Table 2). Neither the first nor the second set of dream reports showed a significant difference between the UWD and control group

on the frequency of bizarre and non-bizarre elements ($\chi^2_{(1)} = 0.17$, $p = 0.403$, $V = 0.02$ and $\chi^2_{(1)} = 0.18$, $p = 0.417$, $V = 0.03$).

Table 2.
Percentages of bizarre and non-bizarre dream elements

Element	1st set of dream reports		2nd set of dream reports	
	UWD	Control	UWD	Control
Bizarre	18.8%	20.7%	16.9%	19.6%
Non-Bizarre	81.2%	79.3%	83.1%	80.4%

Threat

Across the two sets of dream reports, both groups showed low instances of threat, with the UWD group showing slightly more threats (12.5% and 28.6%) than the control group (11.1% and 0%). However, this difference was not significant ($\chi^2_{(1)} = 0.10$, $p = 0.686$, $V = 0.02$ and $\chi^2_{(1)} = 2.03$, $p = 0.269$, $V = 0.39$). In total, three of the sixteen UWD patients' dream reports contained a physical threat and two of these contained escape attempts, although neither escape attempt was realistic. Two of the 24 controls' dream reports contained a physical threat and neither of these contained an escape attempt.

Approach versus Avoidance Behaviour

Across both the control and the UWD groups, and across both sets of dream reports there were more approach dream reports than avoidance dream reports. In the first set of dream reports, the control group presented with more avoidance dream reports (22.2%) than the UWD group did (0%). In the second set of dream reports, the UWD group presented with more avoidance dream reports (14.3%) than the control group did (0%). However, neither difference was significant ($\chi^2_{(1)} = 1.85$, $p = 0.242$, $V = 0.27$ and $\chi^2_{(1)} = 0.93$, $p = 0.538$, $V = 0.27$).

Discussion

This study aimed to explore what potential role the amygdala might play in dream affect, while also exploring the effect that bilateral amygdala calcifications may have on various other qualities of dreaming. Although access to UWD patients is somewhat restricted, this study still provided a unique opportunity to address the dearth of previous research in this area. This study also aimed to develop new measures and coding techniques for dream analysis as a way of ascertaining these goals. This study also sought to investigate the validity of the Threat Simulation Theory (TST).

Affect

Given that amygdala damage has repeatedly been linked to the impairment of negative affect (especially fear and anger) in waking life (e.g. Adolphs & Damasio, 1999; Adolphs et al., 1994; Damasio, 1999; LeDoux, 2003; Panksepp, 1998; Willensky et al., 2006), the idea that amygdala damage might lead to impaired fear, anger, and negative affect in dreaming is perhaps the most pertinent and defensible hypothesis examined by this study. Indeed, several dream theories have proposed a central role for the amygdala in the generation of negative emotion (and particularly fear) in dreaming (Domhoff, 2001; Hobson et al., 2000; Revonsuo, 2000). However, results to this effect were mixed.

In the first set of dream reports, the UWD group did show significantly less negative affect than the control group. However, in the second set of dream reports, the mean negative affect score for the UWD group was in fact slightly higher than the mean score of the control group, though this was not significant. When all the data was combined into one *t*-test, the UWD group showed lower levels of negative affect than the control group. However, this difference was not significant, and the effect size was relatively small.

No significant differences were found in the intensity of fear or anger, which is in line with the results reported by Denny (2011). Once again, though, the descriptive statistics for the second set of dream reports presented a slightly different picture to those of the first set of dream reports. In the first set of dream reports the UWD group showed less fear and anger than the control group. However, in the second set of dream reports, the UWD group showed slightly more fear and anger than the control group.

The idea that the amygdala is central to emotional intensity and the predominance of negative affect in dreams (Hobson, 2000) is therefore called into question. Furthermore, the findings stand in opposition to the role of the amygdala as predicted by Domhoff (2001) with the continuity hypothesis of dreaming. According to this hypothesis, the amygdala's role in dreaming should be similar to its waking role. The findings also stand in contrast to the TST. Revonsuo (2000) argues that the evolutionary purpose of dreaming is the priming of an amygdalocortical fear response network. Within this network, the amygdala is involved in generating appropriate fearful reactions to threatening stimuli. However, the continued presence of fear in the dreams of UWD patients undermines this theory.

In addition, differences between the UWD and control groups concerning the intensity of positive affect and the rest of the basic emotions measured were also not significant and were at times contradictory.

Although these results stand in contrast to the dream theories outlined above, as well as to research that implicates the amygdala in emotional processes during waking life, they are in line with the results of the only other study investigating affect in dreaming following amygdala damage. Denny (2011) found no significant differences between UWD patients and a control group in intensity of any basic emotions. In addition, no significant differences were found by grouping these basic emotions into an amygdala related and a non-amygdala related group, as well as grouping negative emotions and positive emotions together. Given that the present study also found no difference using new data and different measurement techniques, this controversial finding has been now been strengthened.

These results are also in line with studies that have found that patients with amygdala lesions are still able to experience negative emotions (Anderson & Phelps, 2002; Feinstein et al., 2011). Wiest and Brainin (2010) and Wiest et al. (2011) reported a UWD patient who experienced panic attacks and was able to process and experience fear. As hypothesised by Denny (2011), it may be that the amygdala is not specifically involved in the internal generation of emotion. Most studies linking the amygdala to affect have made this link in terms fear conditioning, electrical stimulation, or the external recognition of fearful expressions (Le Doux, 2003). The finding that UWD patients experience dream affect which is, in most instances, comparable to that of a control group, refutes the idea that the amygdala is critical for the internal generation of emotion during dreaming.

Wish Fulfilment

No significant difference was found between the levels of wish-fulfilment in the UWD patients' and controls' dream reports. The hypothesis that such a difference might be found was based chiefly on a qualitative examination of the first set of dream reports which suggested that the UWD dream reports seemed frequently to consist of simple wish fulfilment dreams of the type conceptualised by Freud (1900/1954). In the first set of dream reports, the mean wish-fulfilment was indeed higher for the UWD group than the control group. However, in the second set of dream reports the pattern was in the opposite direction. These findings contradict the idea that the amygdala might play a role in generating anxious responses to disturbing wishes.

Nightmares

Although significantly fewer of the UWD group dream reports involved nightmares than did the control groups' in the first set of dream reports, the second set of dream reports once again showed an opposite, though non-significant pattern.

Over activation of the limbic system in patients with post-traumatic stress disorder (PTSD) has been used to explain the elevated prevalence and severity of nightmares experienced by such patients (Levin & Nielsen, 2006; Levin, Fireman & Nielsen, 2010). Various dream theorists have also speculated that the amygdala is involved in the generation of fear in nightmares (Domhoff, 2001; Revonsuo, 2000). Although the current study does not prove that the amygdala is not involved in the generation of nightmares, it does suggest that the amygdala might not be a critical component the production of nightmares.

Dream-Like Quality (DLQ)

The control group consistently showed a non-significantly higher mean DLQ score than the UWD group and this effect was of a moderate size for the first set of dream reports ($r = -.30$). However, it would be a stretch to interpret these findings as supportive of the idea postulated by Hobson (2004) that the amygdala is central to the generation of dream plots. The DLQ assessment, which has been frequently used to determine the extent to which a dream report reflects a well-developed dream-like story, was included here for exploratory purposes. These

findings suggest that the dreams of UWD patients constitute stories that are comparable to the dreams of healthy people.

Bizarreness

Although the control group showed a slightly higher percentage of bizarre dream elements than the UWD group in both the first and second set of dream reports, this was not statistically significant and the percentages were in fact relatively similar across the two groups. The data therefore suggests that amygdala damage does not impact the generation of bizarreness in dreams.

This hypothesis was based primarily on a qualitative observation that the UWD dream reports seemed to be less bizarre than the control dream reports, as well as on the finding that lower amygdala density was correlated with reduced dream bizarreness (De Gennaro et al., 2011). However, the well-established content analysis of bizarreness developed by Revonsuo and Salmivalli (1995) was applied to the data and failed to find a significant difference in over-all bizarreness between the UWD patients and the control group.

Threat Simulation Theory

Low incidence of threat and escape, as well as of avoidance behaviour (as compared to approach behaviour), were found throughout both experimental groups and both sets of dream reports. In addition, there were no significant differences between the UWD group and the control group on either the threat or the approach/avoidance measure.

Threat Simulation Theory views the amygdala as critical both in the generation of, and response to, threat in dreams (Revonsuo, 2000; Revonsuo & Valli, 2009). Contrary to this, this study in fact observed slightly more threats in the UWD dream reports than the control dream reports. In addition, two of the UWD dream reports contained escape attempts, whereas none of the control dream reports did. Although these differences were not statistically significant, the findings undermine the idea that the amygdala is responsible for the generation of, and response to, threat in dreams. These findings are in line with those of Malcolm-Smith and Solms (2004), who found that only 8.48% of dreams contained realistic life-threatening situations.

The UWD group did demonstrate less avoidance behaviour than the control group in the first set of dream reports. However, in the second set of dream reports the UWD group

demonstrated more avoidance behaviour than the control group. This suggests that, contrary to the assumptions of the TST, the amygdala is not central to threat-avoidance behaviours in dreaming. These findings stand in contradiction to those of Valli et al. (2008) who report that threat is over-represented in dreams. Valli et al. (2008) reached this conclusion by comparing the incidence of threat in dreams to the incidence of threat in waking life. Due to a lack of information regarding threat in the waking life of the participants, it was not possible to make a similar comparison in the present study. However, this study is in line with Malcolm-Smith et al. (2012), who found that avoidance behaviour was significantly less prevalent than approach behaviour in dream reports.

Methodological Developments

This study aimed to refine the techniques used by Denny (2011) to measure affect in dreaming. Denny (2011) calculated the intensity of negative affect by grouping the intensities of fear, anger, panic, and grief. This approach elicited no significant differences between UWD disease patients and a control group. However, a qualitative examination of the dream reports suggested that negative affect was more intense in the control dream reports. It was thought that a measure that required raters to specifically code the intensity of negative affect in its entirety (as opposed to only coding specific emotions) might be more sensitive to picking up these differences. When applied to the existing set of dream reports, this new measure did indeed pick up a significant difference in the intensity of negative affect, suggesting that measuring negative affect in its entirety may indeed be more effective than measuring specific negative emotions separately.

The measures used to assess the prevalence of nightmares and wish fulfilment were unique to the present study. This study could not assess the validity of these two measures. However, high levels of inter-rater agreement (79% and 93% respectively) do speak to the utility of the measures. A possible critique of these measures is that the results they obtained were inconsistent across the two sets of dream reports (within the first set of dream reports, the UWD dream reports had a higher mean wish-fulfilment and lower incidence of nightmares, in the second set of dream reports this pattern was reversed). It is possible that this is due to problems with the implementation of the measures.

However, other, more established methods, also found this contradictory pattern. In general, the first set of dream reports from the UWD patients showed slightly less unpleasant emotional qualities (less negative affect, less fear, rage, anger and sadness, fewer nightmares, and less avoidance behaviour) and more pleasant emotional qualities (more positive affect, more play, more wish-fulfilment and more approach behaviour) than the controls. However, in the second set of dream reports this effect was largely reversed, although these differences were generally of a smaller magnitude to those found in the first set of dream reports. The bizarreness and DLQ measures, which are not specifically sensitive to emotion, did not show this pattern. The fact that the differences between the first and second set of dream reports seemed to be consistent across these measures suggests that the measures were to a certain extent tapping into the same underlying qualities of the dream reports. In other words, the consistent differences suggest that the measures were valid.

The most likely explanation for the differences between the two sets of dream reports is the simple variability of dream content. The idea that the manifest content of an individual's dreams can vary greatly is widely accepted (Domhoff & Schneider, 2008; Hobson & Kahn, 2007). In this context, it is unsurprising that there were differences between the first and second set of dream reports.

Limitations

Most of the limitations of this study were related to certain aspects of the population under investigation. Urbach Wiethe Disease provides a unique opportunity to explore bilateral amygdala damage in humans; however, it was difficult to gain access to UWD patients. Not only is UWD an extremely rare condition (Claeys et al., 2007; Lupo et al., 2005), it was also difficult to gain access to patients due to ethical considerations. The sensitive and rare nature of the patients' condition means that caregivers and gatekeepers need to limit the amount of access that researchers have to them. Therefore, the number of patients that could be recruited was limited. However, most previous studies examining UWD patients have been individual case studies, so a group of eight UWD participants is substantial under the circumstances.

Difficulty accessing UWD patients also meant that additional data had to be collected from the same patients that had already been recruited. As a result, the data was not independent and this complicated the process of statistical analysis. This in turn limited the strength of the

conclusions that could be drawn from the data. This said, a number of methods were found to analyse the data without severely violating any statistical assumptions. However these statistical issues should ideally be avoided in future research.

Certain characteristics of the population also restrict the generalisation of these findings to other populations. Firstly, it was necessary to exclude all males identified for the study due to alcoholism. Secondly, the participants were all of a low socio-economic status, and many had received limited education. However, due to the low prevalence of UWD, these conditions are difficult to overcome. Furthermore, if the amygdala is truly critical to dream affect or certain other qualities of dreaming, it is reasonable to suppose that bilateral amygdala calcification would have demonstrated significant differences to controls regardless of their socio-economic background or gender. This is not to say that socio-economic background and gender would not have influenced the results.

The various cultural values of participants should also be considered when researching a highly subjective experience such as dreaming. In many of the dream reports, the participants' Christian beliefs were evident. This strongly impacts the manner in which they would experience and interpret their dreams. In addition, not one of the dream reports contained any incidence of lust, which is quite unusual given that sexual content is relatively prevalent in dreams. The failure to report such content may be due to the conservative beliefs of participants.

In addition, a number of the measures used in this study are still in the process of development. Due to exploratory nature of the study, it was not always possible to use existing measures. This means that the reliability and validity of these measures were not well established, which in turn could impact on the results. The absence of existing measures also meant that it was not possible to determine concurrent validity.

Conclusions

This study compared the dream reports of UWD patients to those of a matched control group on a wide variety of measures. However, it failed to find the significant differences predicted by the literature in terms of dream affect and various other dream qualities. Although the idea that the amygdala plays a role in the generation and experience of dream affect cannot be entirely ruled out, the results of this study taken in combination with those of Denny (2011) present mounting evidence that the amygdala is not as critical to dream affect as previous

literature had speculated. Additionally, the finding that the dream reports of UWD patients seem to be generally comparable to those of healthy individuals, in terms of all the aspects assessed, stands in particularly strong contrast to TST. The question of what, if any, role the amygdala plays in dreaming therefore remains. It may be that dream theories need to incorporate the latest research on the amygdala's waking function more rigorously in order to refine the roles they propose for the amygdala in dreaming.

This study collected a substantial amount of data concerning the amygdala's role in dreaming, and in general suggests that theories conceptualising the amygdala as central to the generation of dream affect may need to be reconsidered. In particular, the idea that the amygdala is central to fear responses and the intensity of negative affect in dreams has been called into question. However, much work remains to be done before the amygdala's role in dreaming can be adequately understood.

References

Adams, R. B., Gordon, H. L., Barid, A. A., Ambady, N. A., & Kleck, R. E. (2003). Effects of gaze on amygdala sensitivity to anger and fear faces. *Science*, 300, 1536.

Adolphs, R. (2003). Cognitive neuroscience of human social behaviour. *Nature Reviews Neuroscience*, 4, 165-178.

Adolphs, R., & Tranel, D. (2004). Impaired judgements on sadness but not happiness following bilateral amygdala damage. *Journal of Cognitive Neuroscience*, 16, 453-462.

Adolphs, R., Tranel, D., & Buchanan, T. W. (2005). Amygdala damage impairs emotional memory for gist but not details of complex stimuli. *Nature Neuroscience*, 8, 512-518.

Adolphs, R., Tranel, D., Damasio, H., & Damasio, A. R. (1994). Impaired recognition of emotion in facial expressions following bilateral damage to the human amygdala. *Nature*, 372, 669-672.

Adolphs, R., Tranel, D., Damasio, H., & Damasio, A. R. (1995). Fear and the human amygdala. *The Journal of Neuroscience*, 75, 5879-5891.

Agargun, M. Y., & Cartwright, R. (2003). REM sleep, dream variables and suicidality in depressed patients. *Psychiatry Research, 119,* 33-39.

Alcaro, A., Huber, R., & Panksepp, J. (2007). Behavioural functions of the mesolimbic dopaminergic system : an affective neuroethological perspective. *Brain Research Review*, 56, 283-321.

Appenzeller, S., Chaloult, E., Velgo, P., Macedo de Souza, E., Zanardi Aroujo, V., Cendes, F. & Min Li, L. (2006). Amygdala calcifications associated with disease duration in lipoid proteinosis. *Journal of Neuroimaging*, 16

Avila-White, D., Schneider, A., & Domhoff, G. W. (1999). The most recent dreams of 12-13 year-old boys and girls: a methodological contribution to the study of dream content in teenagers. *Dreaming, 9,* 163-171.

Braun, A. R., Balkin, T. J., Wesensten, N.J., Carson, R. E., Varga, M., Baldwin, P., … Herscovitch, P. (1997). Regional cerebral blood flow throughout the sleep-wake cycle : an $H_2{}^{15}O$ PET study, *Brain*, 120, 1173-1197.

Brown, J. N., & Cartwright, R. D. (1978). Locating NREM dreaming through instrumental responses. *Psychophysiology, 15,* 35-39.

Burton, P., Gurrin, L., & Sly, P. (1998). Extending the simple linear regression model to account for correlated responses: an introduction to generalized estimating equations and multi-level mixed modelling. *Statistics in Medicine, 17,* 1261-1291.

Cartwright, R. D., Lloyd, S. R. (1993). Early REM sleep: a compensatory change in depression? *Psychiatry Research, 51,* 245-252.

Claeys, K. G., Claes, L. R. F., Van Goethem, J. W. M., Sercu, S., Merregaert, J., Lambert, J., … DeJonghe, P. (2007). Epilepsy and migraine in a patient with Urbach-Wiethe disease. *Seizure*, 16, 465-468.

Costafreda, S. G., Brammer, M. J., David, A. S., & Fu, C. H. Y. (2008). Predictors of amygdala activation during the processing of emotional stimuli : a meta-analysis of 385 PET and fMRI studies. *Brain Research Reviews*, 58, 57-70.

Cote, D. N. (1998). Head and neck manifestations of lipoid proteinosis. *Otolaryngology – Head and Neck Surgery*, 119, 144-145.

Dahan, L., Astier, B., Vautrelle, N., Urbain, N., Kocsis, B. & Chouvet, G. (2007). Prominent burst firing of dopaminergic neurons in the ventral tegmental area during paradoxical sleep. *Neuropsychopharmacology*, 32, 1232-1241.

Dang- Vu, T. T., Deseilles, M., Albouy, G., Darsaud, A., Gais, S., Rauchs, G., … Maquet, P. (2005). Dreaming : a neuroimaging view. *Schweizer Archiv fur Neurologie und Psychiatrie*, 156, 415-425.

De Gennaro, L., Cipolli, C., Cherubini, A., Assogna, F., Cacciari, C., Marzano., C., … Spalletta, G. (2011). Amygdala and hippocampus volumetry and diffusivity in relation to dreaming. *Human Brain Mapping*, 32, 1458-1470.

Denny, H. (2010). Amygdala dysfunction and dream affect in Urbach Wiethe disease (Unpublished honours thesis). University of Cape Town, South Africa.

Domhoff, G. W. (1996). *Finding meaning in dreams: A quantitative approach.* New York, NY: Plenum Press.

Domhoff, G. W. (1999). New directions in the study of dream content using the Hall and Van de Castle Coding System. *Dreaming, 9,* 115-137.

Domhoff, G. W. (2000). Methods and measures for the study of dream content. In M. H. Kryger, T. Roth, & W. C. Dement (Eds.), *Principles and Practices of Sleep Medicine* (3rd ed., pp. 463-471). Philadelphia, PA: W. B. Saunders.

Domhoff, G. W. (2001). A new neurocognitive theory of dreams. *Dreaming, 11,* 13-33.

Domhoff, G. W. (2005). The content of dreams: methodologic and theoretical implications. In M. H. Kryger, T. Roth, & W. C. Dement (Eds.), *Principles and Practices of Sleep Medicine* (4th ed., pp 522-534). Philadelphia, PA: W. B. Saunders.

Domhoff, G. W., & Schneider, A. (2008). Similarities and differences in dream content at the cross-cultural, gender, and individual levels. *Consciousness and Cognition, 17,* 1257-1265.

Drevets, W. C. (2003). Neuroimaging abnormalities in the amygdala in mood disorders. *Annals of the New York Academy of Sciences*, 985, 420-446.

Fitzmaurice, G. M., Laird, N. M., & Ware, J. H. (2004). *Applied longitudinal analysis.* Hoboken, NJ: John Wiley and Sons.

Freud, S. (1954). *The interpretation of dreams* (J. Strachey, Trans.). London, United Kingdom: George Allen and Unwin.

Hobson, A. (2007). Wake up or dream on? Six questions for Turnbull and Solms. *Cortex,43,* 1113-1115.

Hobson, A., & Kahn, D. (2007). Dream content: individual and generic aspects. *Consciousness and Cognition, 16,* 850-858.

Hobson, A., & McCarley, R. W. (1977). The brain as a dream state generator: an activation-synthesis hypothesis of the dream process. *The American Journal of Psychiatry*, 134, 1335-1348.

Hobson, A., Pace-Schott, E. F., & Stickgold, R. (2000). Dreaming and the brain: towards a cognitive neuroscience of conscious states. *Behavioural and Brain Sciences*, 23, 793-1121.

Hurlemann, R., Patin, A., Onur, O. A., Cohen, M. X., Baumgartner, T., Metzler, S., ... Kendrick, K. M. (2010). Oxytocin enhances amygdala-dependent, socially reinforced learning and emotional empathy in humans. *The Journal of Neuroscience*, 30, 4999-5007.

Irwin, W., Davidson, R. J., Lowe, M. J., Mock, B. J., Sorenson, J. A., & Turski, P. A. (1996). Human amygdala activation detected with echo-planar functional magnetic resonance imaging. *NeuroReport*, 7, 1765-1769.

Kenny, D. A., Mannetti, L., Pierro, A., Livi, S., & Kashy, D. A. (2002). The statistical analysis of data from small groups. *Journal of Personality and Social Psychology, 83,* 126-137.

LaBar, K. S., Gatenby, J. C., Gore, J. C., LeDoux, J. E., & Phelps, E. A. (1998). Human amygdala activation during conditioned fear aquistion and extinction: a mixed-trial fMRI study. *Neuron,* 20, 937-952.

LeDoux, J. E. (2003). The emotional brain, fear, and the amygdala. *Cellular and Molecular Neurobiology*, 23, 727-738.

Lena, I., Parrot, S., Deschaux, O., Muffat-Jolly, S., Sauvinet, V., Renaud, B., ... Gottesman, C. (2005). Variations in extracellular levels of dopamine, noradrenaline, glutamate, and aspartate across the sleep-wake cycle in the medial prefrontal cortex and nucleus accumbens of freely moving rats. *Journal of Neuroscience Research*, 81, 891-899.

Levin, R., Fireman, G., & Nielsen, T. (2010). Disturbed dreaming and emotion dysregulation. *Sleep Medicine Clinics*, 5, 229-239.

Levin, R., & Nielsen, T. A. (2007). Disturbed dreaming, posstraumatic stress disorder, and affect distress: a review and neurocognitive model. *Psychological Bulletin*, 133, 482-528.

Levin, R., & Nielsen, T. (2009). Nightmares, bad dreams, and emotion dysregulation: a review and new neurocognitive model of dreaming. *Current Directions in psychological science, 18,* 84-88.

Malcolm-Smith, S., Koopwitz, S., Pantelis, E., & Solms, M. (2012). Approach/avoidance in dreams. *Consciousness and Cognition*, 21, 408-412.

Malcolm-Smith, S. & Solms, M. (2004). Incidence of threat in dreams: a response to Revonsuo's threat simulation theory. *Dreaming*, 14, 220-229.

Mancia, M. (2005). The dream between neuroscience and psychoanalysis. *Schweizer Archiv fur Neurologie und Psychiatrie*, 156, 471-479.

Maquet, P., Peters, J., Aerts, J., Delfiore, G., Degueldre, C., Luxen, A. & Franck, G. (1996). Functional neuroanatomy of human rapid-eye-movement sleep and dreaming. *Nature*, 383, 163-166.

Maren, S. (2001). Neurobiology of pavlovian fear conditioning. *Annual Review of Neuroscience*, 24, 897-931.

Morris, J. S., Frith, C. D., Perret, D. I., Rowland, D., Young, A. W., Calder, A. J., & Dolan, R. J. (1996). A differential neural response in the human amygdala to fearful and happy facial expressions. *Nature*, 383, 812-815.

Moselhy, H. F., Georgiou, G., & Kahn, A. (2001). Frontal lobe changes in alcoholism: a review of the literature. *Alcohol & Alcoholism, 36,* 357-368.

Nielsen, T. (2004). Chronobiological features of dream production. *Sleep Medicine Reviews, 8,* 403-424.

Nielsen, T. A., & Germain, A. (2000). Post-traumatic nightmares as a dysfunctional state. *Behavioural and Brain Sciences*, 23, 978-979.

Nielsen, T., & Levin, R. (2007). Nightmares : a new neurocognitive model. *Sleep Medicine Reviews, 11,* 295-310.

Nofzinger, E. A., Mintun, M. A., Wiseman, M., Kupfer, D. J., & Moore, R. Y. (1997). Forebrain activation in REM sleep : an FDG PET study. *Brain Research*, 770, 192-201.

Palagini, L., & Rosenlicht, N. (2011). Sleep, dreaming and mental health: a review of historical and neurobiological perspectives. *Sleep Medicine Reviews*, 15, 179-186.

Panksepp, J. (1992). A critical role for "affective neuroscience" inresolving what is basic about basic emotions. *Psychological Review, 99,* 554-560.

Panksepp, J. (1998). *Affective neuroscience: the foundations of human and animal emotions*. New York: Oxford University Press.

Panksepp, J. (2005). Affective consciousness: core emotional feelings in animals and humans. *Consciousness and Cognition, 14,* 30-80.

Panksepp, J. (2007). Criteria for basic emotions: is DISGUST a primary "emotion"? *Cognition and Emotion, 21,* 1819-1828.

Pesant, N., & Zadra, A. (2006). Dream content and psychological well-being: a longitudinal Study of the continuity hypothesis. *Journal of clinical psychology*, 62, 111-121.

Pessoa, L., & Adolphs, R. (2010). Emotion processing and the amygdala: from a 'low road' to 'many roads' of evaluating biological significance. *Nature Reviews Neuroscience*, 11, 773-782.

Petersen, D. B., Gillam, S. L., & Gillam, R. B. (2008). Emerging procedures in narrative assessment: the index of narrative complexity. *Topics in Language Disorders, 28,* 115-130.

Philips, M. L., & Young, A. W. (1997). A specific neural substrate for perceiving facial expressions of disgust. *Nature*, 389, 495-498.

Revonsuo, A. (2000). The reinterpretation of dreams: an evolutionary hypothesis of the function of dreaming. *Behavioural and brain sciences*, 23, 793-1121.

Revonsuo, A., & Salmivalli, C. (1995). A content analysis of bizarre elements in dreams. *Dreaming, 5,* 169-187.

Revonsuo, A., & Tarkko, K. (2002). Binding in dreams: the bizarreness of dream images and the unity of consciousness. *Journal of Consciousness Studies, 9,* 3-24.

Schredl, M. (2010). Dream content analysis: basic principles. *International Journal of Dream Research, 3,* 65-73.

Schredl, M., & Reinhard, I. (2011). Gender differences in nightmare frequency. *Sleep Medicine Reviews, 15,* 115-121.

Sergerie, K., Chocol, C., & Armony, J. L. (2008). The role of the amygdala in emotional processing: A quantitative meta-analysis of functional neuroimaging studies. *Neuroscience and Biobehavioural Reviews*, 32, 811-830.

Siebert, M., Markowitsch, H. J., & Bartel, P. (2003). Amygdala, affect and cognition in 10 patients with Urbach-Wiethe disease. *Brain*, 126, 2627-2637.

Solms, M. (2000). Dreaming and REM sleep are controlled by different brain mechanisms. *Behavioural and Brain Sciences*, 23, 793-1121.

Tranel, D., Gullickson, G., Koch, M., & Adolphs R. (2006). Altered experience of emotion following bilateral amygdala damage. *Cognitive Neuropsychiatry*, 11, 219-232.

Valli, K., & Revonsuo, A. (2009). The threat simulation theory in light of recent empirical evidence: a review. *American Journal of Psychology*, 122, 17-38.

Valli, K., Strandholm, T., Sillanmäki, L., Revonsuo, A. (2008). Dreams are more negative than real life: implications for the function of dreaming. *Cognition and Emotion, 22,* 833-861.

Van Hougenhouck-Tulleken, W., Chan, I., Hamada, T., Thornton, H., Jenkins, T., McLean, W. H. I., ... Ramsay, M. (2004). Clinical and molecular charecterization of lipoid proteinosis in Namaqualand, South Africa. *British Journal of Dermatology*, 151, 413-423.*i*

Whalen, P. J., Shin, L. M., McInerny, S. C., Fischer, H., Wright, C. I., & Rauch, S. L. (2001). A functional MRI study of human amygdala responses to facial expressions of fear versus anger. *Emotion*, 1, 70-83.

Wilensky, A. E., Scafe, G. E., Kristensen, M. P., & LeDoux, J. E. (2006). Rethinking the fear circuit: the central nucleus of the amygdala is required for the acquisition, consolidation,

and expression of Pavlovian fear conditioning. *The Jornal of Neuroscience*, 26, 12387-12396.

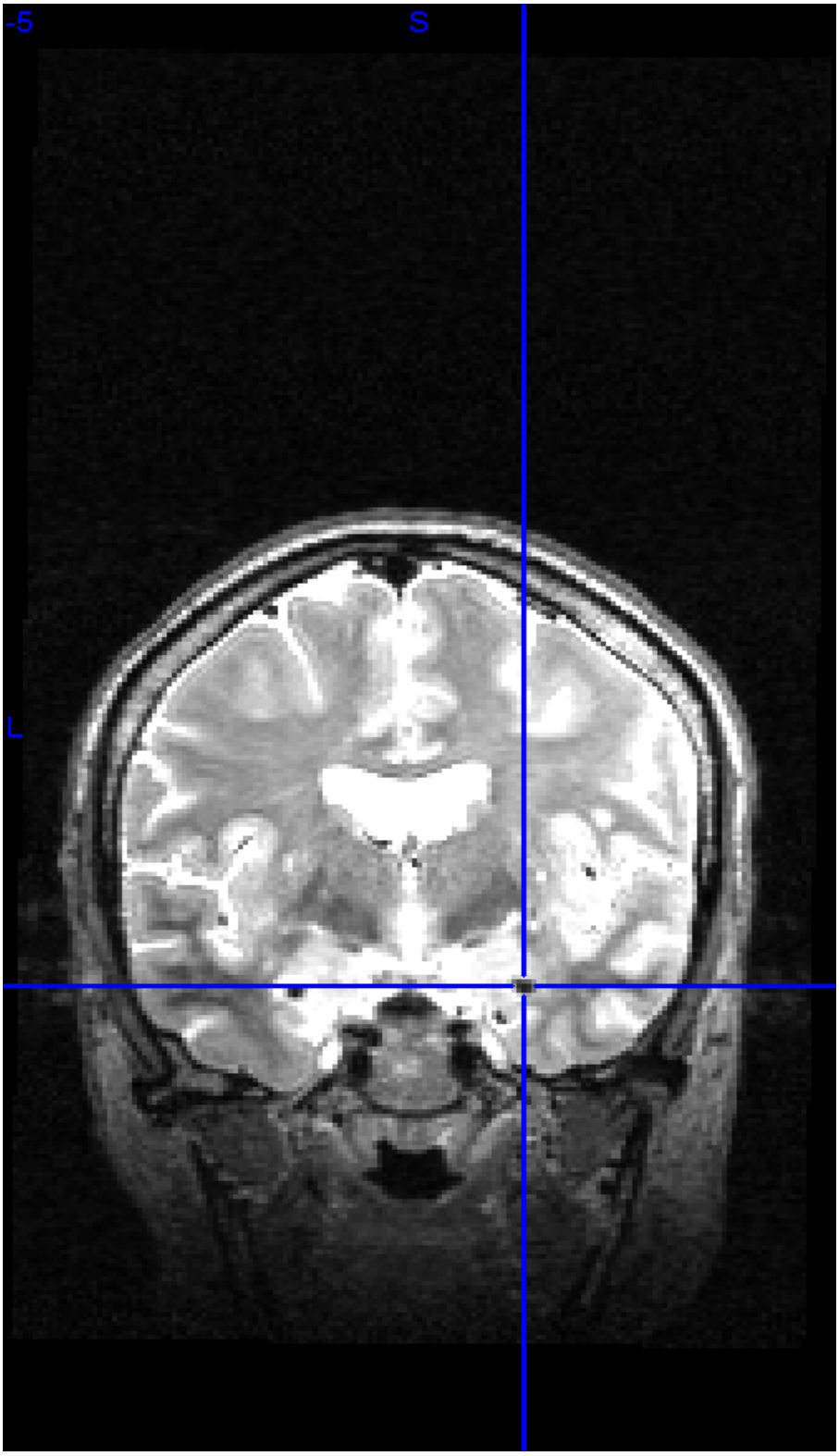
Yang, T. T., Menon, V., Elliez, S., Blasey, C., White, C. D., Reid, A. J., ... Reis, A. L. (2002). Amygdalar activation association with positive and negative facial expressions. *NeuroReport*, 13, 1731-1741.

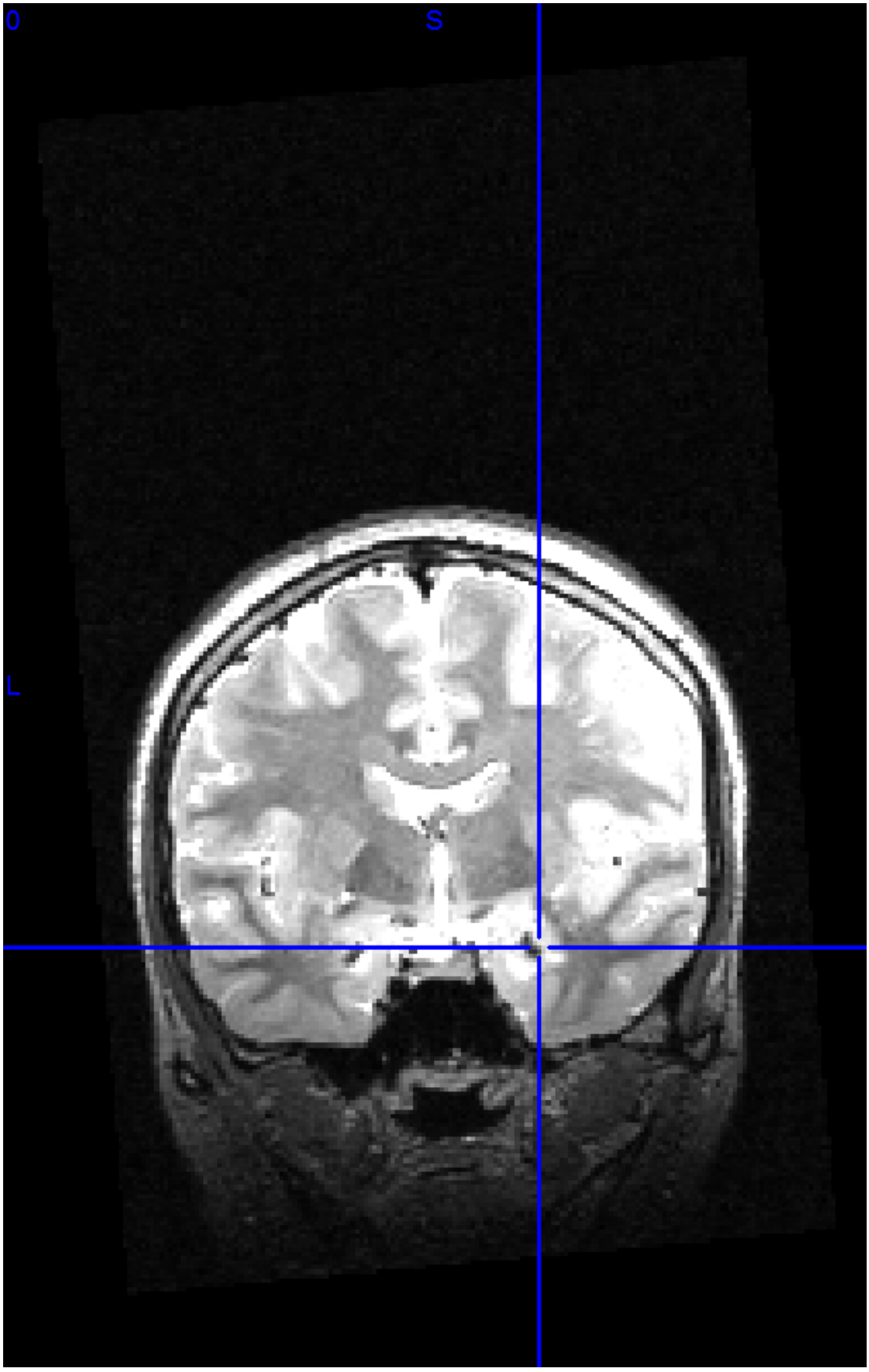
Zadra, A., Desjardins, S., Marcotte, E. (2006). Evolutionary function of dreams: a test of the threat simulation theory in recurrent dreams. *Consciousness and Cognition, 15,* 450-463.

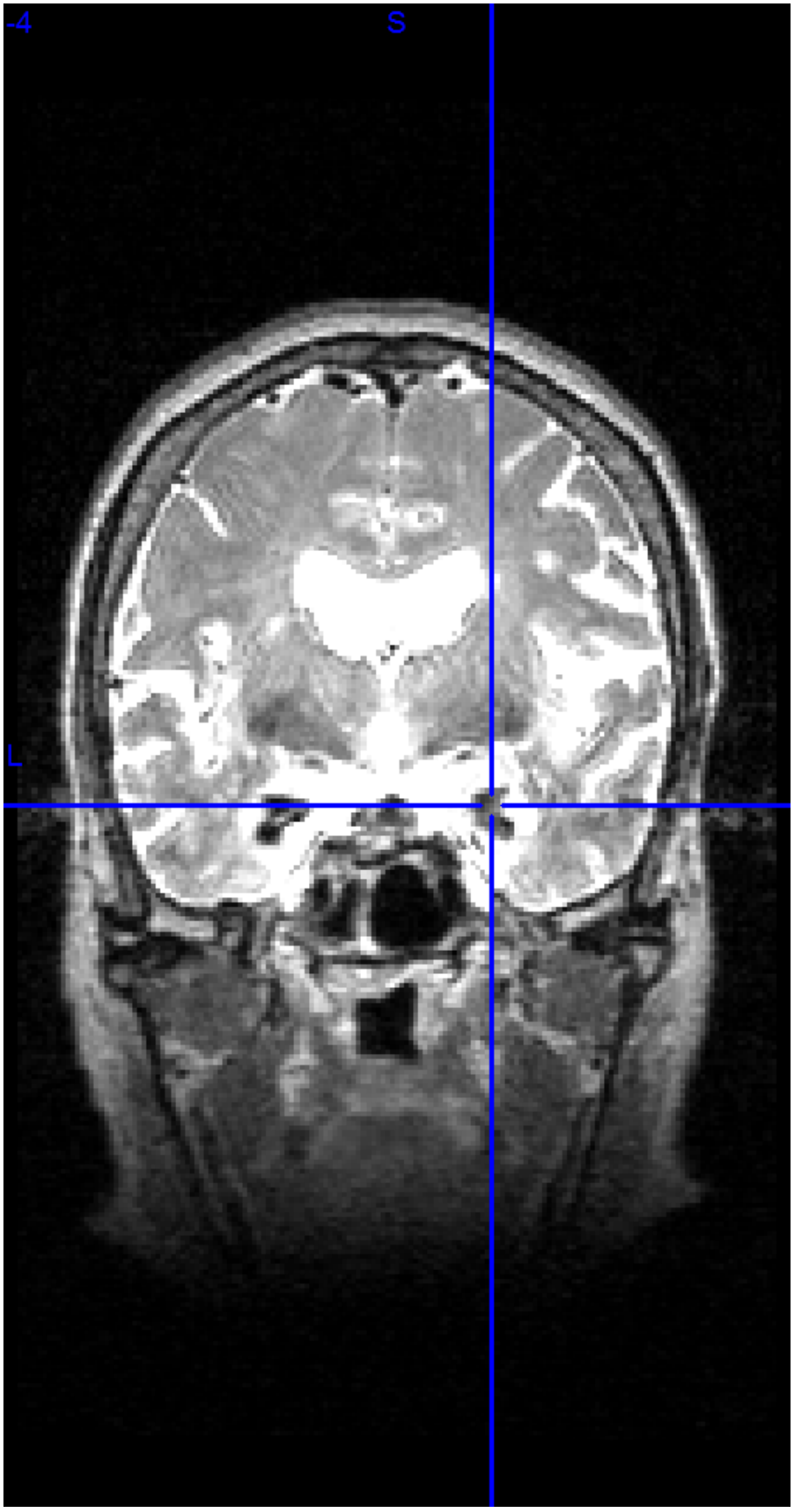
Zadra, A., Donderi, D. C. (2000). Nightmares and bad dreams: their prevalence and relationship to well-being. *Journal of Abnormal Psychology, 109,* 273-281.

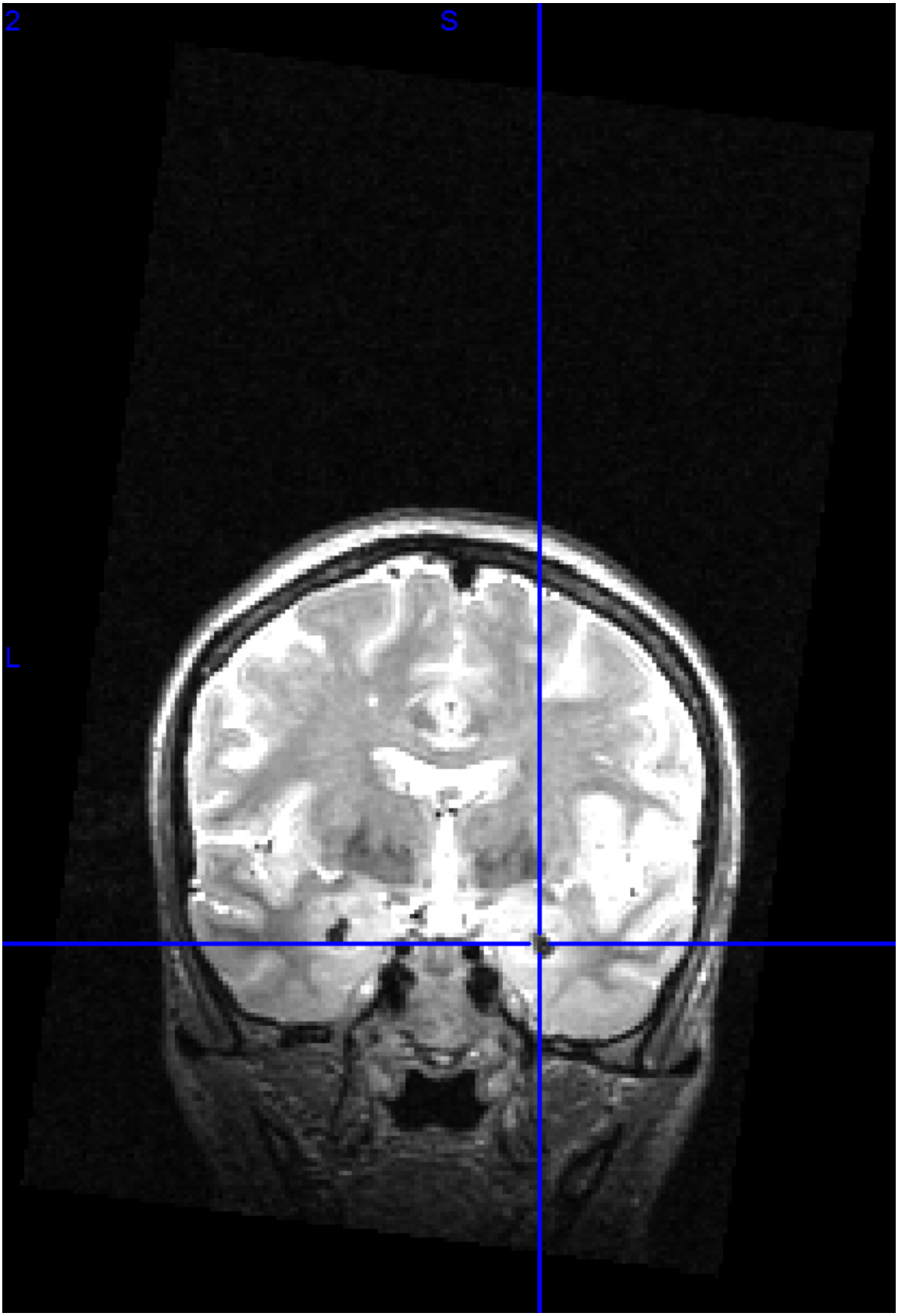
Appendix A

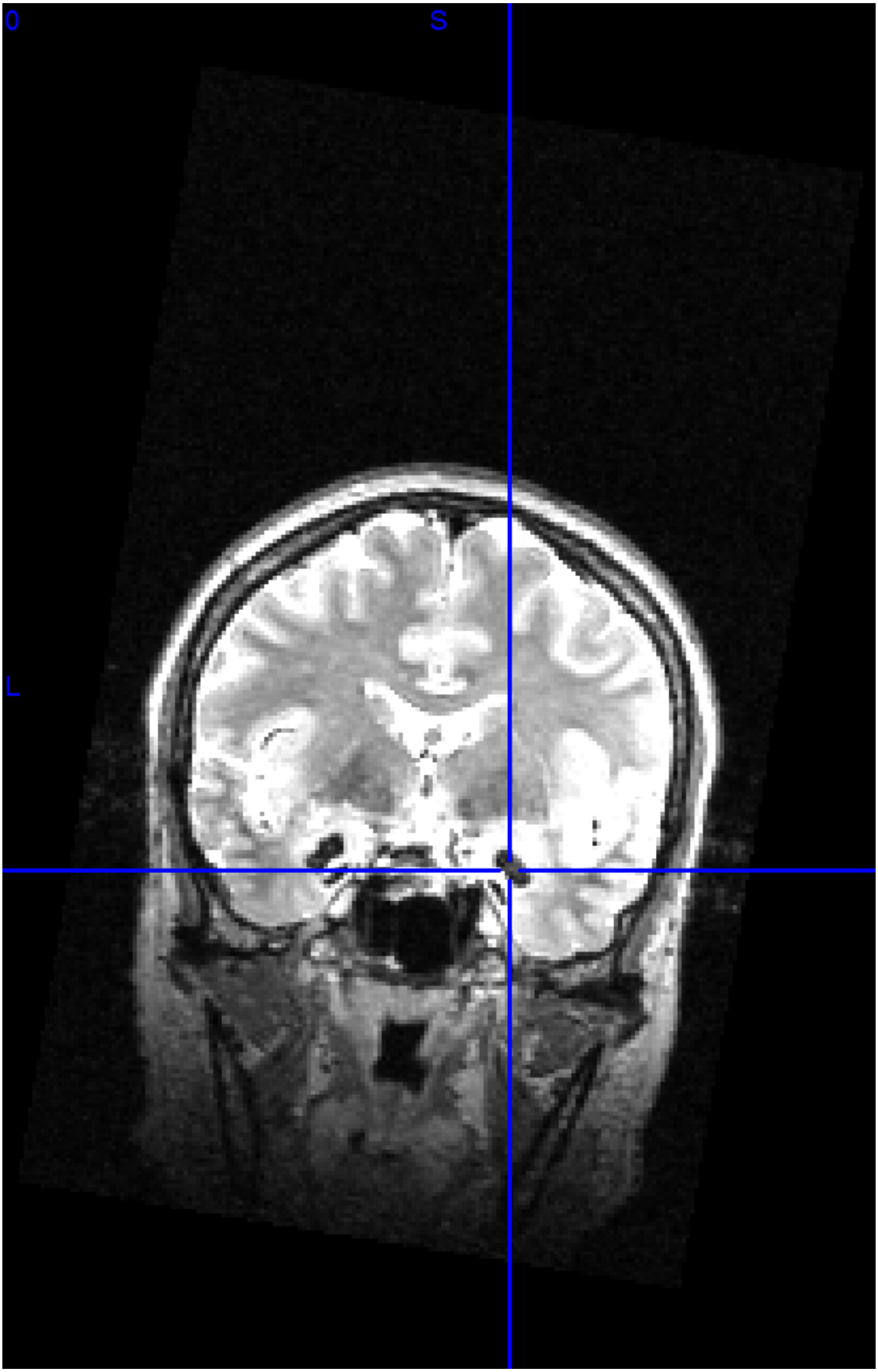
MRI Scans of UWD Patients

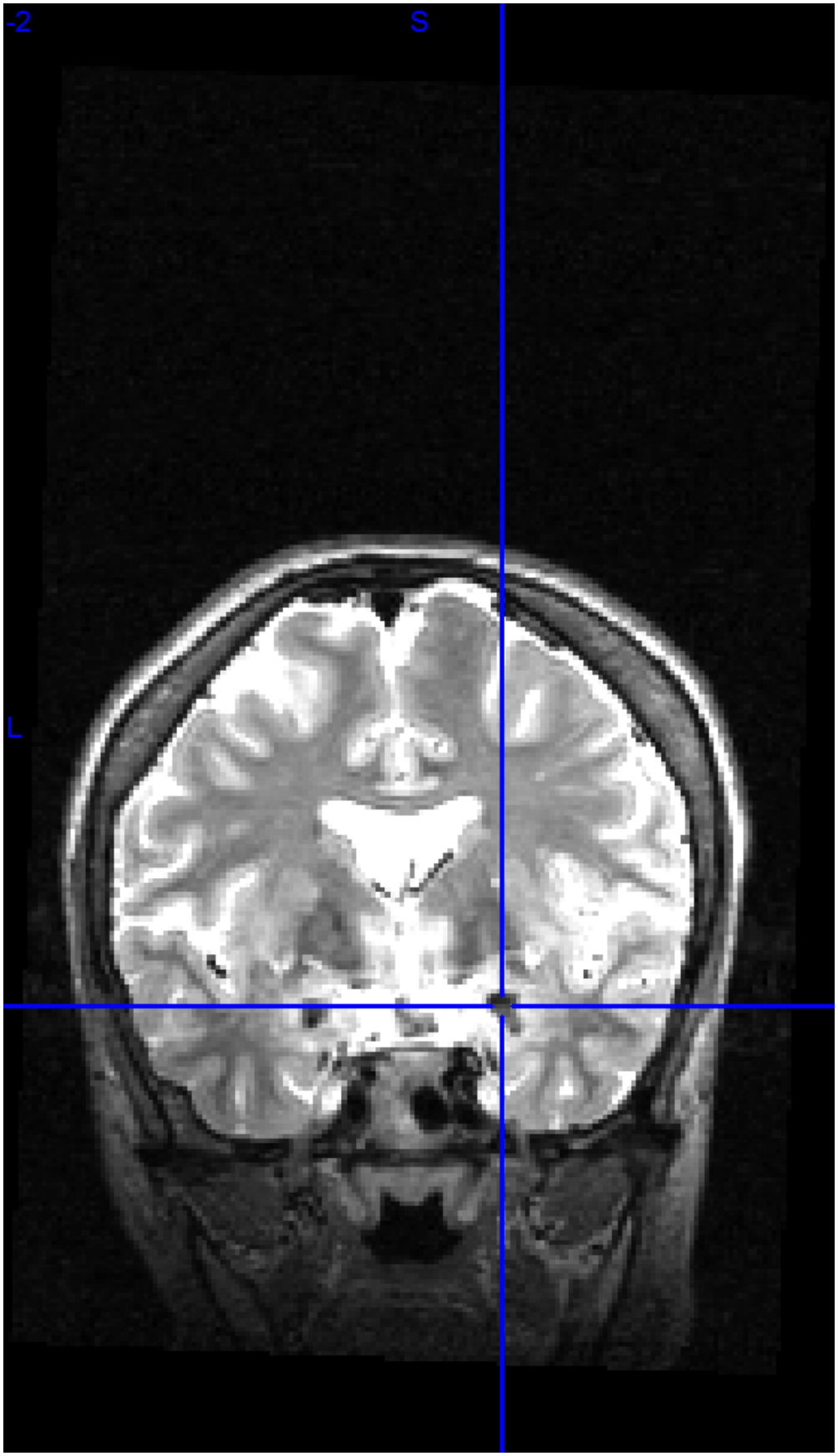



0
S
L


-4
S
L


2
S
L


0
S
L


-2
S
L

Appendix B

The MRD Report

MOST RECENT DREAM REPORT

We would like you to describe the last dream you remember having, whether it was last night, last month, or last year.

Please describe the dream exactly and as fully as you remember it. Your report should contain, whenever possible: a description of the setting of the dream, whether it was familiar to you or not; a description of the people, their age, sex, and relationship to you; and any animals that appeared in the dream. If possible describe your feelings during the dream and whether it was pleasant or unpleasant. Be sure to describe exactly what happened to you and the other characters in the dream. Continue your report on the other side and on additional sheets if necessary.

Appendix C

Instructions For Coders

General Overview

The work I'm going to ask you to do will involve coding a series of dreams along different measures. First, I'll train you in the coding methods and have you code practice dreams.

Once you understand each coding method, we will move onto the actual data analysis. We will ask you to code for affect, narrative complexity and bizarreness by consensus. This entails that you will discuss the rating of each dream on each of these measures amongst yourselves until you all agree, and then you'll record the result. I won't be involved in this coding at all; although I will be in the room with you should any problems arise.

In addition, there are a number of measures which I will ask you to each code individually. I'll explain the methods for this part of the coding to you, and then ask you to complete this coding in your own time at home. Obviously you'll be paid for all the time you spend on it. For this individual section we will need to achieve 80% consensus on the practice dreams before you can start with the actual data analysis.

AFFECT

1) Here, you are required to indicate to what extent each of the following categories of emotion is present in the dream that you are coding:

A	Anger/Rage: Aggression:	Anger refers to feelings of strong displeasure or hostility; annoyance; irritation; fury; resentment. Rage refers to feelings of violent explosive anger. Hostility; violence; feelings of aggression.
B	Sexual Love/Erotism:	Sexual love refers to the fulfilment of sexual gratification of any kind. The desire for sexual gratification, or the *anticipation* of any sexual interactions, should be rated under category D.
C	Playfulness: Joy: Exuberance:	Finding or making causes for amusement; pleasantly humorous or jesting; full of fun and high spirits. Any actions relating to play should be rated here as well. Happiness; pleasure; enjoyment; bliss; delight. Enthusiasm; excitement; liveliness; energy; high spirits; cheerfulness
D	Seeking/Curiosity: Anticipation:	To try to locate or discover; the act of searching for something; to try to obtain. *Curiosity* refers to feelings of inquisitiveness or interest. To look forward to, especially with pleasure; expectance; suspense; hopefulness.
E	Care/Nurturance: Affection:	To watch over; be responsible for; physical and emotional care and nourishment; to take care of or to nurture someone or something. A feeling of warm personal attachment or deep affection, as for a parent, child, spouse or friend. Feelings of love should be included here only if of a non-sexual type – if feelings of love are both sexual and affectionate, then both categories (B and E) should be chosen.
F	Fear: Anxiety: Apprehension:	A distressing emotion aroused by impending danger, evil, pain, etc., whether the threat is real or imagined; the feeling or condition of being afraid; dismay, dread, terror, fright, panic. Distress or uneasiness of mind caused by fear of danger or misfortune. Uneasiness; worry; nervousness; hesitation.
G	Sorrow/Grief/Loss:	Mental suffering or pain caused by separation, loss or despair; a source of deep mental anguish, torment, distress.
H	Dominace/Power/Control:	Feelings of authority or control over others; asserting authority over others; control over events and people; feelings of power, high-status. DO NOT rate feelings of *wanting* power here, these should be considered anticipatory and rated under category D.

Please use the following 0-3 scale:

3=these emotions were very intense

2= a moderate amount of these emotions were present

1=very little of these emotions were present

0= these emotions were absent

2) On the same scale – please rate:

A – The general intensity of the positive affect shown in the dream as a whole.

B – The general intensity of the negative affect shown in the dream as a whole.

3) Using the same scale, please rate to what extent you could call this dream is a wish-fulfilment dream, or to what extent you think this dream constitutes the fulfilment of a wish. Please make this rating based on your own personal, common-sense understanding of what wish fulfilment might be.

4) Would you call this dream a nightmare? Please answer yes or no. Again, please make this decision based on your own personal, common-sense understanding of what a nightmare is.

BIZARRENESS

1) Here, please first identify each content element and assign it to a content category. Once you have done this, please indicate on the form how many instance of each content category you observed.

2) Now, please identify each content element as either: non-bizarre, incongruous, vague, or discontinuous. Please indicate on the form how many of each bizarreness-type you observed under each content category.

The Content Analysis of Bizarreness Scale.[1]

Scoring is carried out in two stages: (1) Element identification and (2) Content/bizarreness scoring (see text for details). The use of this scale requires that there is adequate background information concerning how the dream events relate to the personal waking reality of the dreamer.

Identification of Content Elements

General principles

(1) Every identified element is assigned to one and only one content category.

(2) Every dream element carrying novel information is identified when it is mentioned for the first time in the dream report. For example, an object and all the adjectives used to describe its features are each identified as distinct elements.

[1]The original scale used in this study as well as the dreams analyzed were in Finnish. Some of the translations presented here may be only approximate.

(3) If new features of a previously mentioned element are mentioned, they are scored as new elements. Redundant information is not to be scored.

(4) An element is identified only when it is explicitly mentioned in the dream report. No elements are to be inferred on the basis of context.

(5) Elements are identified only in such parts of the dream report which are described as real events from the point of view of the dreamer. If dreamed events or objects are represented as unreal in the dream (e.g. events or objects in a movie watched in the dream) they are not to be scored.

There are 14 content element categories. Of these, seven refer to different kinds of object-like entities which are directly perceived in the dream (Self, Place, Persons, Animals, Body Parts, Plants, Objects). In the dream report, these elements consist of (1) nouns referring to these entities (e.g., dog, man, home, tree, table) or (2) adjectives or other words describing the perceptible features of these entities (e.g., big, small, old, green, angry, broken). The rest of the content categories refer to different kinds of entities and their identification is explained below in detail.

Classification of bizarreness

(1) Every bizarre feature is scored as bizarre only when it is mentioned for the first time in the dream. The bizarre element sets the context for what can be considered as a further bizarreness. Thus, the direct implications of a bizarre assumption in the dream are not themselves considered as independently bizarre. Only elements which bring further bizarre assumptions to the dream are scored as independently bizarre (cf. Hunt, 1982, p.594). Thus, dreaming of seeing a kangaroo in the bushes on my backyard is scored as a bizarre animal (animal in a wrong context). But if I dream that I am in Australia and in this dream there is a kangaroo in the bushes, it is not an exotic animal in this context, but Australia is scored as a bizarre place (the place is an unlikely context

for me). And if I next see cloudberries growing in a forest in Australia, this is of course a bizarre plant (plant in a wrong context).

(2) Every element is non-bizarre until shown to be bizarre. That is, if the judges disagree as to whether a certain element is bizarre or not, the burden of proof is on the one claiming that the element is bizarre.

There are 3 mutually exclusive bizarreness categories and 1 non-exclusive category. The general features of the

Bizarreness Categories:

1. Non-bizarre element. A dream element (or its feature) which is ordinary and congruous with waking reality.

Example: I dream that I am in my room which appears as it is in waking reality [*non-bizarre place*].

2. Incongruous element. A dream element which has at least one of the following properties:

> 2a. Internally distorted or contextually incongruous elements. An element which has a feature that does not belong to it in waking reality or which appears in a context in which it would not appear in waking reality.
> Example: My room is much bigger than it is in reality [internally distorted place].
> My room is in the middle of a forest [contextually incongruous place].
>
> 2b. Exotic elements. An element which is highly unlikely to occur in the dreamer's waking reality, but the occurrence of which is nevertheless possible in principle.
> Example: I was in a tropical jungle [exotic place].
> I met the Secretary General of the United Nations [exotic character].
> 2c. Impossible elements. An element or a feature of an element the existence or occurrence of which is not possible in waking reality.

> My dead grandfather came to visit us [impossible character]. I was flying above the city like Superman [impossible action]. We were on an alien planet [impossible place].

3. Vague element. An element or a feature of an element the character or identity of which is indeterminate, unknown or obscure in a way which does not occur in waking life.

Example: I was in a place which was my room but at the same time it was also a submarine [indeterminate identity of place].
I was in some city but I do not know or remember which one [vague identity of place].

Bizarreness categories 1-3 are mutually exclusive and each content element falls into one and only one of these categories. There was a further bizarreness category in addition to these which could be assigned to a content element.

4. Discontinuous element. An element which is temporally discontinuous; it suddenly and unexpectedly appears or disappears or is transformed in the dream. The content of a discontinuous element is always the one to which the element belongs after the transformation. In case the discontinuity is total (i.e. everything else but the Self changes) but the discontinuity is not in any way noticed or commented (e.g. "and *suddenly* I was..."), it is considered and scored as a whole new dream, not a discontinuity within one dream.

This category was not mutually exclusive with the others, since an element can be discontinuous independently of whether it is non-bizarre, incongruous, or vague.

DEFINITIONS OF CONTENT CATEGORIES AND BIZARRE CONTENT ELEMENTS

1. Self

Definition: The subject (or its features) who acts in or observes the dream world. The person or being from whose point of view the dream world is experienced and who appears in the first

person in the dream report. The features scored as features of Self are those which belong to the identity of the Self (age, sex, size, race, profession).

1.1. *Non-Bizarre Self*

The self in the dream is not mentioned being in any way different from the corresponding person in the real world. The self of the dream is essentially the same person with features similar to the dreamer's self when awake.

1.2. *Incongruous Self*

a) [Distorted] The self in the dream has a feature which does not belong to the person in real life. The dream self is the waking self, but somehow distorted (e.g. different age, sex, profession, social status etc.).

b) [Exotic] The self in the dream is not the same person as in real life. The dream self is identified as a different person, not only as a distortion of the waking person.

c) [Impossible] The self in the dream is not a real human being at all. It is an animal, a robot, a supernatural being, or some other fictional or unreal character.

1.3. *Vague Self*

There is no determinate self in the dream, or it is very obscure or indeterminate and difficult to describe.

1.4. *Discontinuous Self*

The self in the dream suddenly and unexpectedly appears, transforms or disappears.

2. Place

Definition: The immediate surroundings (and its features) and geographical location of the dream events or the dream self. For example: room, building, street, forest, train, city, country. Implies that the dream events are represented from a point of view within the place. If e.g. a building is

observed only from the outside, it falls under the category of Object. Features of Place include, for example, temperature and other weather conditions (darkness, lightness), and all "global" features which are not features of a single Object or other element in the Place.

2.1. *Non-Bizarre Place*

The place in the dream is either a familiar place similar to the one in the real world or an unfamiliar but ordinary place.

2.2. *Incongruous Place*

a) [Distorted] A familiar place which in the dream has a feature which does not belong to it in real life. Also a familiar place in a wrong geographical or temporal context.

b) [Exotic] A place which is very unfamiliar and a very unlikely one for the subject to find himself in in real life.

c) [Impossible] A place in which it is not physically possible for the subject to be (e.g. outer space, a fictional place).

2.3. *Vague Place*

A place the nature or identity of which is obscure or indeterminate.

2.4. *Discontinuous Place*

A sudden and unexpected appearance, transformation, or disappearance of the place.

3. Time

Definition: The explicitly mentioned temporal context of the dream events. Time of the day, date, month, season, year, era.

3.1. *Non-bizarre time*

The time mentioned in the dream is normal and well in accordance with the dream events (e.g. going to work at 8 o'clock in the morning).

3.2. *Incongruous time*

a) [Distortion] The time mentioned in the dream is not congruous with the dream events (e.g. it is night but the sun is shining).
b)[Exotic time] The time mentioned in the dream clearly deviates from the present real time and is far from the present reality of the dreamer, but belongs to his or her possible past or future.
c)[Impossible time] The time mentioned in the dream cannot belong to the possible personal past or future of the dreamer. The dream events take place in the distant past or future.

3.3. *Vague time*

The time of the dream events is obscure or indeterminate.

3.4. *Discontinuous time*

A sudden and unexpected change of or break in the temporal context of the dream.

4. Persons

Definition: The human or humanoid or other intelligent characters, and groups formed by such characters, perceived by the subject in the dream. Features to be scored as features of persons include age, sex, size, race, profession.

4.1. *Non-bizarre person*

A familiar person who is not mentioned differing from the corresponding real person or an unfamiliar but ordinary person.

4.2. *Incongruous person*

a)[Distorted person] A person with a feature that does not belong to that person in reality (e.g. different appearance or age) or a person in a wrong context (e.g. in a different role or place).
b) [Exotic person] A person that is very unlikely to be met by the dreamer in real life.
c) [Impossible person] A person that does not or cannot exist (e.g. a dead or a fictional character)

4.3. *Vague person*

A person whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous person*

A person who suddenly and unexpectedly appears, transforms, or disappears.

5. Animals

Definition: Animate characters other than Persons perceived in the dream, and groups formed by such characters. Includes non-humanlike unknown monsters and alien creatures.

4.1. *Non-bizarre animal*

A familiar or ordinary (species of) animal.

4.2. *Incongruous animal*

a)[Distorted animal] An animal with a feature that does not belong to it in reality (e.g. different appearance) or an animal appearing in a wrong context.

b) [Exotic animal] An animal that is very unlikely to be met by the dreamer in real life.

c) [Impossible animal] An animal which does not or cannot exist.

4.3. *Vague animal*

An animal whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous animal*

An animal which suddenly and unexpectedly appears, is transformed, or disappears.

6. Body Parts

Definition: Human and animal bodies and their parts and features perceived in the dream. The parts can belong to a character (the beak of a bird) or they may be detached (a bearskin, a tooth). Also the fluids of the body (blood, slime, etc.) and perceivable injuries of the body (bruises, tumors, bumps, rash, pimples, etc.).

4.1. *Non-bizarre body part*

An ordinary body part which is does not differ from the corresponding real one.

4.2. *Incongruous body part*

a)[Distorted body part] A body part with a feature that does not belong to it in reality (e.g. different appearance) or a body part in a wrong context (e.g. an additional or missing body part).

b) [Exotic body part] A body part that is very unlikely to be met by the dreamer in real life (the trunk of an elephant, synthetic body parts).

c) [Impossible body part] A body part which does not or cannot exist (e.g. detached but living and moving body parts)

4.3. *Vague body part*

A body part whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous body part*

A body part which suddenly and unexpectedly appears, is transformed, or disappears.

7. Plants

Definition: All kinds of vegetation (trees, flowers, bushes, mushrooms, grass) and their parts (berries, fruits, vegetables, roots, branches, leaves) perceived in the dream.

4.1. *Non-bizarre plant*

A familiar plant which is not mentioned differing from the corresponding real plant or an unfamiliar but ordinary one.

4.2. *Incongruous plant*

a)[Distorted plant] A plant with a feature that does not belong to it in reality (e.g. different appearance) or a plant in a wrong context.
b) [Exotic plant] A plant that the dreamer is very unlikely to come across in real life.
c) [Impossible plant] A plant which does not or cannot exist (e.g. moving plants)

4.3. *Vague plant*

A plant whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous plant*

A plant which suddenly and unexpectedly appears, is transformed, or disappears.

8. Objects

Definition: A part (or a feature of a part) of the inanimate environment, which is perceived in the dream. Different objects can be perceived in different ways (vision, touch, hearing).

4.1. *Non-bizarre object*

A familiar object which is not mentioned differing from the corresponding real object or an unfamiliar but ordinary one.

4.2. *Incongruous object*

a)[Distorted object] An object with a feature that does not belong to that object in reality (e.g. different appearance), or an object in a wrong context (e.g. in an inappropriate place).
b) [Exotic object] An object that the dreamer is very unlikely to come across in real life.
c) [Impossible object] An object which does not or cannot exist.

4.3. *Vague object*

An object whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous object*

An object which suddenly and unexpectedly appears, is transformed, or disappears.

9. Events

Definition: Events are causal changes taking place in the inanimate environment or in animate objects, which cannot be considered as the intentional actions of any single character (e.g. weather processes, the behaviour of objects when not guided by dream characters, collective

events like wars, riots, gatherings). Incidents which happen to the dream characters without their control (bumping into something, finding something etc.).

4.1. *Non-bizarre event*

A familiar event or incident which is not mentioned differing from the corresponding real event or an unfamiliar but ordinary one.

4.2. *Incongruous event*

a)[Distorted event] An event with a feature that does not belong to that event in reality (e.g. the event does not have its regular causal consequences), or an event in a wrong context (e.g. in a different role or place).
b) [Exotic event] An event that is very unlikely to take place in real life (e.g. the eruption of a volcano in England).
c) [Impossible event] An event which does not or cannot take place (e.g. objects flying by themselves, broken objects mending by themselves)

4.3. *Vague event*

An event whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous event*

An event which suddenly and unexpectedly appears, is transformed, or disappears (e.g. a sudden event taking place without any preceding causal antecedent).

10. Action

Definition: Actions are intentional acts carried out by the animate characters in the dream. Also the behaviour of devices directly controlled or assumed to be controlled by animate characters (cars, airplanes). Also actions of speaking when no referral to the content of speech is made

(content belongs to Language). If action is only planned but not carried out by the Self, it belongs to Cognition.

4.1. *Non-bizarre action*

A familiar action which is not mentioned differing from the corresponding real action or an unfamiliar but ordinary action.

4.2. *Incongruous action*

a)[Distorted action] An action with a feature that does not belong to that action in reality (e.g. abnormal or repeated failure in a trivial action) or an action in a wrong context (e.g. in an inappropriate role or place).
b) [Exotic action] An action that is very unlikely to be carried out in real life (e.g. very risky or perverted or criminal action).
c) [Impossible action] An action which is not physically possible (e.g. flying by flapping one's arms, breathing under water without diving equipment)

4.3. *Vague action*

An action whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous action*

An action which suddenly and unexpectedly (unmotivatedly) is carried out, transformed, or suspended and forgotten.

11. Language

Definition: Words and sentences uttered by the animate characters in the dream and other linguistic messages and symbols: writing, text, numerical symbols. The message is evaluated by its form and its content.

4.1. *Non-bizarre language*

An ordinary expression which has a grammatically correct form and a content semantically and pragmatically appropriate.

4.2. *Incongruous language*

a)[Distorted language] An expression with a feature that does not belong to normal colloquial language (e.g. grammatical errors, semantical errors, neologisms), or a grammatically correct expression in a wrong context (e.g. use of foreign language, a message uttered by an inappropriate speaker, or expressing a statement which does not correspond with reality).
b) [Exotic language] An expression that is very unlikely to be uttered in real life (e.g. expresses an extremely absurd thought or illogical reasoning)
c) [Impossible language] An expression which is completely irrelevant, irrational and absurd and does not make any sense at all.

4.3. *Vague language*

An expression whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous language*

An expression which suddenly and unexpectedly appears, is transformed, or disappears.

12. Cognition

Definition: The internal intellectual and mental functions of the Self. For example: internal speech, thoughts, beliefs, value judgements, reflection on events, planning, problem solving, decision making, reasoning, mental imagery, knowing and understanding. The mental functions of other characters in the dream are not scored in this category but according to how they are perceived by the subject (as speech, action, emotion etc.).

4.1. *Non-bizarre cognition*

A familiar or logical or otherwise adequate thought or cognitive process.

4.2. *Incongruous cognition*

a)[Distorted cognition] A thought or cognitive process with a feature that does not belong to it (e.g. grammatical or semantic errors in internal speech, false memories, false understanding, uncritical acceptance of dubious beliefs, delusional beliefs not based on anything actually perceived in the dream, false or unfounded knowledge).
b) [Exotic cognition] Disoriented, irrational and illogical cognitive functioning.
c) [Impossible cognition] Loss of control of cognitive processes, continuous obsessive thoughts or mental images, irrelevant and disorganized thoughts, inability to think at all, termination of all voluntary cognitive processes.

4.3. *Vague cognition*

Cognitive processes whose presence or nature or is obscure or indeterminate.

4.4. *Discontinuous cognition*

Cognitive processes which suddenly and unexpectedly appear, are transformed, or disappear.

13. Emotions

Definition: Emotional states and feelings experienced and expressed by the dreamer or expressed by other dream characters. Includes emotions, feelings, moods, emotional attitudes (desires), and actions which refer to expression of emotions (crying, laughing).

4.1. *Non-bizarre emotion*

An emotion which is adequate in the context in question and would not be unlikely to appear in a corresponding waking situation.

4.2. *Incongruous emotion*

a)[Distorted emotion] An ordinary emotion with a feature that does not belong to it (exaggerated emotional reaction) or an emotion or lack of it which is unlikely in a comparable waking situation.
b) [Exotic emotion] A very extreme emotional reaction rarely encountered in waking life but which is somehow related to the dream events.
c) [Impossible emotion] A very extreme emotional reaction which is not in any way related to the dream events.

4.3. *Vague emotion*

An emotion whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous emotion*

An emotion which suddenly and unexpectedly appears, is transformed, or disappears.

14. Sensations

Definition: Sense experiences which occur independently of voluntary cognitive processes and which do not refer to objects outside of themselves (e.g. pains, itches, sensations of heat, pleasure, odor, nausea, sleepiness etc.).

4.1. *Non-bizarre sensation*

A familiar or ordinary sensation which appears in an appropriate context.

4.2. *Incongruous sensation*

a)[Distorted sensation] An ordinary sensation with a feature that does not normally belong to it (e.g. synesthesia, sensations of abnormal intensity, a sensation in an inappropriate context, or lack of normal sensation).
b) [Exotic sensation] A very unlikely sensory experience which is somehow related to the dream (e.g. blindness, deafness, disorganization of senses).
c) [Impossible sensation] Sensory experiences not physically possible (supernatural senses, indescribable or alien sensory experiences).

4.3. *Vague sensation*

A sensation whose presence or nature or identity is obscure or indeterminate.

4.4. *Discontinuous sensation*

A sensation which suddenly and unexpectedly appears, is transformed, or disappears.

Threat

Please choose either yes or no in response to each question, except for question 3, where you are required to choose between ancestral or modern. Note: If the answer to question 1 is no, do not continue with the other questions. If the answer to question 4 is no, do not answer question 5.

1) Does the dream contain a realistic physical threat to the dreamer?
   If yes:
2) Is the threat life threatening?
3) Is the threat ancestral or modern?
   Ancestral: ecologically valid threats - those present in our ancestral past, or similar to those present in our ancestral past, e.g. violent crime (murder, rape, assault, robbery) – include being threatened with a gun or shot at.
   Modern: Significant physical threats which have no equivalent in our ancestral past, e.g. major surgery, traffic accidents, airplane disasters, hijacking.
4) Does the dreamer escape the threat?
   If yes:
5) Is the escape realistic?

Avoidance and Approach Behaviour

1) Decide whether the main activity in the dream as a whole involves 'avoidance' or 'approach' behaviour on the dreamer's part. The behaviour must be rated either 'avoidance' or 'approach'; there is no other alternative. If more than one event is described, code the sequence of events as a whole. 'Avoidance' behaviour is defined as: 'the main activity of the subject of the dream is an attempt to avoid something through fleeing, freezing, hiding or the like'. 'Approach' behaviour is defined as: 'the main action of the subject of the dream is an attempt to approach something through engagement, exploration, curiosity or the like'. Code the dream in accordance with the dreamer's actual behaviour rather than their feelings, even if these contradict each other. For example, if the dreamer approaches an unknown place despite feeling scared, that is an instance of 'approach' behaviour. Likewise, if the dreamer is curious about an unknown person but hides away from him/her, that is 'avoidance' behaviour.

The following are prototypical examples of 'avoidance' and 'approach' behaviours, based on the scientific literature. These examples are not meant to be exhaustive; they just describe good examples of the two types.

Typical examples of 'approach' behaviour:

1. The dreamer engages with a thing/place/person/problem in an invigorated exploratory fashion, investigating or puzzling over it or trying to make sense of it.
2. The dreamer acts in a persistently or intensely interested/curious/inquisitive fashion.
3. The dreamer is eagerly seeking new sensations or exciting experiences.
4. The dreamer is searching for something or pursuing a goal, even if s/he does not or cannot achieve it.
5. The dreamer acts as though s/he is looking forward to something and/or anticipating something.
6. Almost any little thing stimulates the dreamer's interest.

Typical examples of 'avoidance' behaviour:

1. The dreamer is acting in an apprehensive, tense, worried or generally nervous fashion.
2. The dreamer is attempting to escape and avoid something unpleasant.
3. The dreamer is frozen or rooted to the spot by something frightening.
4. The dreamer is stuck and cannot reach a decision about something.
5. The dreamer misses an opportunity due to worry or anxiety.
6. The dreamer acts as though s/he dreads something bad.

Appendix D

Ethical Approval from the UCT Department of Psychology Ethics Committee

UNIVERSITY OF CAPE TOWN

Department of Psychology

University of Cape Town Rondebosch 7701 South Africa
Telephone (021) 650 3414
Fax No. (021) 650 4104

4 May 2009

Dr. Georg Fodor
c/o Department of Psychology
University of Cape Town
Rondebosch 7701

Dear Dr Fodor,

I am pleased to inform you that ethical clearance has been given for your project:

Emotional experience in Urbach-Wiethe Disease: A neuro-psychoanalytic study.

I wish you all the best for your study.

Yours sincerely,

Johann Louw PhD
Professor

Appendix E

Patient Information Sheet

You are invited to participate in a study on the effects of Lipoid Proteinosis (LP) on emotion and dreaming. Specifically, we are trying to document whether LP influences the emotional life or dreams of those affected by it.

If you consent to participate in this study, you will be required to answer the following questions (show questionnaires). The interviewer will be Sr. Mara Brandt and the interview will take place in private. Your responses will be recorded on a digital recorder (show recorder and memory card). Each participant will have their own memory card which will bear a number. No name or other personal information will be written on it. All the memory cards will be translated (your voice to English text) by one person who does not know you and who will only see the number on the card. This person will never know who you are.

The translation bearing the number will be analysed by another researcher who will also never know who you are or whether you have LP or not because your voice will not carry over from recording to text. Only once all the transcripts have been analysed will this researcher be told which transcript numbers are LP and which are not, as well as the age and sex of each transcript, but no names or other personal information will be given.

There are no anticipated personal risks involved in this research, apart from the temporary feelings associated with remembering distressing events. The data gathered from this research may be published, but your contribution and data will remain entirely anonymous.

Prior to the end of the interview there will be a debriefing session during which Sr Brandt will ask whether there is anything arising from this interview that you feel needs further attention (e.g. if the interview has triggered any strong emotions that you feel you need help coping with and you would like to talk to someone about). If so, Sr Brandt will discuss this with you in more detail and report back to Dr Morgan who will take the necessary action such as arranging for you to see a local psychologist or social worker. If you become aware of any problems once Sr Brandt has left you can contact her or Dr Morgan at any time (contact details below).

You are free to withdraw from the study at any point, without having to provide a reason.

NB: Your decision to participate or not participate will in no way impact on your ongoing medical care and treatment.

Should you have any questions or queries about the research or your participation, please do not hesitate to contact the investigators:

Dr Barak Morgan: 021 406 6840 (work); 083 417 6264 (cell)

Sr Mara Brandt: 027 682 2594 (home); 071 076 3999 (cell)

……..

I have read and understood this page and been given the opportunity to ask questions.

Signed: _____ on _____20____

Witness: _____