# Amygdala dysfunction and dream affect in Urbach-Wiethe disease

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**Abstract**

This study aimed to investigate the amygdala's involvement in dream affect. The amygdala is well known in the literature for its role in emotional processing, especially fear and anger. The amygdala is thought to modulate dream content in REM (rapid eye movement) sleep and is thought to account for large proportion of negative emotion in dreaming, as it is heightened during REM sleep. Patients with amygdala hyperactivity report greater negative emotions during dreaming and more nightmares. Studies have not yet investigated the effect of amygdala lesions on dream affect. Urbach-Wiethe disease (UWD) patients are useful in this regard as they have relatively isolated bilateral amygdala calcifications. Eight UWD patients and eight matched controls were recruited from a small rural community in the Northern Cape province of South Africa. Participants were all female, coloured, Afrikaans speaking, and aged 23-69. Participants were interviewed using the Most Recent Dream method. Dream reports were then coded for intensity of various basic emotions using a measure created for the purpose of this study. The measure was based on the seven basic neurobiological emotional systems identified by Panksepp (1998, 2006). Mixed-design ANOVAs were used to investigate between-group and within-group differences for each emotion, amygdala related versus non-amygdala related emotions, and positive versus negative emotions. The results showed that there were no significant differences in emotional intensity between the UWD patients and matched controls. No within-group differences or interaction effects were found in either group. These findings cast doubt on previous literature concerning the amygdala's central role in dream content.

*Keywords:* Urbach-Wiethe disease, dreaming, amygdala, emotion, dream reports

Emotions are a large component of human consciousness (Barrett, Mesquita, Ochsner, & Gross, 2007). They also pervade our dreams, an endogenous variety of consciousness (Hobson, 2004). Dreams are highly vivid and affective experiences which share various spatial, perceptual, and social qualities with wakefulness (Nielsen & Stenstrom, 2005; Nir & Tononi, 2010). The continuity hypothesis of dreaming has postulated that waking events are reflected in dream states (Schredl & Hoffman, 2002), and emotional experience in particular has shown similarities between wakefulness and dreaming (Pesant & Zadra, 2000; Yu, 2007).

The amygdala has been implicated as the driver of emotions in dreaming due to heightened amygdala activation in REM sleep (Hobson, 2004). The amygdala is an important neural substrate in emotional processing during waking consciousness, with a predominant role in fear and anger processing (LeDoux, 2003). As such, lesion studies involving the amygdala may provide greater insight into the precise role of the amygdala in dreaming. Urbach-Wiethe disease (UWD) patients have been valuable in establishing the functions of the amygdala due to the characteristic bilateral amygdala calcifications associated with the disease (Claeys et al., 2007; Thornton et al., 2008). Despite this, studies have not yet investigated the effect of bilateral circumscribed amygdala lesions on dream affect.

## The Continuity Hypothesis of Dreaming

At its most extreme, the continuity hypothesis considers waking and dreaming as identical states of consciousness, particularly in relation to formal content. The experiences of daily life can be reflected in dreaming, and dream experiences can also pervade waking consciousness (Pesant & Zadra, 2000). This content encompasses formal similarities between events, thoughts, and feelings experienced during these states (Schredl & Hoffman, 2002).

In addition to the formal continuity of experiences between waking and dreaming, similarities have been noted in terms of some aspects of neural activation. Evidence from neuro-imaging studies, lesion studies, neurological and psychiatric disorders have proved useful in establishing similarities and differences between the two states (Nir & Tonini, 2010).

**Similarities between waking and dreaming: Evidence from neuroscience.** Firstly, a review by Gottesmann (2002) has discussed several electroencephalography (EEG) studies that exhibited almost identical activity between waking and rapid eye movement (REM) sleep. Acetylcholine and dopamine release is also maximal during both of these states. In addition, a number of neuro-imaging studies using positron emission tomography (PET) have

shown overall glucose utilization similarities between waking and REM sleep (Braun et al., 1997; Maquet, 2000; Maquet et al., 1996; Nofzinger et al., 1997). Moreover, Maquet and colleagues (2000) reported that brain regions active whilst engaging in a cognitive task were also increased during REM sleep. These findings support the continuity hypothesis as events during wakefulness influenced identical brain regions in REM sleep. Non-rapid eye movement (NREM) sleep however has been reported to have shown a significant decrease in overall glucose utilization in comparison to waking (Nofzinger et al., 2002). Nevertheless, the study did not observe significant reductions in a number of regions, including limbic, hippocampal, cingulate, paralimbic, sensory, and motor areas. This suggests that similar patterns of activation occur in both waking and dreaming in these particular brain regions. Furthermore, some REM and NREM dreams have shown to be identical in terms of vividness and emotional content (Solms, 2000). Neuro-imaging studies have therefore been useful in associating similarities between brain activation across waking and dream states.

Secondly, lesion studies have provided additional support for the continuity hypothesis. For example, Solms (2000) has described several cases in which visual deficits in waking as a result of specific brain damage were extended to dreaming. These lesions were confined to the visual association areas. In contrast, lesions within the primary visual cortex of blind patients did not affect the visual aspects of their dreams. Speech was also found to be intact in brain damaged patients with aphasia. A more recent article by Schwartz, Dang-Vu, Ponz, Duhoux, and Maquet (2005) has echoed these findings. Nevertheless, there is at least some consistency between neural functioning in waking and dreaming.

Thirdly, evidence from neurological and psychiatric disorders has been useful for investigating similarities between waking and dreaming. Patients with temporal lobe epilepsy (TLE) have increased limbic system activation during seizures, which also occurs during sleep (Silvestri & Bromfield, 2004; Vercueil, 2005). Activity during waking is therefore equivocal in dreaming. In addition, patients with post-traumatic stress disorder (PTSD) have similar neural activation during waking and dreaming. A high incidence of nightmares is common to PTSD, which is partially accounted for by increased limbic activation and decreased prefrontal activation during waking and dreaming (Levin, Fireman, & Nielsen, 2010). Schizophrenic patients also provide support for the continuity hypothesis; PET scans conducted during hallucinatory states in schizophrenics are reflective of activation in dreaming (Hobson, 2004). Neuroscience has therefore helped to uncover numerous correspondences between waking and dreaming. Despite these findings, the extreme version of the continuity hypothesis is a highly controversial claim. This study will only consider the

continuity of affective mechanisms and the emotions experienced in waking and dreaming - a more diluted version of the hypothesis. The analysis of emotional experience in waking and dreaming is an especial source of support, in combination with neuropsychological findings.

**The continuity of emotion between waking and dreaming.** A study by Nielson, Deslauriers, and Baylor (1991) found that reports of emotional experiences during dreaming and waking were comparable. More recently, a study by Pesant and Zadra (2000) investigated emotional content in waking and dreaming, where a positive correlation was found for negative emotions. Domhoff (2001) reviews a number of studies that have also shown equivalent emotional content across these two states. A more recent study by Yu (2007) investigated the emotional content prior to, during, and after dreaming. Each stage was positively correlated in terms of emotional intensity and similarities were evident in the experience of various positive and negative emotions. These findings are reflective of the consistency of emotional content across dreaming and wakefulness.

Neuro-imaging studies have shown increased limbic and paralimbic activation during REM sleep (Braun et al., 1997; Maquet et al., 1996; Nofzinger at al., 1997). According to Nofzinger (2006) these patterns of activation during REM sleep reflect emotional processing, as are active during wakeful experiences of emotion. Patients with PTSD and TLE have enhanced limbic activation during wakefulness and dreaming. As such, they experience heightened emotions during waking and have a higher incidence of nightmares (Levin & Nielsen, 2007; Levin et al., 2010; Silvestri & Bromfield, 2004; Vercueil, 2005). Additionally, depressed patients have heightened activation in emotional processing areas during waking and this significantly increases in REM sleep (Nofzinger, 2006). A study by Peterson, Henke, and Hayes (2002) assessed limbic system activation in healthy participants using a self report measure known as the Limbic System Checklist (LSC-33, Teicher et al., 1993) and compared this to emotional content in dreaming. Participants with heightened limbic activation had significantly greater proportions of negative emotions in their dreams.

In summary, research suggests that REM dreams in particular have similar emotional processing activation and experiences to waking. Furthermore, the amygdala is one such structure that is active across these states and is strongly implicated in emotional processing (Braun et al., 1997; Hobson, 2004; Maquet et al., 1996; Nofzinger at al., 1997).

## The Amygdala and its Role in Dreaming

The amygdala is a small structure, consisting of 13 nuclei housed within the temporal lobe. The amygdala is a functional component of the limbic system (Adolphs, 2010). It is

implicated in the detection of emotional salience from the environment (LeDoux, 2003). Studies have also shown the amygdala's involvement in reward processing (Murray, 2007) and social cognition (Todd & Anderson, 2009). In spite of these functions, the majority of research indicates a primary role in fear processing (LeDoux, 2003).

Neuro-imaging studies have shown a functional role of the amygdala in fear processing, especially in fear conditioning. An fMRI study by Phelps et al. (2001) found significantly increased amygdala activation in healthy participants in anticipation of an aversive electric shock. These findings have been replicated in animal studies (LaBar, 2007). In addition, electrical stimulation of the human amygdala has evoked experiences of fear in TLE patients (Gloor, Olivier, Quesney, Andermann, & Horowitz, 1982; Lanteaume et al., 2007). Emotional facial recognition studies have also shown increased amygdala activation in response to fearful facial expressions (Costafreda, Brammer, David, & Fu, 2008; Sergerie, Chochol, & Armony, 2008).

In addition to fear, the amygdala also responds strongly to aggressive stimuli. This has been observed in fMRI studies involving emotional facial processing (Adams, Gordon, Baird, Ambady, and Kleck, 2003; Whalen et al., 2001). As such the amygdala plays a role in threat detection, and particularly ambiguous threat (Adams et al., 2003). The amygdala appears to be central to the fear and rage systems suggesting a hardwired mechanism in the fight or flight response (LeDoux, 2003; Panksepp, 1998; 2001; Panksepp & Zellner, 2004).

However, the amygdala has also been reported to respond to a variety of positive and negative emotions. A study by Yang et al. (2002) compared amygdala responses to happy, sad, angry, and fearful facial expressions. All emotions led to significant amygdala activation, with no significant differences between emotions. These findings were replicated by Hamann, Ely, Hoffman, and Kilts (2002). Thus, the amygdala may be an important neural substrate in processing positive and negative emotional stimuli. In summary, the amygdala has classically been associated with fear and anger processing, but there is evidence to suggest that it may in fact be associated with processing emotional stimuli in general.

**Amygdala activation and function in dreaming.** Amygdala activation is significantly heightened during REM sleep in comparison to waking (Braun et al., 1997; Maquet, 2000; Maquet et al., 1996; Nofzinger et al., 1997). Furthermore this activation has been correlated with activation in surrounding regions of the temporal lobe. As such, the amygdala is thought to modulate cortical activity in REM sleep (Halász, Terzano, Parrino, & Bódizs, 2004). The prevalence of exaggerated emotion during dreaming from increased amygdala activation, is regarded as a generator of dream plots, instead of an outcome of such

experiences (Hobson, Stickgold, & Pace-Schott, 1998). In addition, heightened amygdala and limbic activation during REM sleep accounts for the intense and predominantly negative emotions experienced during dreaming (Hobson, 2004). Dreams report studies have found a dominance of negative affect (Nielsen et al., 1991; Schredl & Doll, 1998; Smith et al., 2004) and this bias is particularly strong for threat (Valli, Strandholm, Sillanmäki, & Revonsuo, 2008). However, other studies have reported a balance of positive and negative emotion (Kahn, Pace-Schott, & Hobson, 2002). Nonetheless, the amygdala is regarded as a substrate of enhanced emotion during dreaming, and perhaps of enhanced negative emotion in particular.

Heightened amygdala and limbic activation accounts for the increased intensity of predominantly negative emotions in dreams and a greater incidence of nightmares. These affective changes have been observed in a number of disorders, such as TLE, PTSD, depression and sleep paralysis (Fukuda, 2005; Levin et al., 2010; Nofzinger, 2006; Silvestri & Bromfield, 2004; Vercueil, 2005). Studies involving amygdala lesions however are limited in relation to their influence on dream affect. Nevertheless, Benca, Shelton, Droster, and Kalin (2000) found that bilateral amygdala lesions in rhesus monkeys resulted in fewer awakenings compared to control monkeys. The control group exhibited greater stress as all monkeys had been restrained during the procedure. These findings suggest that amygdala activation is somehow linked to sleep and wakefulness, as well as to negative emotional processing. Amygdala lesion studies in humans in relation to dream affect have never before been conducted.

**Urbach-Wiethe Disease and Amygdala Dysfunction**

Urbach-Wiethe disease (UWD), also known as Lipoid Proteinosis, is a rare genetic disease caused by a mutation within the extracellular matrix protein 1 gene (ECM1) (Claeys et al., 2007; Lupo et al., 2005). As such, only 250 to 300 cases have been reported in the literature. These figures are minute at a global level and large samples are extremely difficult to come by. The vast majority of studies have only investigated one or two patients (Appenzeller et al., 2006; Claeys et al., 2007; Lupo et al., 2005; Wiest, Lehrer-Baumgartner, & Baumgartner, 2006). However, unique events of geographical isolation have resulted in a raised prevalence of the disease in South Africa. A small community in the Northern Cape province of South Africa has the highest known number of UWD cases worldwide. Studies by Van Hougenhouck-Tulleken et al. (2004) and more recently by Thornton et al. (2008)

have investigated samples from this population, consisting of approximately 30 patients in total. These studies have accounted for 10% of the world's cases.

Characteristic symptoms of UWD include a collection of skin problems, a hoarse voice, and bilateral symmetrical calcifications of the amygdala (Appenzeller et al., 2006; Claeys et al., 2007; Lupo et al., 2005; Salih et al., 2011; Thornton et al., 2008; Van Hougenhouck-Tulleken et al., 2004). The latter often only occurs in early adulthood, as amygdala calcification is a slow and gradual process. Furthermore roughly 50-75% of UWD patients develop these amygdala calcifications. The calcifications are also variable and are not always confined to the amygdala. The majority of cases however have shown well circumscribed amygdala lesions (Claeys et al., 2007; Salih et al., 2011; Thornton et al., 2008).

A number of studies have investigated the effect of amygdala lesions on emotional processing in UWD and temporal lobectomy patients. Emotion recognition studies dominate the literature, particularly through the use of emotional facial expressions. Findings have been variable, but several studies have shown impairments in the recognition of fear (Adolphs, 2010; Hurlemann et al., 2007; Thornton et al., 2008) but spared vocal depictions of fear (Anderson & Phelps, 2000). Adolphs, Tranel, Damasio, and Damasio (1994, 1995) investigated emotional recognition in SM, a UWD patient with focal bilateral amygdala damage. Deficits were observed in the recognition of fearful faces, as well similar facial expressions, including surprise, anger, sadness, and disgust. Thornton and colleagues (2008) however, found deficits in the recognition of both positive and negative emotions. In contrast, Siebert, Markovitsch, and Bartel (2003) found that all UWD patients could accurately recognize fear and anger. These findings go against the amygdala's supposed primary role in fear processing. The authors however, reasoned that participants may have developed strategies for emotional recognition, and parts of the amygdala could still have been intact. Further to this, Hurlemann and colleagues (2007) investigated emotional recognition of faces in a pair of identical twins with UWD. Only one of the pair was found to have a significant impairment in fear recognition.

Furthermore, emotional memory and fear conditioning have been impaired in patients with amygdala damage. A study by LaBar, LeDoux, Spencer, and Phelps (1995) found that participants with unilateral amygdala lesions following temporal lobectomies had impaired conditioned responses to aversive auditory stimuli. Brain damage in these cases, however, extended beyond the amygdala. Adolphs (2010) has discussed a number of impairments in patient SM. These deficits have included impaired emotional declarative memory, impaired

fear conditioning, and a lack of autonomic arousal during fear conditioning. Episodic autobiographical memory was also impaired in a case of UWD studied by Wiest and colleagues (2006). In addition, Hurlemann et al. (2007) showed a lack of emotional influence on memory in patients with amygdala lesions, suggesting an absent modulatory role of the amygdala. Emotional memory recollection is also impaired in UWD patients, and these impairments have extended to odour-figure association tasks (Siebert et al., 2003). In contrast, some patients with amygdala lesions have shown impaired fear recognition but no deficits in fear memory (Brierley, Medford, Shaw, & David, 2004).

Additionally, the experience and behavioural manifestations of fear have been impaired in UWD patients. Patient SM has been prominent in the literature for her diminished experience of fear. This is well documented in a recent study by Feinstein, Adolphs, Damasio, and Tranel (2011). SM's behavioural response and subjective experience of fear were assessed in three natural fear inducing settings. These settings included a trip to a pet shop, a haunted house, and seeing a scary film. Despite having a phobia of snakes, SM willingly touched them. Furthermore she exhibited intense curiosity and no avoidance towards fearful stimuli. She also reported no feelings of fear in all three situations. The researchers questioned her about her traumatic past, where only feelings of anger and sadness were expressed, without feelings of fear. In contrast, Anderson and Phelps (2002) found no impairments in both negative and positive emotional processing in patients with amygdala damage compared to healthy controls. An earlier study involving a facial expression generation task, showed that amygdala damaged patients were able to generate all emotional facial expressions correctly, some of which were better than healthy controls (Anderson & Phelps, 2000).

Several studies have contradicted the emotional impairments in many of the aforementioned amygdala lesion studies, particularly for fear processing. Firstly, Wiest et al. (2006) have documented an UWD patient with localized bilateral amygdala calcifications. The patient was prone to panic attacks and had no deficits in fear processing. According to Panksepp (1998; 2006) the fear system centrally includes the amygdala. However fear processing can possibly occur in absence of the amygdala by the use of alternative pathways (Wiest et al., 2006).

Furthermore, patients with UWD have intact fear processing during rapid exposure to fearful facial expressions. Patient SM had impaired conscious recognition of fear, but intact unconscious fear processing (Tsuchiya, Moradi, Felsen, Yamazaki, & Adolphs, 2009). In addition, the recognition of fearful faces may not be due to impaired recognition per se, but

rather due to the lack of orientation towards the eye area in faces. Abnormal eye gaze has been observed in patient SM. However, on instruction to orient to the eye area, SM was able to accurately recognize fear. Thus, amygdala damage may reflect a more abstract level of fear processing (Adolphs, 2010; Adolphs et al., 2005). These findings should be interpreted with caution as they are limited to case studies. Nevertheless, the majority of studies have shown impaired emotional processing in patients with bilateral amygdala damage, especially in the context of fear. However, these studies have also concerned single case reports for the most part. No studies in the literature have considered whether or not these deficits will extend to dreaming in patients with amygdala lesions.

**Rationale and Specific Aims and Hypotheses**

Studies of patients with amygdala lesions have been confined to waking consciousness in the literature of emotional processing. The findings have also been variable, but have generally implicated the amygdala as a detector of negative emotional salience from environmental stimuli (LeDoux, 2003). Studies of healthy human participants as well as animal studies give added support of these claims (LaBar et al., 1995; LeDoux, 2003). Furthermore, the amygdala is widely considered to be the predominant neural substrate of fear processing, and to a lesser extent of anger processing (LeDoux, 2003; Panksepp, 2001; Panksepp & Zellner, 2004).

With regards to dreaming, research has been limited to healthy participants and to participants with neurological and psychological disorders with *hyperactivation* of the amygdala. Patients with TLE, PTSD, sleep paralysis, and depression have exhibited heightened emotional processing both in waking and dreaming, a greater incidence of nightmares, and experience predominantly negative emotions (Fukuda, 2005; Levin et al., 2010; Nofzinger, 2006; Silvestri & Bromfield, 2004; Vercueil, 2005). In contrast, no research has yet looked at the effect of human amygdala lesions on the emotional content of dreams. As such, UWD patients are ideal candidates, as the majority of cases have symmetrical, bilateral, and well circumscribed lesions of the amygdala (Claeys et al., 2007; Thornton et al., 2008). Furthermore, these lesions are a natural product of the disease process, resulting in gradual amygdala calcification over time (Appenzeller et al., 2006).

This preliminary study provides a valuable opportunity as it investigates a relatively large sample of UWD disease patients from an isolated community in the Northern Cape province of South Africa. The majority of studies in the literature have been limited to mainly single case studies of UWD (Claeys et al., 2007; Lupo et al., 2005; Wiest et al., 2006). These

minute samples reflect the scarcity of patients due to the extremely rare nature of the disease. The relatively large South African sample has occurred as a result of the Founder Effect (Van Hougenhouck-Tulleken et al., 2004), being the increased prevalence of a mutated allele due to the limited genetic variability in the founding individuals of a population (Lawrence, 2005). As such, this population enables the investigation of the amygdala's function in dreaming. The aim of this exploratory study was therefore to investigate whether the putative deficits in emotional processing in waking as a result of amygdala dysfunction are extended to dreaming, as proposed by the continuity hypothesis. A measure was designed in order to establish these differences by rating the emotional intensity of several basic emotions. Furthermore, the study aimed to investigate whether the amygdala was linked to dream affect due to its heightened activation in REM sleep (Braun et al., 1997; Hobson, 2004; Maquet et al., 1996; Nofzinger at al., 1997). As such the following two hypotheses were investigated:

(1) Patients with amygdala calcifications will report significantly fewer instances of fear and aggression and lower intensity of these emotions than healthy controls during dreaming.

(2) Patients with amygdala calcifications will differ significantly in comparison to healthy controls in terms of the intensity and type of emotions experienced during dreaming.

## Method

### Design and Setting

This study was part of a larger study that investigated the neuropsychology of UWD (Thornton et al., 2008). The nested study was granted ethical approval by the Department of Psychology's Ethics Committee at the University of Cape Town (see Appendix A). The present study focused on the emotional experiences of dreaming in a group of UWD patients and healthy controls. Dream reports were obtained using the Most Recent Dream (MRD) method (Domhoff, 1999). The reports were collected from the participants' homes in a small rural community in the Northern Cape province of South Africa. The design was a cross-sectional case control study using UWD patients and locally matched controls.

Additional participants were recruited from the University of Cape Town. These were undergraduate psychology students. The students were recruited in order to assess the reliability and validity of a measure created for the purpose of the study. Dream reports were obtained from the students in a classroom at the university.

### Participants

**UWD patients and matched controls.** The participants included eight UWD patients and eight matched controls from the local area. The participants were matched in terms of age, gender, and years of education. Larger samples could not be obtained due to difficulties in gaining access to the UWD patients, who are considered a vulnerable group.

All of these participants were coloured, Afrikaans speaking females. Males had been excluded from the study due to high rates of alcoholism in the majority of men from the community. Alcoholism causes structural changes within the brain, particularly as a result of atrophy. This has shown to impair cognitive and emotional functioning and memory (Harper, 2009). Male participants would therefore confound the results.

Participants were between the ages of 23 and 69 years of age. Children with UWD were excluded from the study as amygdala calcification is only prominent by early adulthood (Appenzeller et al., 2006). This ensured that only patients with a fully calcified amygdala were recruited. Participants had received 3-12 years of education and were all of low socioeconomic status (SES).

The UWD patients included in this study all had complete bilateral calcification of the amygdala, as demonstrated by the neuro-imaging results reported by Thornton et al. (2008). This was an essential criterion in order to investigate differences between the patients and healthy controls.

Participants were recruited using non-probability purposive sampling as a selective UWD group and matched control group were used. Random sampling was not possible due to the low overall prevalence of UWD in the South African population and the elevated rates in a single rural community.

**University students.** Students were recruited to take part in the study via the Student Research Participation Programme (SRPP). This is an online system which allows students to select a research study to take part in so that they can meet their duly performed (DP) requirement. Non-random probability sampling was again used, being haphazard sampling. A total of 29 students took part in the study. All students were first language English speakers, between the ages of 18 and 25. The majority of the student participants were female ($n$ = 24) and only a handful of participants were male ($n$ = 5).

## Materials

**The Most Recent Dream method.** The MRD method is a standardized technique that is used to collect dream reports. It involves a verbal (oral or written) account of the last dream that a participant can remember. The instructions facilitate a detailed account of a dream (Domhoff, 1999), so the technique was of great use to the present study. The MRD method

allows for large samples to be collected quickly and with ease. An alternative is lab reports, however these are costly and time consuming. The MRD method has shown no differences in terms of dream content in comparison to lab reports when dream reports are analysed using the Hall/Van de Castle (HVdC) coding system (Domhoff, 1999). The MRD method was the method of choice as UWD patients are a vulnerable group. The technique allowed for patients to take part in this study from their home environment. The MRD method was administered in the context of a semi-structured interview for the UWD and matched control participants. The method was administered in its usual format to the university students (see Appendix B).

**The Affective Neuroscience Dream scale.** The Affective Neuroscience Dream scale (ANDS) was a measure that I developed purely for the purpose of this study. Its aim was to measure the intensity of the seven neurobiological emotional systems as indentified by Panksepp (1998, 2001, 2006) in dream reports. These systems include seeking, rage, fear, lust, care, play panic, and grief. The last two emotions are subgroups of panic. Although this is not the only emotion classification system, these basic emotions hold promise as they are linked to specific neural substrates. The amygdala for example, is classified as a component of the fear and anger system (Panksepp, 1998).

The ANDS assessed the intensity of each of the above-mentioned emotions using interval rating scales. Each rating scale was numbered from 0 (*absence of emotion*) to 3 (*maximal intensity*). A score of 1 or 2 referred to *minimal intensity* or *moderate intensity* of the emotions respectively (see Appendix C).

No other measure has yet been developed that specifically assesses the intensity of basic emotions in dreaming. The closest alternative was the HVdC coding system. However, emotions are only a small aspect of this comprehensive measure of dream content (Hall & Van de Castle, 1966). Furthermore, the emotions assessed are not linked to neural systems.

## Procedure

**Inter-rater reliability and validity assessment of the ANDS.** Students were recruited in order to assess the inter-rater reliability and validity of the scale. Convergent validity could not be established as no other measure yet exists that specifically assesses emotional intensity in dreaming. Validity was instead conceptualized as the consistency between subjective ratings of dream affect from the dreamer's perspective and the independent raters objectively inferred ratings of dream affect. Although this method is

questionable as to whether it truly reflects validity, the emotions included in the scale have been validated by a vast array of neurobiological research (Panksepp, 1998).

Informed consent was granted by all students taking part in this aspect of the study. Students were instructed that they did not have to take part in the study, could withdraw at any time without consequence, and could ask questions freely throughout the experiment. In addition, confidentiality and anonymity were assured (see Appendix D). Three sessions with approximately 10 participants per session were held in a university classroom. Participants firstly wrote down their most recent dream in accordance with the MRD method (see Appendix B). They then read through the ANDS instructions and coded their own dreams (see Appendix C). This procedure took approximately 20 minutes in total. At the end of the experiment participants were thanked for their participation and debriefed. Participants received both a verbal and typed debriefing (see Appendix E). They were also again given the chance to ask any questions related to the experiment.

The 29 dream reports collected were typed and then administered to two independent raters without any knowledge of the present study. The independent raters were instructed to code these reports also by using the ANDS. This was necessary in order to establish consistency between raters. This also allowed for a comparison between the independent rater ratings and the student (dreamer) ratings in order to establish validity.

**UWD patients and matched controls: Dream report collection and coding.** The data collected from the UWD patients and matched controls was carried out as part of the larger study. All participants gave informed consent prior to being interviewed. A nurse fluent in Afrikaans was recruited and trained to interview the participants, which took place in their own homes. All interviews lasted no more than half an hour.

Participants were asked whether they had dreams and if they could describe a dream they had recently. The interview was audio recorded which allowed the nurse to engage more with the participants. Furthermore, a conversational style was adopted in order to mimic a real life conversation, and the MRD method (Domhoff, 1999) was carried out orally. This allowed for greater ecological validity (Rosenthal & Rosno, 2008). At the end of the interview participants were thanked for the participation and debriefed. They were also given the chance to ask any questions and to talk about how they felt during the interview.

The interviews were then transcribed by an independent Afrikaans transcriber, in order to minimize researcher influence (Rosenthal & Rosno, 2008). The dream reports were not translated into English in order to prevent the loss of context or meaning across languages.

Once transcribed the dream report interviews were then coded by the two independent raters, again using the ANDS. The raters were fluent in Afrikaans and English. Furthermore neither I nor the independent raters were aware of what condition the participants belonged to. A double-blind procedure was therefore in place (Rosenthal & Rosno, 2008).

**Data Analysis**

All analyses were conducted using the statistical program SPSS version 19.0 (SPSS Inc., 2010). Data analysis was carried out in two parts. Firstly inter-rater reliability and the validity of the scale were assessed. Secondly differences in emotional intensity were investigated in the UWD group and matched control group.

**Inter-rater reliability and validity analyses.** The intra-class correlation coefficient (ICC) was used in order to assess inter-rater reliability between the two independent raters (Field, 2009). The data collected from the student group was used in order to assess this. The ICC was also used in order to establish validity between the independent rater ratings and the dreamer ratings. In this case an average rating of the independent raters was compared to the dreamer ratings for each emotion per dream report. An analysis of variance (ANOVA) was carried out to test the statistical significance of the intra-class correlations and 95% confidence intervals were obtained.

An ICC of 1 indicates complete reliability and 0 refers to a lack of reliability (Rankin & Stokes, 1999). An acceptable level of reliability is variable amongst the literature. Some researchers have considered .75 and above as acceptable, whereas other have argued this to be poor to moderate. A reliability value of .80 or above is considered as high reliability, and appears to be more common in the literature (Mao, Hsueh, Tang, Sheu, & Hsieh, 2002; Ottenbacher, Hsu, Granger, & Fiedler, 1996). Social science research however is prone to low reliability (Field, 2009).

**Demographic differences.** Two independent-samples *t*-tests were carried out in order to see if there were between-groups differences for age and years of education between UWD patients and matched controls. As participants were matched, no significant differences were expected. Data were missing from one control participant for both of these variables so had been excluded from the analysis. Gender differences were not assessed as all participants were female.

**Dream length.** Dream length was measured by counting the total number of words in each dream report. The UWD patients and matched controls were then compared in terms of dream length using an independent-samples *t*-test. It was important to establish any

differences between groups as longer dreams may have contained a greater variety of emotions and higher emotional intensities in comparison to shorter dreams.

**ANDS coding analyses.** Two sets of emotional intensity ratings were obtained as both independent raters coded the UWD and matched control dream reports. These ratings were averaged before any analyses took place. Descriptive statistics were initially obtained to see whether there were any obvious differences in terms of emotional intensity between the UWD patients and the matched controls.

To establish between-group and within-group differences, several mixed-design ANOVAs were conducted. The first mixed-design ANOVA enabled an overall comparison of all emotions in the UWD and matched control group. A second mixed-design ANOVA was conducted to compare amygdala and non-amygdala related emotions. A third mixed-design ANOVA was conducted to assess differences between positive and negative emotions. Significant effects were then followed up using simple effects analysis and pairwise comparisons. Prior to these analyses, the assumption of normality was assessed.

## Results

### Inter-rater Reliability and Validity

The ICC for inter-rater reliability was .70 (95% CI: .63-.76), which suggests moderate reliability. The ICC value was also statistically significant, $F(231, 231) = 5.74$, $p < .001$.

The ICC for average independent rater versus the dreamer ratings was .67 (95% CI: .44-.79) and was statistically significant, $F(231, 231) = 3.59$, $p < .001$. This correlation suggests moderate validity. These findings indicate that the measure had adequate rater agreement and rater-dreamer agreement, suggesting that the scale was reliable across raters and valid.

### Participant Demographical Information

There were no significant age differences between UWD ($M = 46.00$) patients and matched controls ($M = 43.71$), $t(13) = 2.92$, $p = .775$. In addition, no significant differences were found in the number of years of education between UWD patients ($M = 8.75$) and matched controls ($M = 9.14$), $t(13) = 3.13$, $p = .759$. The data suggests that both groups were equivalent in terms of age and education.

### Differences in Dream Length

Dream length was assessed across the two groups using an independent-samples *t*-test. Neither the UWD group nor the matched control group deviated severely from

normality. Both groups where shown to be slightly positively skewed and there were no outliers present in the data. Observation of the cell means showed that the matched control group ($M$ = 357.86) had the longest dream length, whereas the UWD patients ($M$ = 175.34) had the shorted dream length (see Table 1). Levene's test was not significant, which suggested that the assumption of homogeneity was upheld, $F(1, 14) = 0.45$, $p = .512$. No significant differences in dream length were found between UWD patients and matched controls, $t(14) = 1.33$, $p = .206$.

**Table 1**

*Means and Standard Deviations of Dream Length*

| | UWD | | MC | |
|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* |
| Dream length | 248.25 | 150.95 | 357.86 | 178.67 |

*Note.* UWD = Urbach-Wiethe Disease patients; MC = matched controls. Dream length was operationalized as the total number of words per dream report.

**Between-group and Within-group Differences in Emotional Intensity**

Descriptive statistics for each emotion in UWD patients and matched controls are listed in Table 2. The majority of emotions slightly deviated from normality in all groups and were positively skewed. Fear and grief were the only emotions with normal distributions and were only observed in the matched control group. Two extreme outliers were present in the UWD group which were for anger and lust. The majority of ratings were zero for both of these emotions. Only one non-extreme outlier was present in the matched control group and this was due to a higher intensity rating of play in one of the matched control dreams.

A 2 (Group: UWD or Matched Control) X 8 (Emotion: Fear, Anger, Play, Seeking, Lust, Panic, Grief) mixed-design ANOVA was then conducted to assess if there were any significant between-group differences. Levene's test was variable across the eight emotions. Fear ($p = .076$), play ($p = .612$), care ($p = .146$) and grief ($p = .334$) were not significant, suggesting that the assumption of homogeneity was upheld. Anger ($p < .001$), seeking ($p = .001$), and lust ($p = .014$), were significant, suggesting that the assumption of homogeneity had been violated. Levene's was not defined for panic as all of the intensity ratings were zero in both the UWD group and matched control group (see Table 3). The ANOVA indicated that there was no significant main effect for group, $F(1, 14) = 1.86$, $p = .194$, $\eta_p^2 = .117$.

**Table 2**
*Means and Standard Deviations of Emotional Intensity*

| | UWD (*n* = 8) | | MC (*n* = 8) | |
|---|---|---|---|---|
| **Emotion** | *M* | *SD* | *M* | *SD* |
| Fear | 0.63 | 0.95 | 0.81 | 0.53 |
| Anger | 0.06 | 0.18 | 0.50 | 0.53 |
| Play | 0.88 | 1.03 | 0.50 | 0.96 |
| Seeking | 0.38 | 0.35 | 0.00 | 0.00 |
| Lust | 0.06 | 0.18 | 0.25 | 0.46 |
| Care | 0.25 | 0.46 | 0.94 | 0.90 |
| Panic | 0.00 | 0.00 | 0.00 | 0.00 |
| Grief | 0.13 | 0.23 | 0.19 | 0.26 |

*Note.*UWD = Urbach-Wiethe Disease patients; MC = matched controls.

**Table 3**
*Levene's Test of Homogeneity of variance for the Individual Emotions*

| **Emotion** | ***F* (1, 14)** | ***p*** |
|---|---|---|
| Fear | 3.68 | .076 |
| Anger | 69.44 | < .001 |
| Play | 0.27 | .612 |
| Seeking | 18.29 | .001 |
| Lust | 7.93 | .014 |
| Care | 2.37 | .146 |
| Panic[a] | - | - |
| Grief | 1.00 | .334 |

[a] Levene's test of homogeneity was not defined.

Within-group differences were also assessed. Mauchley's test indicated that the assumption of sphericity was violated, $\chi^2(27) = 88.32$, $p < .001$. The Greenhouse-Geisser estimate was then used and indicated that a significant main effect of emotion was present, $F(1.96, 27.40) = 3.70$, $p = .039$, $\eta_p^2 = .209$. No significant Group x Emotion interaction was found, $F(1.96, 27.40) = 1.61$, $p = .219$, $\eta_p^2 = .103$. The significant main effect for emotion was followed up using a series of *post-hoc t*-tests with a Bonferroni correction. All emotions

were compared against one another and no significant differences were found (all $p > .05$). The significant main effect for emotion was most likely due to type I error.

**Amygdala versus Non-amygdala Related Emotions**

Sum totals were used to group amygdala related emotions and non-amygdala related emotions together. These groupings were based on the neural substrates of the basic emotion systems identified by Panksepp (1998, 2006). The amygdala related emotions included fear and anger, whereas the non-amygdala related emotions included play, seeking, lust, care, panic, and grief. A 2 (Group: UWD or Matched Control) X 2 (Emotion: Amygdala Emotions or Non-Amygdala Emotions) mixed-design ANOVA was conducted to establish between-group and within-group differences for amygdala related and non-amygdala related emotions.

Firstly, between-group differences were investigated. The cell means suggested that UWD patients ($M = 0.69$) had the lowest intensity of amygdala related emotions, whereas the matched controls ($M = 1.31$) had the highest intensity. Non-amygdala related emotions did not seem to greatly differ across groups (see Table 4). Levene's test was non-significant for amygdala related emotions, $F(1, 14) = 1.98$, $p = .182$ and non-significant for non-amygdala related emotions, $F(1, 14) = 0.16$, $p = .696$. The assumption of homogeneity of variance was therefore upheld for both emotion groupings. No significant main effect was found for group, $F(1, 14) = 1.86$, $p = .194$, $\eta_p^2 = .117$.

Within-groups effects were then investigated. Sphericity was not defined so the Greenhouse-Geisser estimate was used. No significant within-subjects effect was found for emotion, $F(1, 14) = 2.64$, $p = .126$, $\eta_p^2 = .159$. There was also no significant Group x Emotion interaction, $F(1, 14) = 0.21$, $p = .656$, $\eta_p^2 = .015$.

**Table 4**
*Means and Standard Deviations of Amygdala and Non-Amygdala Related Emotions*

| | **UWD (*n* = 8)** | | **MC (*n* = 8)** | |
|---|---|---|---|---|
| **Emotion** | *M* | *SD* | *M* | *SD* |
| Amygdala | 0.69 | 1.03 | 1.31 | 0.70 |
| Non-amygdala | 1.69 | 1.19 | 1.88 | 1.46 |

*Note.* UWD = Urbach-Wiethe Disease patients; MC = matched controls.

**Positive Emotions versus Negative Emotions**

A further analysis was conducted where sum totals were used to group emotions of positive and negative valence together. Play, seeking, lust, and care were grouped as positive emotions. Conversely, fear, anger, panic, and grief were grouped as negative emotions. A 2 (Group: UWD or Matched Control) X 2 (Emotion: Positive or Negative) mixed-design ANOVA was conducted to establish between-group and within-group differences for positive and negative emotions. Descriptive statistics are listed in Table 5.

Between-group differences were firstly assessed. Levene's test was not significant for positive emotions, indicating that the assumption of homogeneity of variance was upheld, $F(1, 14) = 0.11$, $p = .741$. This was also the case for negative emotions, $F(1, 14) = 2.74$, $p = .120$. The between-subjects ANOVA revealed no significant main effect for group, $F(1, 14) = 1.86$, $p = .194$, $\eta_p^2 = .117$. This suggests that no significant differences were found between groups on the intensity of positive and negative emotions.

Within-group differences were then investigated. Sphericity was not defined so the Greenhouse-Geisser estimate was used. No significant within-group effect for emotion was found, $F(1, 14) = 1.04$, $p = .326$, $\eta_p^2 = .069$. There was also no significant Group x Emotion interaction, $F(1, 14) = 0.37$, $p = .551$, $\eta_p^2 = .026$.

**Table 5**

*Means and Standard Deviations of Positive and Negative Emotions*

| | **UWD (*n* = 8)** | | **MC (*n* = 8)** | |
|---|---|---|---|---|
| **Emotion** | *M* | *SD* | *M* | *SD* |
| Positive | 1.56 | 0.46 | 1.69 | 0.46 |
| Negative | 0.81 | 0.59 | 1.50 | 0.59 |

*Note.* UWD = Urbach-Wiethe Disease patients; MC = matched controls.

## Discussion

This preliminary investigation is the first to investigate the effects of amygdala lesions on dream affect. The findings of this study are in contrast to previous literature, suggesting that the amygdala is a modulator of REM sleep dreaming and that it accounts for the predominance of negative emotion in dreaming (Halász et al., 2004; Hobson, 2004; Hobson et al., 1998). Neither hypothesis was confirmed by the results, as no significant differences in intensity were observed between the UWD patients and matched controls. In addition, no significant differences were observed when amygdala and non-amygdala dependent emotions were compared, and when emotions of positive and negative valence were compared. Also,

no within-group differences or interaction effects were observed. These findings will be discussed in relation to previous literature in the field both in support and in opposition of these findings.

Overall, no significant differences in emotional intensity were found between UWD patients and matched controls. A significant main effect for emotion was only observed when all of the basic emotions were analysed. However, after conducting *post-hoc* tests, which consisted of a series of comparisons across each emotion, no significant differences were found. The significant main effect of emotion may be explained by the absence of panic in both the UWD patients and the matched controls. The lack of panic in the dream reports would have reduced the variance and within-subjects error. The significant effect was therefore most likely due to a type I error. This is assumed because the error had been controlled for in the *post-hoc* tests, which found no significant differences in all of the emotion comparisons. The findings suggest that the intensity of fear and anger was not significantly reduced in UWD patients. Amygdala lesions therefore did not affect their capacity to generate or experience fear and anger during dreaming. These findings go against previous research concerning the amygdala in fear and anger processing.

Studies involving healthy human participants have shown increased amygdala activation during fear conditioning, which is consistent with animal research (LaBar, 2007; Phelps et al., 2001). Furthermore, emotional facial expression recognition studies have shown increased amygdala activation in response to both fear and anger (Adams et al., 2003; Costafreda et al., 2008; Sergerie et al., 2008; Whalen et al., 2001). Conversely, patients with amygdala lesions have shown deficits in emotional facial recognition, particularly in the recognition of fearful and angry faces (Adolphs et al., 1994, 1995; Hurlemann et al., 2007; Thornton et al., 2008). Impairments in emotional memory and fear conditioning have also been observed in patients with amygdala lesions (Adolphs, 2010; LaBar et al., 1995; Siebert et al., 2003; Wiest et al., 2006). Furthermore, patient SM was unable to experience fear subjectively and did not show appropriate fear responses and behaviour to fearful stimuli (Feinstein et al., 2011).

However, a smaller number of studies have not observed emotional processing impairments in patients with amygdala lesions, which are more consistent with the findings of this study. For example, patients with amygdala damage are able to generate emotional facial expressions (Anderson & Phelps, 2000), have not exhibited any differences to controls in terms of the positive and negative emotional experience (Anderson & Phelps, 2002), have shown no deficits in emotional memory (Brierley et al., 2004), and are able to recognize

fearful and angry faces (Siebert et al., 2003). Also, although patient SM showed a diminished experience of fear, she was still able to experience anger and sadness when recollecting traumatic life events (Feinstein et al., 2011). Furthermore, Wiest et al. (2006) observed an UWD patient who experienced panic attacks and had intact fear processing. Finally, abnormal gaze may explain impaired fear processing in UWD disease patients, as they are able to adequately process fear on instruction to orient to the eye area of fearful faces (Adolphs, 2010; Adolphs et al., 2005).

The lack of impairment in fear and anger in the dreams of UWD patients in this study is open to several lines of explanation. Firstly, patients may have still had intact emotional memories of fear and anger prior to amygdala calcification. A study by Brierley and colleagues (2004) found that fear and anger memories were not impaired in patients with amygdala lesions. However, only a small proportion of dreams contain episodic memories of waking events (Fosse, Fosse, Hobson, & Stickgold, 2003). These episodic memories are generally experienced as day-residues and from events that occur one week prior to dreaming, rather than events from a distant past (Nielsen & Stenstrom, 2005). UWD patients would not have undergone any further amygdala calcification in such a short space of time.

Secondly, an alternative pathway may have activated, such as the amygdalo-cortical pathway. This pathway is implicated in the both rapid and unconscious processing of fear (Adolphs, 2010). Patient SM was found to have intact fear processing during a visual search task and masked presentations of fearful and angry faces. Patients with bilateral amygdala lesions can therefore recognize rapid presentations of emotional faces (Tsuchiya et al., 2009). This pathway may have activated during dreaming in the UWD patients, allowing them to adequately process fear, but is unlikely as is generally associated with unconscious processing and dreams are a form of conscious experience.

Another explanation for lack of impairment in the emotional intensity of fear and anger in the dreams of UWD patients is that the amygdala may not be specifically involved in the internal generation (as opposed to, for example, external recognition or conditioning) of these emotions. A case study of an UWD patient conducted by Wiest et al. (2006) showed that the patient could successfully generate and experience fear during waking. Also, the majority of research that has implicated the amygdala in fear and anger processing has stemmed from studies involving conditioning and electrical stimulation of the amygdala (LeDoux, 2003; Panksepp, 1998). These studies suggest that the amygdala is activated during external stimulation and that this results in the generation of emotion. However, the amygdala may not necessarily be involved in the endogenous generation of emotion, as UWD patients

from the present study were able to experience fear and anger no different to the dreams of the matched controls. No studies have yet directly investigated the amygdala's role in the endogenous generation of emotion.

In addition to the lack of impairment of fear and anger, no deficits were observed in other negative emotions and positive emotions. These findings have been echoed by Siebert and colleagues (2003) who found no deficits in the recognition of positive and negative facial expressions in UWD patients. These findings paint an opposite picture to a number of studies that have found impaired recognition of both positive and negative emotional facial expressions (Thornton et al., 2008). Moreover, amygdala activation has been shown to increase in response to both positive and negative emotional facial expressions in healthy participants (Hamann et al., 2002; Yang et al., 2002). Electrical stimulation of the amygdala has also been shown to evoke a range of positive and negative emotions, but fear has been the predominant emotion (Lanteaume et al., 2007). In addition, patient SM has not only exhibited deficits in fear processing but has also shown deficits in seeking. Feinstein and colleagues (2011) found that SM experienced an overwhelming sense of curiosity, which Panksepp (1998) would define as 'seeking'. These studies therefore suggest that emotional processing deficits as a result of lesions to the amygdala are not only confined to fear and anger.

The continuity hypothesis also did not apply to the findings of this study, as previously-reported deficits in waking emotional processing were not found to apply to dreaming. The present study did not however investigate emotional processing deficits in waking. As such the continuity of emotional intensity across waking and dreaming cannot be ascertained from the present study. Nevertheless, previous research has shown deficits in the recognition of fear and anger in UWD disease patients (Adolphs et al., 1994, 1995; Thornton et al., 2008). As such, emotional processing deficits in waking may not apply to dreaming. The lack of continuity between waking and dreaming has also been observed in patients with aphasia and cortical blindness. These patients have not shown any dreaming deficits in language and vision respectively (Solms, 2000).

In contrast, several studies have provided evidence for the continuity of emotional experience across waking and dreaming. This has been observed in healthy participants (Domhoff, 2001; Nielsen et al., 1991; Pesant & Zadra, 2000; Yu, 2007). Additional support of the continuity of emotion has been obtained from studies investigating the effect of amygdala hyperactivity. For example, patients with PTSD and TLE experience heightened limbic activation during waking and dreaming. Limbic hyperactivity may explain heightened emotions during waking and more a frequent occurrence of nightmares in these patients

(Levin & Nielsen, 2007; Levin et al., 2010; Silvestri & Bromfield, 2004; Vercueil, 2005). Furthermore, as several studies have shown intact emotional processing in UWD patients (Anderson & Phelps, 2000, 2002; Brierley et al., 2004; Hurlemann et al., 2007), this too may explain the lack of impairment in dream affect.

The findings of this study also go against the theory of the amygdala's central modulatory role in REM sleep dreaming (Haláz et al., 2004). The findings suggest that the amygdala may not be a generator of dream plots (Hobson et al., 1998). UWD patients were able to experience affective dreaming and had similar emotional intensities in all emotions to the matched controls. These findings suggest that the major neural substrate or neural network of dream affect may be outside of the amygdala region. For example, one neural substrate may be the pulvinar nucleus of the thalamus, which is a structure that has been implicated in rapid, unconscious fear processing (Tsuchiya et al., 2009). Furthermore, these findings are in conflict with a number of neuro-imaging studies. Studies have shown significant increases in amygdala activation as well as activation of surrounding limbic regions during REM sleep compared to waking (Braun et al., 1997; Maquet, 2000; Maquet et al., 1996; Nofzinger et al., 1997).

**Limitations and Future Directions**

This study had a number of limitations, the biggest of which was sample size. Eight UWD patients were included in the study, along with their eight matched controls. However, UWD is an extremely rare genetic disease and participants are difficult to find (Claeys et al., 2007; Lupo et al., 2005). Both children and males had been excluded from the study due to alcoholism and to ensure complete amygdala calcification respectively. The sample was considerably large following the restrictions and exclusion criteria followed, and the majority of studies investigating UWD patients have been limited to only one or two patients (Appenzeller et al., 2006; Claeys et al., 2007; Lupo et al., 2005; Wiest et al., 2006). Larger samples have been reported by Thornton et al. (2008) who also investigated the Northern Cape community. Their sample consisted of 27 UWD patients. Due to restricted access and gatekeeper difficulties, larger samples such as this could not be attained. Future research should seek permission to study larger samples from this group.

Another limitation is that the findings are restricted in their generalization to other populations. This is because males were excluded from the study and participants were of a specific cultural and socioeconomic background. Future studies should therefore include UWD males and matched controls without a history of alcoholism. This may pose a

challenge for researchers due to the extremely restricted number of such patients available. The inclusion of male participants would also be useful in order to assess gender differences.

An additional limitation of this study is that emotional intensity in dreaming was only investigated. As a result, the continuity between emotional processing in waking and dreaming could not be examined. The findings were therefore based on the assumption that impaired emotional processing from amygdala calcification in waking would also be extended to dreaming. As no impairments were found, this was assumed to be a result of the lack of emotional deficits during waking. Future research should therefore aim to confirm emotional deficits from amygdala damage in both waking and dreaming in the same participants.

The study was also cross-sectional, so dream reports were only collected at one point in time. Longitudinal studies may be of greater benefit as will allow for a more comprehensive investigation of dream affect impairment in these patients. Future studies should consider investigating a single population of UWD patients in childhood and again in adulthood in order to directly compare the effects of amygdala calcification.

Another limitation was the method used for collecting dream reports. The MRD method (Domhoff, 1999) has not been validated for its use with the ANDS. The MRD method has however been validated using the HVdC coding system (Hall & Van de Castle, 1966). No differences in dream content have been found when the HVdC coding system is compared to dream reports from REM awakenings (Domhoff, 1999). Future studies should aim to validate the MRD method for its use with the ANDS by comparing dream content with dream reports obtained from REM awakenings in healthy participants. Future studies should also consider using dream diaries as this would allow for a more comprehensive investigation of dream affect.

A further limitation was the inter-rater reliability of the ANDS. Inter-rater reliability was only moderate. To some researchers, however these results would be considered as poor reliability (Ottenbacher et al., 1996). The independent raters were not given any training on their assessment of emotional intensity, and neither did the student participants. This enabled a more controlled comparison of emotional intensity ratings between the independent raters and the students. The raters and students only read the ANDS instructions. Despite the lack of practice or training, the measure gave comprehensive details of each basic emotion. Future studies should perhaps consider allowing raters to practice using the scale on random dream report samples obtained from a dream report database.

Inter-rater reliability and validity may not have been high due to the subjective nature of dreaming. The dream reports were retrospective accounts of the students' dreams. Independent raters were unable to directly infer the dreamer's emotional experience. Future studies should consider standardizing the ANDS in order to enhance the consistency between raters, as well as to more accurately assess the intensity of emotions in dream reports.

A final issue is that concurrent validity could not be assessed as no other measure that specifically measures the intensity of dream affect was found to exist. The HVdC coding system (Hall & Van de Castle, 1966) does include emotion categories, but was not useful to the present study as emotions are only a small aspect of the measure and the emotions do not have a neurobiological basis. Nevertheless, the ANDS was useful to the present study as the emotional systems included in the scale are based on neurobiological research (Panksepp, 1998, 2001, 2006). Future studies should use larger samples and alternative methods in the assessment of validity, such as a correlation matrix. This would establish whether emotions of identical valence and emotions that are theoretically grouped are positively correlated, and also whether emotions of opposite valence are negatively correlated.

## Conclusion

This preliminary study was the first to investigate the effect of amygdala lesions on dream affect in UWD patients. These patients were invaluable to this study as they have bilateral calcifications of the amygdala. No differences in emotional intensity were found in UWD patients in comparison to the matched controls. The findings suggest that patients without an amygdala are still able to process fear and anger in their dreams. Previous research has strongly implicated the amygdala in fear and anger processing, where lesions have resulted in the impairment of these emotional systems. This study calls into question these central functions of the amygdala. The findings also cast doubt on theories implicating the amygdala as the modulator of REM sleep and as the driver of dream plots. UWD patients were able to experience fully affective dreaming, identical to the matched controls. The small sample size limits generalization of the findings, but is still larger than previous studies, even after the exclusion of males and children. Future research is required to establish whether UWD patients have diminished experiences of fear and anger in waking, and whether these deficits extend to dream affect in the same patients. Longitudinal studies should also aim to compare UWD patients in childhood and adulthood. This study casts doubt on a plethora of studies implicating the amygdala as a substrate of dream affect. Future studies should aim to distinguish between the external generation and the endogenous generation of emotion. The

amygdala may only be involved in externally generated emotion as this has been the prime focus in the literature. The endogenous generation of emotion may not involve the amygdala and provides a potential explanation of the present study's findings.

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# Appendix A

## Ethical Approval from the Department of Ethics Committee, UCT

**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 B**

**The Most Recent Dream method**

# MOST RECENT DREAM REPORT

We would like you to write down 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

## The ANDS Instructions

# AFFECTIVE NEUROSCIENCE DREAM SCALE

Please read the entire dream report and familiarise yourself with its content. Then look through the list of emotions below, and indicate which emotions are present in the dream report. An emotion is present if an element of the emotion is evident in the dream – not all the suggested conditions need to be evident. For instance, if the dream contains an element of 'worrying' but not of 'unable to relax due to fear or anxiety', FEAR is present, as one of the conditions has been met.

If the emotion is absent, please place a '0' in the *Score* column for that emotion.

If the emotion is present, please indicate the intensity of this emotion. The intensity refers to the strength of the emotion when the dream is considered as a whole. Indicate this by placing a '1', '2', or '3' next to the emotion under *Score*.

| *Emotion Definition* | *Score* |
|---|---|
| **FEAR:** Feelings of sudden startle or persistent, anxiety, nervousness, worry and tension all indicate fear. Characteristic behaviours include hiding, freezing, fleeing, and heightened vigilance. These behaviours commonly occur in response to threat, danger, or expected pain or injury. Physical manifestations of fear include a strong and rapid heartbeat, rapid shallow breathing, dry mouth, sweating, trembling, diarrhoea, and general restlessness. Cognitive manifestations of fear include difficulties in decision making, ruminating in an anxious way, and the inability to relax. | |
| **ANGER:** Feelings of rage, hot aggression, hatred, contempt, intense frustration and irritation centrally characterize anger. These feelings are often expressed rapidly and automatically. Destructive, violent, vengeful, and threatening behaviour that is verbal or physical in nature frequently express anger. Anger can also be expressed in a cold and spiteful manner. | |
| **PLAY:** Rough-and-tumble play conveys the essence of this emotion – especially in children. Other forms of play include physical and non-physical games usually games with rules, toys, and the use of dramatic and linguistic "role playing" devices. Play can induce feelings of intense joy, exuberance, fun, glee, happiness, and (especially) laughter. Play can also have a pleasurable, competitive element. | |
| **SEEKING:** Feelings of intense interest, craving, engaged curiosity, eager anticipation, and excitement. Foraging, exploration, wanting and appetitive behaviours such as hunger, thirst, and sexual drive all encompass seeking. Cognitively, seeking includes the desire to solve problems or puzzles, as well as the search for higher meaning. Seeking also includes feelings of positive expectancy and optimism, such as the sense of being able to accomplish almost any goal. | |
| **LUST:** Feelings of gratification or pleasurable release or discharge from the consummation of any desire or appetites such as wanting, food, water, or sex. Erotic acts, sexual pleasures and delights, and orgasm centrally encompass this definition of 'lust'. Consummation of desire can also be experienced in the cognitive domain, such as the pleasure that is felt on finding a solution to a difficult intellectual problem. | |
| **CARE:** Feelings of nurturance, love, social attraction, affection and bonding particularly towards juveniles. Care is centrally characterized by maternal behaviour. Care also extends towards friends, pets, those who are sick and others in need. Cognitively care includes the desire to protect and look after (and to feel needed by others). | |
| **PANIC:** This emotion is epitomized by acute separation distress, where individuals feel the need to search for, call or cry out for their loved ones. Intense anxiety is experienced from the sudden, undesired or unexpected loss of a loved one. 'Panic' is differentiated from 'fear' by its association with an anticipated or actual loss ("something will be taken away from me") as opposed to the | |

| | |
|---|---|
| **PANIC:** This emotion is epitomized by acute separation distress, where individuals feel the need to search for, call or cry out for their loved ones. Intense anxiety is experienced from the sudden, undesired or unexpected loss of a loved one. 'Panic' is differentiated from 'fear' by its association with an anticipated or actual loss ("something will be taken away from me") as opposed to the danger or injury to the self, and so on ("something will be done to me"). Panic is considered to be | |

Scale:

- 0: Absent
- 1: Trace evidence of the emotion
- 2: Emotion present in moderate intensity
- 3: Emotion present at maximal intensity

## Appendix D

## Student Informed Consent Form

**University of Cape Town**
**Department of Psychology**
**CONSENT FORM**

**Name: _____**
**Student no: _____**
**Psychology course: _____**

I agree to participate in this study. I realize that this information will be used for educational purposes. I understand that I may withdraw from this study at any time and that all information will be treated with confidentiality and anonymity. I understand the intent of this study. I also acknowledge that I have the ability to ask questions at any time during the experiment.

**Signed: _____**
**Date: _____**

## Appendix E
## Student Debriefing

### Participant Debrief

Thank you for taking part in this study. The broader aim of the study is to assess whether there is a link between amygdala activation and emotion in dreaming. Increased amygdala activation is thought to explain the affective component of dreams. We will be looking at fear and anger in particular as the amygdala is activated in waking experience of these emotions. This may also be the case during dreaming. The experiment you have participated in will help in the assessment of inter-rater reliability and validity. Your dream report will be coded for emotional themes by two participants with no knowledge of your identity or the study's intentions. Your ratings and the independent rater scores will be compared in order to achieve the reliability and validity values. Should you have any questions please do not hesitate to contact me. My email address is: dnnhea002@uct.ac.za