

Dreams in Temporal Lobe Epilepsy: A study on the effects of amygdala activation on
emotion in dreaming

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Abstract

Dreaming has been said to arise from the temporal lobe, with emotions directing the plot of dreams. The amygdala is highly active during dreaming sleep and is therefore implicated in dreaming. The amygdala is implicated in FEAR and ANGER in waking life, so it is inferred that it is responsible for the production of these experiences in dreaming. Individuals with temporal lobe epilepsy (TLE) experience epileptiform activity in the temporal that probably increased activation of the amygdala. Previous studies found TLE was associated with increased rates of dysphoric dreaming in TLE when investigating recurrent dreams. Those studies focused on recurrent dreams, while the current study focused on non-recurrent dreams. The study aimed to establish if dreams from individuals with TLE contained higher rates of FEAR and ANGER compared to other emotions in these dreams. This study also aimed to establish if dreams from individuals with TLE differed from those without TLE in rates of FEAR and ANGER. Most recent dream reports were collected from eight participants with TLE and from eight participants without TLE. The Affective Neuroscience Dream Scale (ANDS) was developed for this study to categorise emotions according to underlying neurobiology. The reliability and validity of this scale was assessed. The ANDS was used to code the emotions in these dream reports. Within group analyses showed that FEAR and ANGER were not consistently higher than other basic emotion for the TLE group. Between group analyses found no differences in any of the eight basic emotions, in amygdala-related emotions, in non-amygdala-related emotions, or in emotions when divided according to valence. TLE was well-regulated in participants, so these results indicate a normal dreaming pattern is experienced by individuals whose TLE is well-regulated. This indicates that once the disruption to the amygdala is controlled, dysphoric dreaming is reduced.

Keywords: affective neuroscience; amygdala; ANGER; basic emotions; dreaming; FEAR; temporal lobe epilepsy.

The processes behind dream production have remained elusive for centuries, but researchers have suggested that emotions in dreams appear to direct the plot of the dreams, rather than occur as a reaction to the dream plot (Hobson, Pace-Schott, & Stickgold, 2000). Research on the relationship between the temporal lobe and dreaming led Penfield and Erickson (1941) to suggest dreaming arises from the temporal lobe. Although this may be an oversimplification of the processes necessary for dreaming, a relationship has consistently been found between the amygdala, a group of nuclei located in the medial temporal lobe, and dreaming (Maquet et al., 1996; Peterson, Henke, & Hayes, 2002). The amygdala is active during several aspects of emotion experience in waking life, and its high levels of activation during dreaming sleep suggest a role in the production of the emotion content of dreams (Braun et al., 1997; Davis, 1992; Hobson & Pace-Schott, 2002; Peterson et al., 2002). As the amygdala is frequently implicated in fear experiences (Adolphs, 2008; Feinstein, Adolphs, Damasio, & Tranel, 2010; LeDoux, 2000; Maren, 2001) and in anger experiences (Ewbank, Fox, & Calder, 2010; Lanteaume et al., 2007; Pichon, De Gelder, & Grèzes, 2009) in waking life, it is expected that increased activation of the amygdala during dreaming should alter dream content to include more fear and anger themes.

Characteristics of Dreams

Dreams provide a unique experience of the self, the inner world, and the remembered outer environment (Bassetti, Bischof, & Valko, 2005). These experiences are significantly different from perceptual experiences in waking life yet are experienced as being real by the dreamer. Dreams are rich in auditory, visual, and emotional content that emerges internally, and as such, dreams are considered the mental activity of sleep (Hobson & Pace-Schott, 2002; Nir & Tononi, 2010). Rapid eye movement (REM) sleep is characterized by cerebral and autonomic arousal, and an estimated 80% of dreams occur during this sleep state, which supports the notion that dreams are the product of mental activities in sleep (Nielsen & Levin, 2007; Nir & Tononi, 2010). The remaining 20% of dreams occur mainly in stage two sleep during non-REM (NREM) sleep.

Dysphoric dreaming. Nightmares and bad dreams are forms of dysphoric dreaming (Schredl, 2003). These dreams usually include vivid experiences of fear and

anger, although emotions like disgust and sadness can also occur (Nielsen & Levin, 2007). Nightmares and bad dreams have similar emotional content and are both remembered on awakening, but they differ in that the intensity of a nightmare causes the dreamer to awaken immediately, while bad dreams do not awaken the sleeper. Nightmares and bad dreams are viewed on a continuum where both are manifestations of the same underlying phenomenon, with nightmares being the less common, more extreme manifestation (Robert & Zadra, 2008; Schredl, 2003). It is to be expected that dysphoric dreaming results from stimulation of an underlying mechanism, while increased rates of dysphoric dreaming are the result either of over-stimulation of this mechanism, or of a pattern of dysregulation in the activation of this mechanism.

Dreaming and the amygdala. Dreaming depends on a wide distribution of brain activity and damage to any of the implicated areas results in abnormal dreaming (Solms, 1997). One such area is the amygdala as functional neuroimaging studies consistently show that this area has increased activation during REM sleep that contains dreaming (Hobson, 2009; Maquet & Phillips, 1998). This activation is even higher during dreams that are rich in emotion content, and especially high in dreams containing threatening or fearful imagery (Hobson & Pace-Schott, 2002; Maquet et al., 1996; Peterson et al., 2002; Stickgold, 2001). The amygdala is therefore implicated in the processes necessary for dream formation, and it may be expected that it is specifically responsible for the production of the emotion content of dreaming (Peterson et al., 2002).

In waking life the amygdala is involved in forming and storing emotion memories (Adolphs, 2010). During dreaming sleep, amygdala activation mimics its activation pattern during the processing of associative memories in waking life (Peterson et al., 2002). Researchers therefore posit that dreaming must include processing of these memories, and that this is what gives dreams their emotional content (Braun et al., 1997; Datta, 2000; Maquet et al., 1996; Stickgold, 2001). As the amygdala apparently processes the simulated emotions in dreaming in the same way as emotions in waking life, this could explain why emotions in dreams are experienced as being genuine (Bassetti et al., 2005; Peterson et al., 2002).

The Amygdala and Panksepp's Basic Emotion Theory

Theories of basic emotions in affective neuroscience posit that certain emotions exist that have specific and unique neural correlates (Panksepp, 1998). A

large body of evidence has emerged implicating the amygdala in fear and anger experiences (LeDoux, 2000). One of the most popular and best supported basic emotion theories is Panksepp's (1992, 1998, 2007, 2010) theory, which suggests that seven basic emotions exist, and each has unique underlying neural correlates. Panksepp's (1998) seven basic emotions are FEAR, RAGE, PLAY, SEEKING, LUST, CARE, and PANIC/GRIEF. The capitalisation of the emotion names indicates that these terms refer to emotions with designated brain systems, and to the associated behavioural, physiological, and psychological responses, rather than just the subjective feelings of fear, lust, and so forth (Panksepp, 1992). Of these seven basic emotions, the amygdala is consistently implicated in FEAR and ANGER (Carré, Fisher, Manuck, & Hariri, 2010; Feinstein et al., 2010; Pape & Pare, 2010; Pichon et al., 2009).

FEAR and the amygdala. Pavlovian fear conditioning has been used to establish which neural regions and systems are necessary for different aspects of fear experience during fear conditioning. These studies have found the amygdala is active during the subjective experience of fear, during conditioning for new fears, and that its pattern of activation in response to fear-evoking stimuli is altered by fear extinction trials (Feinstein et al., 2010; LeDoux, 2007; Pape & Pare, 2010; Rabinak & Maren, 2008; Tranel, Gullickson, Koch, & Adolphs, 2006).

Research has shown a pattern of results where increased levels of activation in the amygdala correlate with increased rates or increased intensity of fear and anxiety experiences (Davis, 1992; LeDoux, 2007; Lesting, Geiger, Narayanan, Pape, & Seidenbecher, 2010; Maren, 2001; Shapira et al., 2006). Electrically stimulating the amygdala immediately results in autonomic and behavioural expressions of fear and defensiveness (Cendes et al., 1994; Gloor, 1990; Shapira et al., 2006), while lesions to the amygdala in rats, cats, rabbits, dogs, and humans result in 'taming' or fear reduction (Cendes et al., 1994; Feinstein et al., 2010; Maren, 2001; Rabinak & Maren, 2008). Lesion studies also show that the amygdala is necessary for contextual fear learning because lesioned rats 'forget' their fear of the cage that was used for foot shock administration prior to them being lesioned (LaBar & LeDoux, 1996). These findings suggest that the amygdala is necessary for the formation and retrieval of fear memories.

Human studies have focused on the effects of decreased or inhibited activation of the amygdala. One study found that a patient with selective bilateral damage to the

amygdala did not exhibit fear conditioning for visual or auditory cues paired with fear-evoking loud noises (Bechara et al., 1995). Another study found that patients with unilateral anteromedial temporal lobe resection (including the amygdala) showed clear deficits in auditory fear conditioning (LaBar, LeDoux, Spencer, & Phelps, 1995). A study that attempted to evoke fear in a patient with focal bilateral amygdala lesions found the patient failed to report any fear, and exhibited excitement and curiosity characterised by approach behaviours instead (Feinstein et al., 2010).

ANGER and the amygdala. The amygdala's role in ANGER is less researched than its role in FEAR. Lesion studies found that bilateral lesions to the amygdala resulted in impaired recognition of anger in facial expressions, as well as impaired auditory recognition of anger in speech (Pichon, de Gelder, & Grezes, 2008; Scott et al., 1997). Bilateral ablation of the amygdala in rhesus monkeys and prairie voles resulted in decreased aggression (Emery et al., 2001; Wang, Hulihan, & Insel, 1997) and unilateral amygdalectomies in the treatment of pathological aggression in humans successfully reduced aggression and anger in these patients (Sachdev, Smith, Matheson, Last, & Blumbergs, 1992). Gregg and Siegal (2001) found that electrical stimulation that focused on the lateral nucleus of the amygdala resulted in predatory attack behaviour in cats. Amygdala activation is therefore positively correlated with anger experiences in waking life.

Temporal Lobe Epilepsy: A Disorder With Increased Amygdala Activation

Temporal lobe epilepsy (TLE) is a disorder of complex partial seizures that occurs in the temporal lobe, and which almost invariably affects the amygdala (Zillmer, Spiers, & Culbertson, 2008). The seizures are considered partial because they arise specifically from the temporal lobe, and complex because they cause an alteration in consciousness. When a seizure occurs a group of neurons cease to fire in the normal, relatively independent pattern, and instead spontaneously fire in synchrony. This altered pattern of electrical activity results in increased stimulation of affected areas (Wiebe, Blume, Girvin, & Eliasziw, 2001). Some studies indicate that the cumulative effects of repeated seizures undermine the structural integrity of brain regions affected by seizures such that they are disrupted inter-ictally as well as during seizure activity (Bernhardt et al., 2008; Cormack et al., 2007).

TLE seizures occur more frequently during sleep than during waking life, with approximately 40% of seizures occurring during sleep, while the remaining 60% are

distributed across waking hours at a lower frequency (Herman, Walczak, & Bazil, 2001). Ictal and inter-ictal epileptiform activity increases during sleep, with seizures lasting longer, occurring more frequently, and resulting in more secondary generalisations than when awake (Bazil & Walczak, 1997; Buechler, Rodriguez, Lahr, & So, 2008; Herman et al., 2001; Hermann, Seidenberg, Schoenfeld, & Davies, 1997). REM sleep suppresses epileptiform discharges, so the increased epileptiform activity occurs mainly during NREM sleep.

FEAR and ANGER result from increased amygdala activation, and as TLE seizures stimulate the amygdala, it is not surprising that individuals with TLE report increased rates of fear and anger in their daily lives (Feichtinger et al., 2001; Lesting, Geiger, Narayanan, Pape, & Seidenbecher, 2010; Meldolesi et al., 2007; Meletti et al., 2009). There is also a limited body of research suggesting that individuals with TLE experience increased rates of dysphoric dreaming, although most of these studies do not specify which negative emotions are increased in TLE dreams.

TLE and increased fear experiences. Individuals with TLE report increased rates of fear both at seizure onset and during inter-ictal periods, while rats with induced TLE show higher baseline levels of anxiety and a decreased success rate in fear extinction (Cendes et al., 1994; Feichtinger et al., 2001; LaBar & LeDoux, 1996). Seizure activity may mimic the specific oscillation patterns seen in the amygdala during fear conditioning, and as such the seizures can evoke the same reactions as fearful stimuli would (Lesting et al., 2010). This finding explains the sudden, intense fear that occurs at seizure onset (Feichtinger et al., 2001). Inter-ictal fear is thought to be the result of a general pattern of dysregulation in the amygdala caused by seizures frequently disrupting normal patterns of activation (Lesting et al., 2010). Seizures cause a sudden peak in amygdala activation that is followed by a dip in activation. Disruptions to amygdala activation therefore persist after epileptiform activity has ceased. In addition, the long-term effects of seizure activity result in neuronal loss and pathological changes in the amygdala, which can in time result in permanent alterations in amygdala activation patterns (Cendes et al., 1994).

TLE and increased anger experiences. The occurrence of aggression in TLE is a controversial issue. Anger is less common in TLE than fear, with some studies reporting incidence rates as low as 4.7%, while others report rates as high as 50% (Van Elst, Woermann, Lemieux, Thompson, & Trimble, 2000). Gloor et al. (1982)

studied 29 cases of TLE, and only one participant reported having an epilepsy-related episode of aggression. Only one episode occurred, and the aggression was limited to a subjective state of anger and did not extend to behavioural indicators of anger. In contrast, Meldolesi et al. (2007) studied drug-resistant cases of TLE before and after surgical treatment, and they found a significant decrease in anger rates after treatment. They included self-directed anger in their study, and found that women tended to experience this form of anger rather than anger directed at others. Melletti et al. (2009) found that individuals with TLE were impaired in their ability to recognise facial expression of anger in others, while Scott (1997) found impaired auditory recognition of anger in a single case of TLE.

The dreams of individuals with TLE. Dream recall patterns in TLE mimic those of healthy individuals in that recall is higher after awakening from REM than it is from stage two sleep (Bassetti et al., 2005). However, individuals with TLE exhibit higher level of dream recall, report higher rates of dysphoric dreaming, and report higher rates of vividness and emotional detail (Cipolli, Bonanni, Maestri, Mazzetti, & Murri, 2004). Further, recurrent dreams in TLE are very similar in character to the hallucinations experience by individuals with TLE, suggesting a common underlying mechanism (Silvestri, 2004; Solms, 1997). Despite the relationship between TLE and recurrent dreams having been noted many decades ago (Ferguson et al., 1969), research on the dreams of individuals with TLE is still very limited.

Individuals with TLE experience recurrent, stereotyped dreams that are rich in fearful imagery and tend to recur over very long periods of time (Silvestri, 2004; Solms, 1997). Some studies report that the predominant emotion is fear, and that recurrent dreams in TLE are typically recurrent nightmares (Reami, Silva, Albuquerque, & Campos, 1991; Silvestri, 2004). Case studies using electroencephalogram (EEG) recordings have confirmed that instances of dysphoric dreaming occurred during seizure activity in their participants (Reami et al., 1991; Vercueil, 2005). Bassetti et al. (2005) found increased rates of dysphoric dreaming in participants with TLE, and suspected their finding was due to seizures increasing amygdala activation. Stewart and Bartucci (1986) reported a case where a patient presented with recurrent nightmares and seizure activity in the temporal lobe, and after only two days of anticonvulsant medication his nightmares stopped. Solms (1997) presented nine cases of recurrent nightmares and found that five of these cases definitely presented with epilepsy and electroencephalograms (EEGs) showed the

epileptiform activity affected the temporal lobe. The remaining four cases had not been adequately investigated for epilepsy, so the disorder could not be excluded with absolute certainty. Solms (1997) found the recurring nightmares responded to the surgical removal of the irritative epileptic focus in one case, and to anticonvulsant medication in two other cases. Silvestri (2004) reported 14 individuals with TLE who presented with recurring nightmares, and confirmed seizure activity during a nightmare in stage two sleep. Further, Silvestri (2004) found an inverse relationship between treatment compliance and recurrent nightmares, supporting the hypothesis that the nightmares are caused by seizure activity. Studies have also found that the recurrent dreams of individuals with TLE tend to be higher in vividness and emotion themes when compared to controls (Cipolli et al., 2004; Silvestri, 2004).

As epileptiform activity is suppressed in REM sleep (Herman et al., 2001), it is expected that dreaming that occurs in NREM sleep is influenced by seizure activity that disrupts the amygdala. Dreaming during REM sleep is likely to be affected if the activation pattern in the amygdala has not normalised since the last seizure, or if the long term effects of seizures have resulted in structural changes in the amygdala (Cendes et al., 1994).

The studies discussed above show that individuals with TLE have increased rates of dysphoric dreaming and suggest that epileptiform activity may be responsible for this altered pattern of emotion content in dreams.

Conclusion

The amygdala is highly active during dreaming sleep and is therefore implicated in dreaming. Based on its role in waking life, its role in dreaming is inferred, and it is therefore implicated in the production of the emotion content of dreaming, especially in regards to FEAR and ANGER. Individuals with TLE present with increased amygdala activation, and a limited number of studies have explored the emotion content of dreams in these individuals. These studies have focussed on recurrent dreams, and especially on recurrent nightmares. Further, these studies have recruited individuals with severe or unregulated cases of TLE. Due to the limited number of studies, because these studies have not focused on non-recurrent dreams, and as individuals with well-regulated TLE have not been studied, further research on the dreams of individuals with TLE is necessary to better elucidate the affects of TLE

on dreaming. As the amygdala is disrupted in TLE these results can then be used to make inferences regarding the role of the amygdala in dreaming.

Rationale and Aims of this Study

The temporal lobe, including the amygdala, is implicated in dream production (Hobson & Pace-Schott, 2002; Penfield & Erickson, 1941). The exact role of the amygdala in dreaming is unclear, but it has been suggested that it is responsible for the production of the emotion content of dreams. As the amygdala is implicated in FEAR and ANGER experiences in waking life, research is necessary to establish if it is also implicated in the production of these experiences during dreaming. TLE is a seizure disorder that causes increased amygdala activation, so individuals with TLE provide an opportunity to study the emotion content of dreams during increased amygdala activation. Previous studies have focused on recurrent dreams and on cases where epileptiform activity is not well regulated. Studying the non-recurrent dreams in individuals with well-regulated TLE will clarify the effects of TLE on dream content. This will elucidate further the role of the amygdala in dreaming

This study therefore aimed to establish if individuals with TLE had increased rates of FEAR and ANGER compared to healthy controls. Further, as FEAR and ANGER occur during increased amygdala activation, it was expected that only these emotions, and not the other basic emotions, would be increased in individuals with TLE.

The following questions were therefore asked:

- (1) Do individuals with well-regulated TLE have more FEAR and ANGER themes than other basic emotion themes in their non-recurrent dreams?
- (2) Do individuals with well-regulated TLE have increased FEAR and ANGER themes in their non-recurrent dreams compared to individuals without TLE?

As the theoretical basis for this study stems from studies on the neural correlates of emotions, an emotion scale that identified emotions in a way that reflected underlying neural processes was needed. A subsidiary aim was therefore to design an emotion scale that identified emotions using definitions from affective neuroscience.

Methods

Design

The current study forms a component of a larger study on the role of the amygdala in dreaming. This study investigated differences in emotions in dreaming in individuals with TLE. The presence of TLE suggests increased amygdala activation, so changes in dream content could have reflected the effects of increased amygdala activation. As part of the larger study, a mirror study was conducted on individuals with decreased amygdala activation. Together these two studies should give a picture of what role the amygdala plays in the production of the emotion content of dreams by providing a view of the effects when amygdala activation is decreased, is normal, and is increased.

This study used a quantitative design. This study was only interested in whether amygdala-related emotions (i.e. FEAR and ANGER) occurred, and at what intensity they occurred, so any greater insight about dream content that would have been gained through a qualitative design was not necessary. This study was interested in whether rates of FEAR and ANGER experiences in non-recurrent dreaming were higher in individuals with TLE compared to healthy controls. This study was also interested in whether amygdala-related emotions were greater in the TLE group compared to non-amygdala-related emotions (i.e. PLAY, SEEKING, LUST, CARE, PANIC, AND GRIEF).

This study investigated between-group differences in relation to the absence or presence of TLE in participants, and is therefore quasi-experimental. The presence of TLE was taken to indicate increased amygdala activation, while the absence of TLE was taken to indicate normal amygdala activation.

Data were collected from undergraduate psychology students at the University of Cape Town (UCT). Data collection for the development of a coding system took place on university premises, while data for comparisons between TLE and non-TLE dreams were collected from UCT students using an online questionnaire.

As this study shared participants with a larger study on TLE and nightmares, it received ethical clearance by the Faculty of Health Sciences Human Research Ethics Committee under the larger study (see Appendix A).

Measures

This study made use of two measures, the Most Recent Dream (MRD) report and the Affective Neuroscience Dream Scale (ANDS). The MRD method was used to

acquire dream reports, while the ANDS was designed to code the intensity of selected emotions in dreams.

The MRD report. The MRD report requires participants to write a detailed report of the most recent dream they can remember (see Appendix B). Retrospective dream reports attained outside the sleep laboratory, like the MRD report, show no significant difference in content to those obtained during REM studies in the sleep laboratory (Foulkes, 1979). The MRD form takes an average of 15 to 20 minutes to complete (Domhoff, 1999). The MRD method therefore provides a cost- and time-efficient way to collect reliable samples of dreams. The MRD is an established method with acceptable levels of validity and reliability (Domhoff, 1999).

The ANDS. Panksepp's (1998, 2007, 2010) theory of basic emotions is well supported by current neuroimaging studies. Further, this work provides holistic descriptions for emotion experiences that encapsulate the subjective feeling, the associated autonomic arousal, cognitive and behavioural patterns, and the pattern of changes in neural activity (Panksepp, 1992). This study operationalised the affective, behavioural, and cognitive aspects of these descriptions to develop a coding system that would identify emotions that indicated underlying neurobiological processes (see Appendix C). All seven of Panksepp's (1998) basic emotion were used, and PANIC/GRIEF was divided into separate emotion categories due to differences in the affective experience of these emotions - PANIC refers to an acute experience of loss associated with separation or the threat of separation from a love object, while GRIEF refers to the long-term, chronic sense of loss associated with the permanent loss of a love object (Davis, Panksepp, & Normansell, 2003). The ANDS therefore identified eight emotions.

The ANDS required one to rate a dream in its entirety so each emotion received as single score. Emotions were coded based on intensity, with zero indicating that the emotion was absent, and a score of three indicating that the emotion occurred at maximal intensity. If an emotion occurred several times at different intensities, then it was coded according to the instance of its highest intensity. A dream therefore received eight scores and each score ranged from zero to three.

The ANDS was newly developed for this study. As a new scale, reliability and validity had not been established. Therefore, before being used to code the dreams for the study on differences in emotion content in dreams between participants with TLE and those without ("the TLE study" hereafter), validity and reliability was tested

using dreams from the undergraduate student population at UCT, and using two coders to separately code these dream reports.

Participants

Participants for this study were recruited from the undergraduate psychology student population at UCT. A total of 46 students participated in this study - 30 were recruited for the testing of the reliability and validity of the ANDS, and sixteen were recruited for the TLE study. Students were recruited through the Student Research Participation Program (SRPP) which forms part of the undergraduate psychology courses.

Participants for the reliability testing of the ANDS. The only requirement for participation in this part of the study was that participants had English as their first language. 30 participants completed this component of the study, but one student was eliminated as she failed to correctly follow the instructions on the MRD report and reported several dreams rather than a single dream. A total of 29 dream reports were collected.

Participants for the TLE study. Participants for the TLE study were sourced from a larger study on TLE that is being conducted by a fellow postgraduate student in the UCT psychology department. The larger study requires participants to complete an online questionnaire. For the current study the MRD report was added as a further question and therefore constituted a component of the overall questionnaire. Language proficiency is tested when potential students apply to study at UCT, but to ensure language did not confound the study, participation was limited to individuals who had English as their first language. Participants had to have no brain pathology other than TLE.

Due to the loss of statistical power associated with unequal group sizes in MANOVA, group sizes were kept equal (Field, 2009). 586 students completed the online survey. Of these participants, eight had TLE. The small group size was anticipated as only three to nine of every 1000 people in African countries have TLE (Senanayake & Román, 1993). To ensure equal group sizes, eight random numbers were generated using Microsoft Excel 2007, and the dream reports with these numbers formed the control group.

Procedure and Data Collection

This study was conducted in two phases. The first phase consisted of creating and testing the ANDS, and the second was the TLE study.

Procedures for developing and testing the ANDS. The ANDS was developed by operationalising the definitions provided by Panksepp (1992, 1998, 2007, 2010) for the seven emotions in this basic emotion theory. This was done by focusing on the affective experiences associated with each of the basic emotions. As mentioned above, although PANIC and GRIEF constitute a singular neurological system, the differences in their affective qualities resulted in them being separated for this scale.

The validity of the ANDS is drawn from the strong theoretical basis for neurologically distinct basic emotions, and the research that supports Panksepp's (1998) basic emotions. As no existing emotion scale for dreams is based on affective neuroscientific definitions of emotions, concurrent validity could not be established. It is essential that the scale measures emotions that indicate underlying neurological activity, so comparisons to scales without a neurological foundation would be meaningless. As a new scale, no reliability had previously been established.

The validity and reliability of the ANDS was therefore tested to establish the consistency obtained when the same dreams were coded by different coders, and to establish the consistency of scores when a dream report was rated by the person reporting the dream and by an independent coder. Three separate groups of ten participants were recruited for this phase of the study. Informed consent was obtained from participants at the beginning of each session (see Appendix D). Participants were instructed to complete handwritten MRD reports and were given no indication of what they would have to do next. On completion of the MRD reports, participants were then required to code their dream reports using the ANDS. Participants then received a letter of debrief explaining the purpose of the study (see Appendix E). The dream reports were transcribed verbatim and sent to the independent coders to also be coded using the ANDS. Intraclass correlation coefficients (ICCs) were calculated to establish the consistency between the coders, and to establish the consistency between the coders and the dreamers.

Procedures for collecting the dream reports for the TLE study.

Participants for the TLE study were recruited via the SRPP program, and those who opted to participate were instructed to log onto a website to complete a survey. When students log onto the webpage they are required to give consent before completing the

survey. Thereafter participants are able to withdraw from the survey at any point by simply logging off the page.

Participants were required to complete demographic information such as age, sex, and race, as well as indicate whether or not they had TLE. Participants with TLE were also requested to provide a subjective report of the frequency and intensity of their seizures, as well as an opinion of how well they felt their seizures were regulated. These participants were also requested to indicate if they were on medication for their TLE. All participants were then required to complete MRD reports (see Appendix F for completed dream reports). The MRD report instructions on the website were identical to those issued in print for testing the ANDS. The MRD reports were then coded with the ANDS by the two independent coders who were used during the testing of the ANDS.

Data Analysis

The data were analysed using the SPSS Statistics 19 statistical software package (SPSS Inc, 2010). Separate analyses were done for the initial testing of the ANDS and then for the TLE study. Throughout the study two independent coders were used. These coders had no knowledge of the purpose of this study.

Testing the reliability and validity of the ANDS. As a new a scale developed for this study, the ANDS needed to be tested for reliability and validity.

Reliability of the ANDS. The 29 dream reports that were collected for the testing of the ANDS were used to establish the reliability of the ANDS when used by two separate coders. As each dream was coded for eight emotions, a total 232 items were compared between coders. An ICC was run to establish the consistency between coders. Usually consistency between coders would indicate inter-rater reliability, but as the reliability of the ANDS had not previously been established, this aspect of the study was used to test the reliability of the ANDS.

Validity of the ANDS. The only way to access subjective states is through self-report data (Barrett, Mesquita, Ochsner, & Gross, 2007), so the ANDS would have validity if independent coders could identify the same emotions in a dream report as the person who had the dream would report having experienced. The same 29 dream reports were therefore used to explore the validity of the ANDS in this way. The ratings provided by the dreamers, and the mean ratings from the coders, were compared on 232 items. An ICC was used to establish the consistency between these

ratings, with a high rating indicating that the ANDS validly identifies emotions in dream reports.

The TLE study. Group status was the independent variable in this study, while the rates of each emotion were the dependent variables, meaning the study compared eight dependent variables across two independent conditions.

Descriptive statistics for the emotion rates for each group were calculated. Race, gender age, and average word count for the dream reports were assessed across groups to ensure comparability. Race and gender were categorical, and were assessed visually, while word count and age were assessed with a one-way analysis of variance (ANOVA).

With-in group differences in the TLE group were assessed with a repeated-measures ANOVA. Pairwise comparisons were then run to establish which emotions differed. This was done to assess if the TLE group experienced increased amygdala-related emotions compared to other emotions.

Between-group differences were investigated using four multivariate ANOVAs (MANOVA). One MONOVA was run comparing all eight emotions across groups. A second MANOVA compared only FEAR and ANGER across groups as reduced dependent variables would increase the power of the MANOVA. A third MANOVA assessed group differences for amygdala-related emotions (i.e. FEAR and ANGER) and non-amygdala-related emotions (PLAY, SEEKING, LUST, CARE, PANIC, and GRIEF). A fourth MANOVA explored valence independent of underlying neural processes by comparing negative emotions (i.e. FEAR, ANGER, PANIC, and GRIEF) and positive emotions (PLAY, SEEKING, LUST, and CARE) across groups.

Results

Reliability and Validity of the ANDS

The reliability of the ANDS. The reliability of the ANDS was explored by assessing the consistency of ratings when the same dream reports were coded by separate coders. The level of agreement between the two coders was explored using a two-way, mixed model ICC for absolute agreement for 232 emotion items. A strong single measures ICC of .70 (95% confidence interval: .60-.76, $F = 5.74$, $p < .001$) was attained. This indicated a high level of consistency, so the reliability of the ANDS as assessed with these two coders was considered strong.

The validity of the ANDS. The validity of the ANDS was assessed by exploring the consistency between scores for a dream reports obtained by the dreamer and those obtained for the same reports by independent coders. The validity of the ANDS was assessed using a two-way, mixed model ICC for absolute agreement. 29 dreams, each with eight emotions, were used, so a total of 232 emotion items were compared. The dreamers' ratings of their own dreams and the mean scores for each emotion item from the two independent coders were compared. As the mean scores for the coders were used, the average measures ICC was used. An ICC of .67 (95% confidence interval: .44-.79, $F = 3.59$, $p < .001$) was attained. This is a moderate correlation, and indicates that the agreement between dreamers' rating of their own emotions and rating of the same emotions by independent coders are consistent. This suggests that the ANDS validly codes for emotions as experienced by the dreamer.

TLE Study

Comparability of groups. Descriptive statistics are shown in Table 1. The groups are similar in race and gender. The TLE group had a mean age of 21 (SD = 2.73) and a mean word count of 187.63 words (SD = 178.50). The control group had a mean age of 20.5 years (SD = 1.60) and a mean word count of 120 words (SD = 47.40). A one-way ANOVA was run to assess if significant between-group differences existed for age or word count, as age had a lower standard deviation in the control group, while the TLE group had much higher variability in word count. Assumptions of independence of data and of data being of at least interval scale were met for age and word count. Homogeneity of variance was upheld in age, as Levene's test of homogeneity was not significant, $F(1, 14) = 1.54$, $p > .05$, but was violated in word count as this test was significant, $F(1, 14) = 5.01$, $p = .04$. ANOVAs are robust against violations of homogeneity of variance when group sizes are equal, as they were in this study (Field, 2009). The ANOVA was not significant for age, $F(1,14) = 0.20$, $p > .05$, or word count, $F(1,14) = 1.07$, $p > .05$, meaning the TLE group did not differ significantly from the control group in age or word count.

The TLE participants all indicated that their TLE was well controlled. Seven participants reported being on medication for their TLE, while the eighth reported no medication use as seizure intensity was not severe. This eighth participant reported the highest seizure rate at two to four seizures a month. Four participants reported no

current seizures, and the remaining three reported one seizure a month. Participants received the diagnosis of TLE between five and 13 years ago.

Table 1
Demographic Characteristics of Participants

	TLE Group (<i>n</i> = 8)	Controls (<i>n</i> = 8)
Age		
<i>M</i> (<i>SD</i>)	21.00 (2.73)	20.50 (1.60)
Gender		
M:F	3:5	4:4
Race		
White:Coloured	8:0	7:1
Word Count for MRD Report		
<i>M</i> (<i>SD</i>)	187.63 (178.51)	120.00 (47.40)

Shared Assumptions for TLE study data. A repeated-measures ANOVA and four MANOVAs were run on these data. These statistical analyses all require normal distribution, independence of data, and that data are at least of the interval scale (Field, 2009). In addition, repeated measures ANOVA requires sphericity, and MANOVAs require multivariate normality and homogeneity of covariance. The data in this study are independent, as each participant completed only one dream report, and the data is of the interval level.

Histograms, P-P plots and Kolmogorov-Smirnov testing showed all data were positively skewed. As group size was so small this was anticipated. Only Fear ($D(8) = .25, p > .05$) and Anger ($D(8) = .23, p > .05$) in the TLE group, and Fear ($D(8) = .16, p > .05$) and Panic ($D(8) = .29, p > .05$) in the control group were not sufficient skewed to violate normality, while the remaining 12 data sets clearly violated normality. Repeated-measures ANOVAs are generally robust against violations of normality, and this is increased when group sizes are equal (Field, 2009). Multivariate normality will be undermined in the MANOVAs due to the absence of normality, but MANOVAs are also robust against violations of multivariate normality when group sizes are equal.

Within-group differences for TLE: Repeated-measures ANOVA. The eight basic emotions were compared in the TLE group to establish if any emotions were more dominant than others. As mentioned above, this test requires sphericity. Mauchley's test of sphericity indicated that sphericity had been violated, $\chi^2(27) = 61.21, p < .001$. Degrees of freedom were therefore corrected using Greenhouse-Geisser estimates of sphericity ($\epsilon = .53$). The ANOVA then showed that emotions did not present equally, $F(3.69, 52.58) = 4.80, p = .003$. Multivariate tests were significant, $V = 0.89, F(7, 9) = 10.15, p = .001$, further supporting the finding that emotions were not equal in the TLE dream reports.

To assess where the difference in emotion lay, pairwise comparisons were run. FEAR was found to be significantly higher than PANIC ($p = .04$), LUST ($p = .01$), and GRIEF ($p = .03$). No other significant differences were found.

Between-group differences in all emotions. This study was interested in whether the groups differed in rates of any of the emotions, so I ran a MANOVA comparing the emotions across groups. The mean scores for each emotion in each group are shown in Table 2. LUST and GRIEF were omitted from the test as they both have scores of zero for the TLE group and therefore had no variance. The MANOVA compared the remaining six emotions. Homogeneity of variance was upheld as Box's Test of Covariance was not significant ($p > .05$). Pillai's Trace showed that FEAR, ANGER, PLAY, SEEKING, CARE, and PANIC did not differ significantly across groups, $V = .39, F(6, 9) = 0.95, p > .05$. TLE dream reports did not differ significantly on these emotions compared to controls.

Table 2
Emotion Distribution Across Groups

	TLE Group ($n = 8$) $M (SD)$	Controls ($n = 8$) $M (SD)$
FEAR	1.19 (1.13)	1.38 (1.22)
ANGER	0.69 (0.65)	0.56 (0.82)
PLAY	0.19 (0.53)	0.25 (0.53)
SEEKING	0.69 (0.75)	0.19 (0.37)
LUST	0.00 (0.00)	0.06 (0.18)
CARE	0.44 (1.05)	0.31 (0.88)

PANIC	0.13 (0.35)	0.56 (0.68)
GRIEF	0.00 (0.00)	0.31 (0.46)

Between-group differences in FEAR and ANGER. The current study was specifically interested in whether rates of FEAR and ANGER differed across groups. These emotions had already been compared in the above MANOVA, but as decreasing the number of dependent variables increased the power of a MANOVA, I conducted a MANOVA that only compared FEAR and ANGER (Field, 2009). Homogeneity of covariance was upheld in these data as Box's Test of Covariance was not significant ($p > .05$). Pillai's Trace showed that neither FEAR nor ANGER differed significantly across groups, $V = .01$, $F(2, 13) = 0.08$, $p > .05$. TLE dream reports did not contain significantly different rates of FEAR or ANGER compared to controls.

Between-group differences in amygdala-related emotion and non-amygdala-related emotions. As TLE may cause increased rates of amygdala activation, this study explored whether amygdala-related and non-amygdala-related emotions differed across groups. I calculated an amygdala-related score for each dream report by obtaining the mean score from that report's FEAR and ANGER ratings, and obtained a non-amygdala-related score by obtaining a mean score from that report's rating for PLAY, SEEKING, LUST, CARE, PANIC, and GRIEF. These scores are shown in Table 3. These two scores were then compared across groups using a MANOVA.

Homogeneity of covariance was upheld in this MANOVA, as Box's Test of Equality of Covariance was not significant ($p > .05$). Neither amygdala-related emotions or non-amygdala-related emotions differed significantly across groups according to Pillai's Trace, $V = .01$, $F(2, 13) = 0.72$, $p > .05$.

Table 3

Amygdala-related Emotions and Non-Amygdala Emotions Across Groups

	TLE Group ($n = 8$) $M (SD)$	Controls ($n = 8$) $M (SD)$
Amygdala-related emotions	0.94 (0.65)	0.97 (0.51)
Non-amygdala emotions	0.24 (0.27)	0.28 (0.20)

Between-group difference in valence. The literature suggests that individuals with TLE have increased rates of dysphoric dreaming (Silvestri, 2004; Solms, 1997). To explore if this was true in the current study I ran a MANOVA to establish if there was a between-group difference in negative (i.e. FEAR, ANGER, PANIC, and GRIEF) versus positive (PLAY, SEEKING, LUST, and CARE) emotions. A dysphoric dream does not need all negative emotions to be present, and a nightmare with very high rates of one negative emotion is considered more severe than a nightmare that contained several negative emotions at only moderate intensities. For these reasons, each dream was assigned a negative emotion score based on the highest score from their negative emotions, and a positive emotion score based on the highest score from their positive emotions. For example, if a report scored zero for PANIC and ANGER, one for GRIEF, and three for FEAR, they would receive a score of three for their negative emotion score. These scores are shown in Table 4. Negative emotion scores and positive emotion scores were then compared across groups using a MANOVA.

Homogeneity of covariance was upheld in this MANOVA, as Box's Test of Equality of Covariance was not significant ($p > .05$). Valance was significantly different across groups according to Pillai's Trace, $V = .03$, $F(2, 13) = 0.22$, $p = .03$. Univariate testing was conducted but it did not confirm group difference. A between group comparison of negative emotion found that homogeneity of variance was upheld as Levene's test of homogeneity was not significant, $F(1, 14) = 0.07$, $p > .05$, but that the ANOVA was not significant, $F(1, 14) = 0.37$, $p > .05$. The ANOVA for positive emotion also found that homogeneity of variance was upheld when indicated by Levene's test of homogeneity, $F(1, 14) = 1.03$, $p > .05$, and that the ANOVA was not significant, $F(1, 14) = 0.14$, $p > .05$. Small group sizes are likely to increase type 1 error rates, so the difference in results was interpreted as indicating no group difference. Negative and positive emotions were therefore not significantly different across groups.

Table 4

Negative Emotions and Positive Emotions Across Groups

	TLE Group ($n = 8$)	Controls ($n = 8$)
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TLE Group	Controls
(<i>n</i> = 8)	(<i>n</i> = 8)
<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)

Discussion

The ANDS

The ANDS is the first emotion scale for dreams of its kind. As affective neuroscience increases its focus on the relationship between emotions and their neural correlates, the need for emotion scales that are based on neuroscientifically relevant classifications of emotions becomes more evident.

Several basic emotion theories exist, but Panksepp's (1998) theory was chosen due to the strong neurological foundation for its categories. Based on this theory, the amygdala is implicated in FEAR and ANGER. By developing a scale that aligned with the theoretical basis for the current study, it was possible to measure emotions in a way that represented activity in underlying neurological activity. This avoided the problems that would have arisen if a different emotion scale had been used. The Hall and Van de Castle coding system is often used as it includes a section for emotions. However, for neuropsychological studies this scale can confuse, rather than clarify, explanations of findings. For instance, the Hall and Van de Castle system would code LUST, SEEKING and PLAY as 'happiness', leaving researchers unable to make inferences about the neural correlates behind these emotion experiences.

Shifting toward a coding system where the emotions actually represent underlying neurological processes allowed the current study to make inferences about the effects of the brain processes underlying TLE on emotions in dreams, rather than being limited to only making general inferences about TLE and emotion in dreaming.

Limitations of the ANDS. The ANDS faces the same limitations as other emotion coding systems that depend on subjective reports and require quantification of emotion. These scales are affected by how detailed and specific a report is and there is a risk of misrepresenting emotions because coders are required to objectively quantify subjective states.

The only way to validly learn about a person's emotional state is through subjective reports (Robinson & Clore, 2002). However, people tend to differ in the manner in which they report their emotions, with some being very broad in their descriptions and identifying valence rather than discrete emotions. Some people also

tend to be very specific and only label the emotion, while others will support this with a description of how they felt (Barrett, 2004). This was evident in the dream reports for this study, as some participants were specific in their emotion labels (i.e. “I started panicking”) while others were more vague (i.e. “Not very pleasant”). When emotion reports are being coded by objective coders, it is often easier to identify emotions when the dreamer provided a description with the relevant emotion term. This limitation is not specific to the ANDS, however, but affects all emotion coding systems that depend on written reports.

Objectively quantifying a subjective written report poses the risk that emotions can be incorrectly identified, or that their intensity can be incorrectly rated, as the coder is limited to the report and does not have access to the dreamer to obtain clarification. This is a limitation for all emotion scales that do not allow interviews with the participants. The ANDS, however, was tested against this in the validity trial. When dreamers were allowed to use the ANDS to code their own written reports it was expected that they would accurately identify the emotion present, as well as the intensity at which these emotions occurred. The validity trial found a moderate consistency between ratings provided by dreamers and those provided by independent coders, which indicates that although this limitation should always be kept in mind, the ANDS is resilient against it.

A further difficulty with subjective states is the reliability at which they can be measured, as coders are likely to have differences in emotion knowledge. The ANDS uses very detailed and clear definitions, which are less susceptible to personal bias than broader definitions. The reliability of the ANDS was assessed across two untrained coders, and the consistency in their ratings was high, indicating that the scale is reliable across different coders.

Final remarks on the ANDS. The ANDS added substantial value to this study by allowing emotions to be identified according to neural correlates. Emotion scales always face limitations due to the subjective nature of emotion states, but the validity and reliability trials showed that the ANDS is resilient against such limitations. The ANDS reliably measures emotions in a way that agrees with the dreamer’s impression of their own dream. Further validity and reliability testing is needed so that this scale can be used more widely by other researcher. Further, the studies that showed that the MRD report was comparable to dream studies conducted in sleep laboratories were conducted using the Hall and Van de Castle scale, so it is

suggested that similar studies are conducted to establish if this holds true when coding with the ANDS. This scale is considerably easier to use than the Hall and Van de Castle scale, and requires no training for coders. There is a definite need for scale of this sort, and moving toward using scales based on neuroscientific theory will help ensure progress in affective neuroscience.

Dysphoric Dreaming in TLE

The dreams of individuals with TLE are not well studied, but existing research found increased rates of dysphoric dreaming (Reami et al., 1991; Silvestri, 2004; Solms, 1997). As the epileptiform activity associated with TLE could increase amygdala activation, the current study specifically predicted that individuals with TLE would have increased rates of FEAR and ANGER. Analysis of the TLE dream reports showed that FEAR and ANGER were the most frequent and intense emotions according to descriptive statistics. However, the statistical analysis showed that the only significant difference between emotions was that FEAR was greater than PANIC, LUST, and GRIEF, while ANGER was not significantly greater than any other emotion. It is interesting to note that FEAR was greater than LUST and GRIEF, which are also negative emotions. This suggested that dysphoric dreaming resulted from amygdala-related emotions, rather than from other negatively valenced emotions.

However, a comparison of FEAR and ANGER in the dreams of individuals with TLE to the dreams of individuals without TLE found no significant difference. In fact, there were no significant differences in any of the eight basic emotions across groups. Further, when emotions were grouped according to those that were related to amygdala activation (i.e. FEAR and ANGER) and those that were not (i.e. PLAY, SEEKING, LUST, CARE, PANIC, and GRIEF) there was no difference between groups. This indicated that although FEAR was greater than some other emotions in the TLE group, it was not significantly different to FEAR in the control group, and when emotions were divided according to amygdala-relation, no difference was found.

Previous studies indicated that individuals with TLE had increased rates of dysphoric dreaming, and this study predicted that this would be due to an increase in amygdala-related emotions. However, amygdala-related emotions were not higher in the TLE group compared to non-amygdala related emotions, and amygdala-related

emotions were not higher in the TLE group compared to the control group. Valence differences between groups regardless of underlying neurobiology were explored to establish an their increased dysphoric dreaming was related to a general increase in negatively valenced emotions. No difference was found between groups for valence either.

This study therefore failed to replicate the increased rates of dysphoric dreaming in TLE found in previous studies. Instead, it showed no significant differences between the emotion content of the dreams of participants with TLE to those without TLE.

Explanation for finding normal rates of emotion in TLE dreams. The failure to replicates previous findings of increased rates of dysphoric dreaming in TLE could be due to differences in participants as well as in methodologies used across these studies. This study recruited individuals with well-regulated TLE and focused on their most recent dreams, rather than on recurrent dreams or a range of dreams attained through dream diaries.

Previous studies focused on individuals with severe TLE or whose seizures were less responsive to anticonvulsant medications, on dreams prior to treatment with anticonvulsant medication, or on individuals who required surgical interventions to treat their TLE (Silvestri, 2004; Solms, 1997; Stewart & Bartucci, 1986). Seven of the participants in this study were on medication and reported that their seizures were well controlled, with four of these participants reporting no seizures, and the other three reporting only one seizure per month. The eighth participant did not require medication as seizures were not severe. She reported the highest seizure rate at two to four seizures per month, yet her dream contained no FEAR or ANGER, suggesting that her epileptiform activity did not affect her dream content. As such, all of the participants for the current study reported that their seizures were well regulated or not severe, unlike the participants in previous studies. As such, it is unlikely that amygdala activation in these participants was significantly altered by TLE.

Although this study did not support the relationship between dysphoric dreaming and TLE, it did support previous findings regarding the effects of anticonvulsant medication in TLE on dreams. Silvestri (2004) found that optimizing the drug treatment therapies in individuals with TLE who reported recurrent nightmares resulted in a decrease in these dreams. The finding was so consistent that an inverse relationship between therapy compliance and nightmare occurrence was

established. Stewart and Bartucci (1986) reported that anticonvulsant medication eliminated nightmares after only three days in their patient. Solms (1997) found that anticonvulsant medication either decreased or entirely eliminated dysphoric dreaming in his participants. Snyder (1958) found that his patient only experienced nightmares again when he failed to take his medication, but once medication was continued his nightmares remitted. Several other studies found that dysphoric dreaming decreased along with other symptoms associated with TLE, such as auras or headaches (Boller, Wright, Cavalieri, & Mitsumoto, 1975; Epstein, 1964; Epstein & Freeman, 1981).

It is also interesting to note that most the studies above relied on the participants reporting a problem with nightmares (Snyder, 1958; Solms, 1997; Stewart & Bartucci, 1986), and did not use the MRD report. Self-report data on nightmares would not provide information on dreams other than dysphoric dreams, and would therefore not reflect the rates of dysphoric dreams to ordinary dreams. Dream diaries attain a better overall representation of dreams in an individuals. The Silvestri (2004) study administered diaries , but only did so to individuals whose TLE was not well regulated so it did not reflect the dreams of individuals with well-regulated TLE.

Rates of Emotion and Vividness in TLE Dreams

Some studies found that individuals with TLE have increased vividness and emotion themes in their dreams (Cipolli et al., 2004; Silvestri, 2004). This was not supported in the current study, and none of the eight emotions were found to be significantly higher in the TLE group. Further, as word count could be considered as indicative of the vividness of dream content (Barrett, 2004) as reporting a more vivid dream would require greater detail in the report. Although the TLE dream reports in the current study had greater variability in word count compared to the control group, there was not a significant difference in mean scores for word length between groups. This study therefore did not show increased vividness and emotionality in the dreams of individuals with TLE.

In contrast to Cipolli et al.'s (2004) study that recruited participants with complex partial seizures, including but not limited to TLE, the current study was limited to participant with TLE. Further, although Cipolli et al. (2004) reported that none of the participants experienced seizures for the three day duration of the study, they did not indicate the general seizure incidence rate of their participants. It is therefore speculated that the current study's participants presented with better

regulated TLE, although this cannot be confirmed. This could possibly account for why the current study did not find increased vividness in dreaming.

It is more likely that the discrepancy is due to different methods. Their study focused on recurrent dreams, while mine focused on most recent dreams. It is likely that recurrent dreams are higher in emotion content and vividness. It is possible that the participants in the current study do experience recurrent nightmares, but as they only reported the most recent dreams, they did not report those nightmares, and instead reported more recent dreams that contained less emotion and were less vivid. However, it is interesting to note that non-recurrent dreams are not significantly different in their emotion content compared to healthy controls.

Seizures as the Cause of Dysphoric Dreams

Several studies have suggested that seizures cause dysphoric dreams directly, such that seizure onset correlates with dysphoric dream onset (Reami et al., 1991; Silvestri, 2004; Stewart & Bartucci, 1986; Vercueil, 2005). Using EEGs, these studies confirmed seizures in the temporal lobe during dysphoric dreams. The implication that dysphoric dreams are caused by seizures is that an absence of seizures would result in an absence these dreams. As discussed above, successful treatments do result in such a decrease (Silvestri, 2004). In support of this notion, the current study found that non-recurrent dreams are not disrupted in individuals whose TLE is well regulated. This suggest that individuals whose TLE is not well regulated should be capable of normal dream patterns between seizures. The current study supports findings that show successful treatment of TLE correlates with decreased rates of dysphoric dreaming. However, as it was not possible to compare these participants before and after treatment, this support should be interpreted with caution.

Conclusion

This study investigated whether the dreams of individuals with well-regulated TLE had increased rates of FEAR and ANGER compared to the other basic emotions. It also investigated if rates of FEAR and ANGER in these dreams were different to those in dreams collected from individuals without TLE. As FEAR and ANGER result from increased amygdala stimulation in waking life, it was hypothesised that seizure activity during dreaming would result in increased rates of these emotions. Literature on the dreams of individuals with TLE is limited, but shows that TLE

correlates with increased dysphoric dreaming, as well increased emotionality and vividness (Cipolli et al., 2004; Silvestri, 2004; Solms, 1997). This study did not confirm these relationships. Dream reports from participants with TLE and those without TLE did not differ in any of the eight basic emotions, in amygdala-related emotions, in non-amygdala-related emotions, in positive valence, or in negative valence. Further, the overall characteristics of the dreams, such as word length, vividness, and emotionality were also consistent across groups.

Some studies that investigated the relationship between TLE and dysphoric dreaming also noted that treatment correlated with a decrease in these dreams (Silvestri, 2004; Solms, 1997; Stewart & Bartucci, 1986). As seizure activity was well regulated in the participants in this study, it is probable that seizures did not occur frequently enough to significantly affect their dreams. The current findings therefore support previous studies that showed successful treatment of TLE resulted in normal dreaming patterns. However, as this study did not investigate dreaming prior to treatment for TLE, this finding should be interpreted with caution.

This study showed that non-recurrent dreaming in individuals with well-regulated TLE were not significantly different from the dreams of individuals without TLE. Previous studies showed that increased epileptiform activity correlated with increased dysphoric dreaming, and this study found that decreased epileptiform activity correlated with an absence of these dreams, which indicates that once the disruption to the amygdala was removed dysphoric dreaming ceased. This supports the notion that the amygdala is implicated in dreaming.

Limitations and Future Studies

This study has several limitations that could be addressed by future studies. These include the use of a measure that does not have established reliability and validity, a small sample size, single dream reports, and participants whose TLE was too well regulated to reliably reflect increased amygdala activation.

There is a definite need for an emotion scale for dreams that classifies and measures emotions based on their neural correlates. The limitations that came with designing a new scale for this study were outweighed by the value such a scale would add to the study. However, it would be preferable if a fully standardised scale of this nature could be developed for future research.

This study consisted of only eight participants with TLE, and collected only one dream report from each individual. A larger sample size would provide better representation of individuals with TLE, while dream diaries would provide a better dreaming profile for each participant. Future studies should therefore track the dreams of a larger sample of individuals with TLE over a longer period of time to establish whether any consistent differences exist in this population compared to healthy controls.

Finally, if one wishes to draw inferences regarding the role of the amygdala in dreaming one needs to recruit participants whose epileptiform activity covers a range of severities, from very well regulated to very poorly regulated. A seizure diary should be kept by the participants recording when seizures occur and the subjective rating of seizure severity, and dream diaries should record dream patterns over the same period of time. These two diaries could then be combined to establish if there was a relationship between seizures and dreams in individuals, and then compared across individuals to gain a clearer understanding of seizures and dreaming in general.

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Appendix A

Ethical Approval for Study



UNIVERSITY OF CAPE TOWN

Faculty of Health Sciences
Human Research Ethics Committee
Room E52-24 Groote Schuur Hospital Old Main Building
Observatory 7925
Telephone [021] 406 6626 • Facsimile [021] 406 6411
sumayah.ariefdien@uct.ac.za

15 August 2011

HREC REF: 338/2011

Mr W King,
Psychology
Faculty of Humanities

Dear Mr King,

PROJECT TITLE: NIGHTMARES AND BAD DREAMS IN PATIENTS WITH TEMPORAL LOBE EPILEPSY: A QUANTITATIVE CONTENT ANALYSIS.

Thank you for submitting your new study to the Faculty of Health Sciences Human Research Ethics Committee

It is a pleasure to inform you that the Ethics Committee has formally approved the above-mentioned study.

Approval is granted until 15 August 2012

Please submit an annual progress report (FHS016) if the research continues beyond the expiry date. Please submit a brief summary of findings if you complete the study within the approval period so that we can close our file.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC. REF in all your correspondence.

Yours sincerely

PROFESSOR MARC BLOCKMAN

CHAIRPERSON, FHS HUMAN RESEARCH ETHICS

Federal Wide Assurance Number: FWA00001637.
Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Appendix B

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

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*.

<i>Emotion Definition</i>	<i>Score</i>
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 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.	

<p>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.</p>	
<p>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.</p>	
<p>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, to look after and to feel needed by others.</p>	
<p>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 the acute form of grief.</p>	

Scale:

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

Appendix D

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 realise 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 study.

Signed: _____

Date: _____

Appendix E

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 the reliability and validity of a new scale, the Affective Neuroscience Dream Scale. 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: hmlkat002@uct.ac.za

Appendix F

Dream Reports from Participants with TLE

Dream report #1

Seizures per month: 0

How well-controlled would you say your seizures are? Very well-controlled

How severe would you rate your seizures overall? Mild

I was on a hill sliding down a hill on a board. There were a number of people watching me. Everything had a brown tinge and I remember being full of a sense of adrenaline.

Dream report #2

Seizures per month: Variable (depending on how well she takes medication). Ranges from 1 a week, to 1 a month, to 1 a year.

How well-controlled would you say your seizures are? Very well-controlled

How severe would you rate your seizures overall? Severe

I only remember the last part of this dream as it was relatively familiar to me. I had somehow ended up drowning, probably in the sea, I think I had fallen off a boat. I do not recall noticing any animals or any people after hitting the water. I remember being very frightened and holding my breath as long as I could and finally inhaling. I had been expecting to inhale water and was surprised to be able to breathe under water. Despite having already done so, I was still afraid to breathe after that first breath, certain it would choke me. This last part was unusual as when I usually have a similar dream, I tend to relax and start swimming after that first breath, having realised I can breathe in water I am no longer afraid of it.

Dream report #3

Seizures per week: 0

How well-controlled would you say your seizures are? Very well-controlled

How severe would you rate your seizures overall? Not at all severe.

All I remember of my dream is that the new camera that I has just received was hidden away by someone else under a rock, and I was upset and trying to protect it from those who had taken it

Dream report #4

Seizures per month: 2 to 4

How well-controlled would you say your seizures are? Well-controlled

How severe would you rate your seizures overall? Not at all severe.

Note: Not on medication as felt her seizures weren't severe

I was on a journey, walking along a road carrying a cat which I remembered to be wounded in some way. I felt a very close bond to this cat - lots of love and care for it and i was very careful in being gentle and taking good care of him. I spoke to the cat along the journey and he spoke back to me. At one point the cat entered a near bush. i bent down to find him lying amongst some leaves. I pulled him out from the bush and continued to carry him. the cat and i were talking the whole time, and i know that we were both on a journey to somewhere - i may have been helping him to get somewhere. I do not recall any concrete ending to this dream. If it is any interest, 3 days after my dream (which is today) I found out that my beloved cat at home in johannesburg died today.:(

Dream report #5

Seizures per month: 0

How well-controlled would you say your seizures are? Well-controlled

How severe would you rate your seizures overall? Not at all severe.

I was on a church camp and a male friend of mine who is in my year asked me whether I'd consider him a really good friend, and I said yes, but was confused about why he asked it and wondered why he seemed so awkward. We carried on being good friends and spending a lot of time together, but after a while people started looking at us strangely and suspiciously. Eventually a girl friend of mine, (who had a bit of a thing for this male friend) approached me and demanded angrily why I had gone behind her back and become this guy's girlfriend. I was shocked and hurt that she

could think such a thing of me and told her I was not dating this boy, but when I asked him what was going on he said that asking if I would consider him a good friend had actually meant, "will you go out with me?" He and everyone else thought that I had been so blind and stupid to not have picked up that underlying meaning. I ended up feeling guilty and humiliated.

Dream report #14

Seizures per month: 0

How well-controlled would you say your seizures are? Very well-controlled

How severe would you rate your seizures overall? Mild

This dream is incredibly strange, so just bear with me!! The entire dream, from start to finish, I felt this huge anxiety that I had to be somewhere soon, and so I should get ready for a meeting/interview/appointment - something really important that I could not be late for! (but I still have no idea what it was) anyway. I dreamt that I was in my room at residence - but for some reason it looked slightly different to my res room in reality. It was bigger, in my dream I remember looking around to convince myself that it was actually my room. For some strange reason, I had a stove on top of my fridge (I remember my fridge was exactly the same as my fridge in reality). My very close friend from high school (Whom I am no longer close to - her name is Emma, she is 19) was in my room talking to me, while I was trying to make scrambled eggs! I remember her talking to me and bothering me - I did not want to listen to her, I wanted to make scrambled eggs, because I needed to get ready for this event I mentioned earlier. I remember thinking to myself that I should listen to her because it's the polite thing to do. So I stopped cooking my scrambled eggs, turned around and listened to her. After about 30 seconds when I looked back at my scrambled eggs, all that was in the pot was brown, dirty water. I remember feeling very angry at Emma for ruining my scrambled eggs - and thinking that she is now going to make me late for my important appointment. Then, I remember my closest friend in residence (her name is Luna, she is 18 years old) walking into my room and telling me that she was going somewhere. All of a sudden, Emma was gone and we were standing outside a bus stop. The bus was nice - it was white and had leather seats and curtains. It had no writing on the side, it was just plain white. (It kind of looked like the big SHAWCO bus) I asked Luna where she was going, but she just ignored me and got onto the bus.

It was a huge bus, full of people that I didn't know, but she seemed to know. I needed to ask her where she was going so I got on the bus with her. Just as I got on the bus and sat down, we were all of a sudden on Main Road in Bryanston, Johannesburg. My anxiety had been progressing further and further until now. I screamed at the bus driver to stop, I got off the bus on the road (I remember where I got off the bus very vividly - between the corner of main and sloane street, and the corner of Main and the highway). I then began to think of ways to get back to Cape town for my important appointment. I remember being very worried and panicking. I remember telling myself not to cry, to breathe deeply so that I don't have a panic attack. I remember trying to think rationally of a way to get back - and then my alarm went off, so I woke up.

Dream report #15

Seizures per month: 1

How well-controlled would you say your seizures are? Very well-controlled

How severe would you rate your seizures overall? Severe

was writing an outdoor music exam and managed to get close to 0%. One of my friends happened to be the music teacher and she started shouting at me and drawing over my paper in red ink! Not very pleasant. I don't remember any other specific details.

Dream report #16

Seizures per month: 0

How well-controlled would you say your seizures are? Very well-controlled

How severe would you rate your seizures overall? Not at all severe.

I was at my cousin's wedding (which will really be taking place next week.) However we were in a the lounge of a random house. The lounge had an old fashioned vibe with foral couches, the older generations were sitting in the couches and the rest of us were standing around talking. Looking around there was a door to the left, another to the right and the wall behind me was glass looking onto my aunt's old garden. When I tuned back into the conversation my cousins (who are all girls) were discussing how underdressed some people were and all of a sudden I was in civvies rather than my suit. I started panicking. I ran and opened the door on my right. Inside was a passage

with to more doors. The one I knew had the bride in it so i wasn't allowed in. The other room I knew was a bathroom, but it was locked. So I ran back through the room (which was empty now) to the other door. When I opened it there was a passage just like the other side but there was only one door this time. I opened the door and inside was a small bedroom with an old man crying on the bed. Two women were comforting him. I got really creeped out and ran back through to the other side. But the wedding had started in the main room. When I was running past the wedding stopped, everyone looked at me ,and bride shouted at me and told me to put my suit on. So I ran back through the right door and into the room that she was getting ready in but insted of my suit being there, there was a tap that could not be turned off. I went back into the lounge where everyone told me to turn off the tap. However I noticed my suit hanging above the bride and groom so I used them as stepping stones and fetched my suit. that was the end of my dream.

Dream Reports from Individuals Without TLE

Dream report #6

Outdoors, at school, very familiar. People around me were my friends, males and females, all of the same age (19). When people weren't looking, I could run and levitate and almost fly (not like superman but like floating/gliding). When I told people to watch, I would run and jump but not be able to fly and fall. Feelings of frustration and confusion, however a very pleasant feeling when flying.

Dream report #7

The dream took place at my old school, Bishops. I matriculated in 2004 but in the dream I was still at school. I was about to play a rugby game for the 1st XV (who I played for for two years while I was at school). It was a Saturday morning and there was a lot of energy around the event.. people talking, braais going, children running about. It was a big game, as were most of them at the time. All of a sudden the team starts to run out onto the field (we were playing on the 1st XI cricket field not the rugby field strangely) but I can't find my boots. They run on anyway. I frantically try to search for my boots but I can't find them, I must have forgotten them. I used to live next to school but I didn't think about going home and fetching them during the dream, everything was in slow motion in my situation but everything was happening

quick outside. The team ran onto the field without me.. I had never missed a game before.

Dream report #8

I was in a choir practice with the UCT choir and my best friend Amanda who isn't in the choir in reality. She was trying to convince me not to sing because I have a cold and it would be bad for my voice but we were singing one of my favourite pieces- 'When David Heard' by Eric Whitacre. I couldn't sing properly because I was sick but I was denying that I was sick and was arguing with Amanda about whether I should leave the choir or not. We were sitting in room C9 in the college of music department. I remember feeling very frustrated with Amanda because she isn't in the choir but she was there.

Dream report #9

I was at 'home' in my dream, however it did not look like my actual home - I just remember it feeling comfortable and familiar like home for me does at the beginning of the dream. I was walking through the house trying to find my brother, and calling to him. I could here him answering (like it was a distant voice) me but I couldn't see him anywhere. I remember starting to feel very alone and like I was wondering for a very long as though I was lost. I felt very cold and an eerie feeling like I was being watched. The entire dream seemed to be in grey-scale with random objects highlighted in colour. My alarm woke me up before anything else happened

Dream report #10

I was walking along some sort of path, in a forrest. It had a steep drop off/cliff to the one side and a lot of bush on the other side of me. I had never been to or seen this place before. I was walking with my father. We were the age that we currently are. I have a huge fear of snakes in real life. In my dream a huge snake came out on the bush and tried to bite me or strangle me or something like that. I remember feeling completely frightened to my core. I froze up and felt ill with fear. My dad came to my rescue and fought the snake off, by wrestling it off me. In thius fight he got attacked by the snake and so I felt guilty and totally out of control and panic stricken. I did not know hpw to help him or look after him like he had just looked after me. I remember

waking up feeling very sad because I just couldn't take care of my dad and I had just lost him to one of my greatest fears. It was definitely an unpleasant dream!!

Dream report #11

I was in Johannesburg, driving around in a black automatic car. Driving very fast on a road which had fields on either side. I drove until i got to a stop street which was facing the pavement and above the pavement on a grassy patch which was the embassy for a country. It was the special day for that country and they had a massive show on with dancers and singers. They were all singing a song which I knew and the woman in the front row of singers noticed me singing along. Then i woke up.

Dream report #12

I had a dream (nightmare) lastnight. It was extremely random as I have never had such a dream before. I cant remember everything but the dream entailed a lady (i do not know her), she stood ontop of a building and jumped off the building in order to commit suicide but she fell ontop of my brother and he died too. I then ran to call my parents and the police and then the dream ended. I woke up feeling very stressed out and kept telling myself "it was just a dream"

Dream report #13

I dreamt about whether or not my one digs mate was having sex or not with his girlfriend so I went up into his room at dug through his bin looking for condoms. This was at my digs in Cape Town at it felt very real. I felt as though I was in a state of panic and the feeling was very unpleasant. There were no people in the dream. It was just me in the house alone.