Relationships between personality, cortisol, dreaming and memory

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ABSTRACT

Two studies are presented investigating the combined relationship of personality dimensions and abnormal cortisol levels on dream recall and memory. The first study used a randomized, double blind, placebo controlled experiment using the NEO FFM to assess mediating effects of personality and acute effects of elevated cortisol levels on memory and dreaming. Biological stress was induced by means of administering prednisone to seven participants in the experimental group compared to five participants in the placebo group. The second study compares a control group to a chronic asthmatic group with each group consisting of five participants. Influences of the biological stress response system and the episodic memory system are explored within an ecosystemic framework of personality development. Furthermore, support for the theoretical concept of dream recall representing an episodic memory consolidation process while controlling for personality dimensions is investigated. Findings support previous research with the personality dimension neuroticism influencing dream recall. Extraversion, agreeableness and neuroticism were found to have interaction effects when combined with gender. Dream recall correlated with memory consolidation after controlling for neuroticism , extraversion and cortisol parameters. No significant irregularities were found in the asthmatic group with regards to personality and cortisol circadian rhythms. Asthmatics were found to have diminished dream content when compared to the control group, however, after controlling for gender, these effects diminished.

Keywords; personality; cortisol; memory consolidation; hippocampus; dream analysis; asthma; sleep

The human body continuously aims to achieve an optimal equilibrium state or homeostasis that is necessary for its survival. It is frequently exposed to both internal and external forces or stressors which push it into a state of imbalance. This activates a complex set of psychophysiological processors and behaviours which attempt to bring it back into an optimally functioning state of dynamic equilibrium. One such process is the stress response system (SRS) which involves both the psychological and physiological response to a stressor. Closely associated with the SRS is the stress hormone cortisol, a hormone which affects every major organ in the body (Lovallo, 1997). This includes structures in the brain such as the hippocampus which is linked to our memory system, particularly those relating to remembering life events. Research has found that personality dimensions correlate with cortisol responses to stress (Oswald, et al., 2006). Further, both cortisol dysregulation and hippocampal dysfunction are closely associated with various psychopathologies. The stress hormone cortisol is therefore a confounding factor when understanding both psychophysiological and cognitive interactions within the development of the individual.

Not only has research found relationships between cortisol and personality factors but also in sleep and dream research. Sleep has been implicated as an important factor in maintaining an optimal health and balance in humans. It also associated with learning and memory consolidation and therefore also linked to cognitive organization and development. Additionally, certain personality dimensions correlate with dream content and dream recall frequency (Wolcott & Strapp, 2002). A complex set of relations is therefore beginning to emerge from multiple studies that have found inter-relations between cortisol, personality, psychopathology, dreams and memory consolidation.

Although research remains predominantly explorative at this point, a few theories have been proposed in an attempt to explain the mechanism underlying these relations. Dreaming as a product of the memory consolidation process is one such example (Payne & Nadel, 2004). Based on this assumption, dream studies would provide an excellent opportunity to observe and help understand memory consolidation processes. It is therefore of interest to further investigate such relations to form an integral understanding of an otherwise disconnected and complex set of relations between these variables. Furthermore, better understanding of these relations may help to improve our

understanding of how interacting biological systems may indeed affect the development of more complex and broadly defined constructs such as personality.

Asthmatics are a population known to suffer from abnormal cortisol levels (Heim, Ehlert, & Hellhammer, 2000) and are therefore of interest in such studies. Some research provides evidence that chronic asthmatics experience different quality dreams (Neilsen et al., 1997). Further, certain personality characteristics like alexithymia that are associated with asthmatics are highlighted by Neilsen. This study investigates the relation between memory consolidation and dreams, and how cortisol and personality dimensions impact on these processes to help better quantify relations between such variables.

Personality and Behavior

The highest psychological conceptual description of human beings is the construct of personality. Personality refers to a comprehensive set of attributes such as cognition, emotions, values, attitudes, habits, prejudices and intentions that determine an individual's behaviour within a particular context (Meyer, Moore & Viljoen, 1988, p.462-499). Although there are numerous theoretical models on personality and how it develops, a common characteristic or view of a person's personality is that it contains a unifying self-concept which encapsulates a persons' fundamental core aspects and stable characteristics. The characteristics of the 'self-concept' therefore should be observable and hence measurable in an individual's behaviour patterns. One such personality measuring instrument is the NEO Five Factor Model (FFM) which measures five basic dimensions based on factor analysis. There are five operational constructs that measure global dimensions extraversion, neuroticism, agreeableness, conscientiousness and openness (Costa & McCrae, 1992).

Many theoretical models assume that personality remains relatively stable over an individual's life span. However, by adopting a social cognitive learning perspective, a more dynamic view emerges – the primary assumption being that that all behaviour except for a few reflexes is acquired through learning. The individual therefore develops and modifies their behaviour throughout their lifespan (Bandura & Walters, 1963).

Although the social cognitive model (SCM) does not focus on biological and physiological factors, by adopting an ecosystemic approach in understanding personality

and behaviour, one is able to describe both as a product of complex interacting and heirarchical macro- and micro-systems (Fourie, 1991). This approach incorporates physiological, intrapersonal, verbal and non-verbal communication (Jasnoski, 1984) as well as bodily, cognitive and spiritual dimensions (Hancock, 1985). The ecosystemic approach is therefore well suited in understanding personality as the interplay of cross-disciplinary theoretical models or set of interacting systems at different levels. It allows for the description and understanding of relationships between physical, psychological and social dimensions. Biological and social cognitive models can therefore be incorporated and understood in a larger ecosystemic framework.

One such example of an interacting biological and cognitive systems influencing behaviour is the stress response system (SRS) originally introduced by Walter Cannon in the early 1900's where a complex interaction of behaviour and biological responses in the body provides a general feeling of well-being at the psychological level. Another example is our memory system and how it influences learning, information processing, coping strategies and hence general behaviour patterns. In the following sections, a discussion of how the stress hormone cortisol plays a role in the functioning of each of these two systems is discussed.

Cortisol and the Stress Response System. The SRS is an extremely complex neuroendocrine system consisting of a physiological network of brain structures, neurotransmitters and hormones. One such hormone is the stress hormone cortisol which is secreted under stress induced states (Constatine, Stratakis, & Chrousos, 2007). Cortisol levels are closely associated with stress and if measured in our blood stream or saliva, can be used as an index of general stress levels (Brannon & Feist, 2004).

There is some variation in a way an individual's stress response system will react to a stressor at both the psychophysiological and behavioral levels. The subjective experience of a stressor is unique to an individual and will depend on some extent to their personality profile. Although evidence indicates that one's personality is largely determined (up to 60% of variance) by genetic influences (Bouchard, 1994) it is partly developed as one is exposed to a multitude of experiences. Personality is influenced by social and cognitive development factors, especially in the earlier years of life when core

personality traits are formed. Hormonal actions (including cortisol) in the early years of life can have enduring organizational effects that last throughout an individual's lifetime (Charmandari, Kino, Souvatzoglou, & Chrousos, 2003).The stress response system is also characterized and influenced by genetic origins (Plomin et al, 1994) and is further modified by the development process (Constatine et al., 2007). Thus, a complex interaction of how the individual experiences stressors and responds will contribute to the development of the individual's personality.

Traditionally, biological changes were viewed as an epiphenomenon of an externally experienced stressor, however, there is growing evidence showing that it is rather an interaction process where a normally (or abnormally) functioning stress response system may influence behaviour and personality development. Cortisol affects various cognitive domains including attention, perception, memory, and emotional processing through its action on various brain systems and can further lead to perceptual and cognitive distortions (Erikson, Drevets, & Schulkin, 2003). Cortisol therefore has far reaching effects that interact with both cognitive and affect systems. It is perhaps best understood in the context of personality development through mechanisms of affect regulation and cognition.

Cortisol and Memory Consolidation. How an individual learns from life experiences can be associated with information processing and memory. Memory processing is described in three stages: Firstly, the acquisition of information, secondly, the consolidation of memory, referring to the organization and storage of information over time and thirdly, memory recall referring to the bringing back of the information to mind. Memory can be divided into subsystems which are differentiated through functionality and content (e.g. long-term or short-term memory, semantic, procedural, episodic etc.). Our long-term memory can be subdivided into declarative memory or non-declarative memory systems. The focus of this report is predominantly on the declarative memory system: Declarative memory in this report is defined as a memory system that involves the storage of everyday experiences that is actively interconnected into the general framework of ones knowledge. It is a memory system which supports our ability to consciously recall

previous events as well as facts that can be re-constructed from within the overall memory structure (Eichenbaum, 2001).

Declarative memory is further categorized into semantic and episodic memory systems (Tulving, 1972). Episodic memory in the context of this report refers to a refined version of Tulving's orginal meaning and is defined as stored experiences of a personal nature involving past events. It is the only memory system involving the past allowing conscious time travel (i.e. reflecting on the past, present and future) and further includes spatial-temporal relations of the recalled event (Tulving & Markowitsch, 1998). It is perhaps best understood in the sense that it literally involves the re-experiencing of past events, is therefore conscious and intrinsically subjective (Solms & Turnbull, 2002). Semantic memory is defined as memory related to factual information, a memory system primarily concerned with information about meaning of words, concepts, and classification of concepts. Lastly, another category or memory system is *context memory* which essentially overlaps with the episodic memory (Johnson, 2005). Extending the more traditional view of episodic and semantic memory model, Johnson (2004) defines context memory as a special form of memory not only of specific events but rather a composite memory created by the integration of many memory systems to form multiple elements of self experiences in a particular context. Affect is also integrated within the overall context memory and is further considered to be consolidated together with memory (Johnson, 2005). Johnson furthermore proposed that negative emotions persisting over time are integrated into deeper levels of memory resulting in chronic mood disorders. This would have implications for personality development when considered within a cognitive and affect developmental model.

Both episodic and context memory are closely associated with the hippocampus, a brain structure associated with memory. It is proposed that cortisol has a suppressive function on the hippocampus (memory) and an enhancing effect on the amygdala. (Erikson et al., 2003) thus associating cortisol with hippocampal functioning as well as emotional processing. The hippocampus is also associated with the memory consolidation phase suggesting that the mechanism of memory consolidation is influenced by changing cortisol levels. Additionally, it is proposed that memory consolidation is influenced by emotional valence (Cahill & McGaugh, 1998). Substantial

research over several decades has been undertaken in attempt to understand the memory consolidation process as well as the mechanism(s) behind it. Diverse approaches studying this process range from simple word-association memory tests that measure performance differences after a certain time has elapsed as well as before and after periods of sleep. More sophisticated methods use dream analysis which aim to provide a conscious window into the memory consolidation process that is mentally observable. Recent studies in neuroscience have significantly contributed to the understanding of some of the brains functions that contribute to different types of memory consolidation. A substantial amount of evidence supporting declarative memory consolidation has been recorded (Eichenbaum, 1999; Johnson, 2005; Johnson, 2005; Payne & Nadel, 2004; Rasch & Born, 2004; Squire & Alvarez, 1995; Stickgold et al., 2001; Tulving & Markowitsch, 1998). Evidence for episodic memory consolidation originally came from case studies involving brain damage (Lah & Miller, 2008). More specifically, damage to the hippocampus resulted in retrograde amnesia, a phenomenon explained by Ribot's Law (Ribot, 1881). Ribot's Law refers to the fact that older memories are more durable than newer ones (i.e. memories have a temporal gradient) Ribot's Law is the prime driver behind the concept of memory consolidation theory as it explains that brain damage impairs recently formed memories to a greater extent than older memories.

The neural correlates involved in memory consolidation are the hippocampus which stores recent episodic memories or their traces, and the neocortex, which stores semantic memories (Eichenbaum, 1999; Payne & Nadel, 2004; Rasch & Born, 2004; Squire & Alvarez, 1995; Stickgold., 2001; Tulving & Markowitsch, 1998). An interaction between these two structures and the direction of information flow between them within different brain states is considered key to explaining the process of memory consolidation (Eichenbaum, 1999; Payne & Nadel, 2004; Rasch & Born, 2004; Squire & Alvarez, 1995; Stickgold et al., 2001; Tulving & Markowitsch, 1998).

Support for this functional model comes from case studies involving brain damage and neuroimaging (Giovanello, Schnyer, & Verfaellie, 2008). For example, damage to the hippocampus results in difficulty remembering recent past events but not more distant ones. Similarly, neuroimaging shows that the hippocampus is activated while subjects recall recent past experiences but not more distant ones thus supporting the

theory that memories are consolidated over time and eventually become independent of the hippocampus during recall.

The consequences of poor or diminished episodic and context memory consolidation could affect both long-term memory formation as well as the integration of emotional aspects. The hippocampus has been implicated not only in memory dysfunction but also associated with emotional behaviour including heightened pleasure reactions, anger and severe anxiety responses (Jordaan & Jordaan, 1998, p225). Additional evidence supporting the integration of emotions within the memory consolidation process is provided by Nishida, Pearsall, Buckner, and Walker (2008) and, Cahill and McGaugh (1998). Further, neuroscientific studies have shown that certain psychopathologies such as post traumatic stress disorder and borderline personality disorder correlate with reduced hippocampal volume ((Fertruck et al., 2006)).

Again, if we adopt an ecosystemic view including both biological and cognitive systems, from a social cognitve and affect developmental perspective, one could theorize that an individual's behaviour is partly influenced by the formation of episodic and contextual memory systems. Similarly, memory consolidation dysfunction and abnormal cortisol regulation could contribute to various behaviour patterns and hence influence personality indirectly.

Sleep, Dreaming and Memory Consolidation

There is a long history of research showing evidence for the role sleep plays in consolidation of declarative memory (See Born and Rasch, (2006) and Stickgold, (2001) for a review). Non-declarative memory has also more recently been shown to benefit from the effects of sleep (Walker & Stickgold, 2006). Different types of memory are deemed to be consolidated during different sleep stages (Stickgold, Hobson, Fosse &, Fosse, 2001).

Rasch and Born (2008) showed that declarative memory is consolidated during slow-wave sleep (SWS) through the process of reactivating recently encoded memory traces in the hippocampus. A meta-analysis of sleep stage and memory consolidation studies (Stickgold, Hobson, Fosse &, Fosse, 2001) showed that rapid eye movement (REM) sleep is correlated with (1) procedural learning of visual discrimination tasks, (2)

development of problem-solving skills, (3) processing of emotional memories, (4) learning of complex logic games and (5) learning of foreign languages. The development of context memory has also been attributed to REM sleep: Johnson (2005) argues that during REM sleep, diminished noradrenergic activity provides ideal conditions for recent and associated memories to be activated and hence integrated.

From above, we can conclude that disruption of certain stages of sleep (i.e. REM or SWS) affects the memory consolidation process in different ways: Disrupted sleep patterns not only reduces the amount of memory consolidation taking place, but affects it in specific ways. Johnson (2004) proposes that context memory constitutes and underlies our very conception of 'the self.'

Are Dreams a Mental Window into the Memory Consolidation Process? Dreams provide an opportunity to analyze mental states and conscious experience from a physiological state different than that of normal waking life. It is proposed that dreaming is a byproduct of the memory consolidation process (Payne & Nadel, 2004; Stickgold et al., 2001). There model is based on an intricate communication between episodic and semantic structures during memory consolidation. NREM sleep is claimed to be conducive to this sensitive interaction process. Cortisol circadian cycles disrupt the intricate relation as a result of its impact on hippocampal functioning. According to Payne and Nadel's model, bizarre dreams are an indication of the disturbance in the episodic memory consolidation due to the interruption of communication producing disjointed fragments of the original episode.

A cognitive computational model supporting this mechanism has been presented (Zhang, 2008). Zhang's model simulates and predicts the occurrence of bizarre, segmented dreams as a byproduct of past experiences activated by random noise. The computational model is based on an artificial intelligence (AI) agent that is trained to count and through simulated memory consolidation of hippocampal- neocortex random activation mechanism. The computational model 'learns' from this process while producing similar bizarre, fragmented content as a result of the learning process. Payne and Nadel's model therefore is supported and predicted from a computational perspective as well.

Further, a meta-analysis of dream recall proposes that different sources of memory (semantic, episodic and abstract/self referential, corresponding to different sleep states predict dream recall qualities (Baylor & Cavallero, 2001).Episodic memory sources were found to be more related to NREM sleep whereas REM sleep involved activation of the neocortex segments with reduced hippocampal involvement leading to fragmented and bizarre dreams.

The theory suggests that a mental window exists enabling one to observe the memory consolidation process during sleep and establish the memory sources been consolidated. However, this entails overcoming several challenges regarding aspects of dream recall and reporting before we are able to quantitatively map memory consolidation processes onto dream analysis results and their corresponding variables.

Firstly, there is the question of consistency in dream recall between different participants in dream studies becomes pertinent. A number of theories regarding dream recall aspects have been proposed. The salience hypothesis (Goodenough, 1991) suggests that dreams are remembered on the basis of their emotional impact and bizarreness. The interference hypothesis (Cohen & Wolfe, 1973) places emphasis on the interaction of sleep inertia and working memory, while the life style hypothesis (Schonbar, 1965, cited by Wolcott & Strapp, 2002) places emphasis on personality dimensions with dream recall.

Secondly, there are alternative theories explaining the origins of dreams. The activation and synthesis model (Hobson & McCarley, 1977) suggest that dreams are a product of random activation of neural circuits triggered by emotional arousal and synthesized through higher cognitive processing. The state – trait interactions hypothesis (Schredl & Montasser, 1997) suggests dreams are products of an individual's current emotional state that interacts with more stable personality traits. The continuity hypothesis (see Schredl and Hofmann, (2002) for an overview) broadly proposes that dreaming mirrors wakefulness. This model suggests that personality, life experiences and all psychophysiological states are key determinates in predicting dream content. The continuity hypothesis mostly accommodates existing theories within its broader framework. Adopting this model therefore necessitates the consideration of personality

factors as effect modifiers when observing memory consolidation using dream recall studies.

In all the above mentioned theories, specifically (1) those pertaining to dream recall and (2) those explaining alternative origins of dreams, personality factors can be identified as potential moderating variables in dream studies, albeit to varying degrees and depending on which theory is applied. Indeed, in the next section empirical studies show significant correlations with some personality dimensions and dream recall data. This suggests that personality also be considered as a confounding factor when conducting dream studies for purposes of establishing memory consolidation relations with dream recall.

Personality and Dreaming

Empirical research has shown relationships between dream aspects (such as quantity and quality) and personality type. One aim of this research has been to find significant correlations between specific personality dimensions, on the one hand and variables related to dream analysis such as dream recall frequency (DRF), dream recall content (DRC), dream recall length (DRL) and emotional content, on the other hand. In the following two sections we focus primarily on DRF and DRC as variables correlated with a variety of personality dimensions.

Correlations between Personality Dimensions and Dream Recall Frequency. DRF is often used as a measurable aspect of dream analysis. Not only is it used as a normalizing value when measuring content and detail of dream recall, but is also suggested as a parameter to measure bizarreness or subjective impact of dreams. This is explained by the salient hypothesis implicating that bizarre dreams are more likely to be remembered (Wolcott & Strapp, 2002).

Personality dimensions such as openness to experience, thin boundaries, and absorption, and creativity have been shown to positively correlate with higher DRF (Schredl et al., 2003). Further, neuroticism and introspectiveness have also been shown to have small but significant positive correlations (Blagrove & Akehurst, 2000; Hartmann et al., 1998; Schredl et al., 1999).

Two further interesting findings is the correlation of DRF with the introversion – extraversion scale. Gender was found to moderate these correlations (Wolcott & Strapp, 2002; Blagrove & Akehurst, 2000) with introversion in males correlating positively with higher DRF. In contrast, extroverted females correlated positively with higher DRF. Lastly, females under stress also correlated positively with DRF supporting the state-trait theory.

Correlations Between Personality Dimensions and Dream Recall Content. Some research undertaken prior to 2002 attempted to correlate personality dimensions with DRC. However, conflicting and confusing results obtained are attributed to the failure to distinguish DRC (quality) from DRF (quantity) by simply reporting results under the more general term dream recall (Wolcott & Strapp, 2002). Subsequently, research done by Wolcott and Strapp, (2002) indicated that DRC correlated positively with Type B personality. Further, although they did not find any correlation between DRC and introversion in males, interaction effects were recorded in females who reported more content again suggesting gender as a confounding factor.

Memory Consolidation as a Mechanism to Interpret Dreams. The importance of measuring personality dimensions as a moderating variable to factor out differences between participants in memory consolidation studies using dream analysis has been argued. Further, the bias effects introduced from gender differences in combination with personality need to be considered as well as possible trait-state interactions such as elevated arousal due to stress. In this report, I consider personality, gender and the stress hormone cortisol as confounding factors when interpreting and analyzing dream data within the context of memory consolidation. This provides us with a simple but realizable model to interpret and map dream data quantitatively onto the memory consolidation process - The simplified model will therefore be used to measure any relation between dreaming and memory consolidation process while factoring out personality and gender interaction effects as well as increased arousal states such as elevated cortisol levels.

Of further interest are the long-term effects that could arise as a result of poor memory consolidation or dysfunction. It was mentioned previously that poor memory

consolidation influences various aspects of an individual's cognitive organization. Memory systems and processing, emotional processing and our underlying sense of reality are all critical dimensions defining an individual's own characteristics and behavioral patterns. Therefore it is proposed that personality also be measured to test for any long-term effects correlating with poor and diminished memory consolidation.

Cortisol, Dreams and Personality

Mood disorders are often associated with dysfunctional cortisol regulation (Holsboer, 2000; Owens & Nemeroff, 1993; Young et al, 2004). A growing body of evidence indicates that excess cortisol secretion may contribute to mood disorders (Holsboer, 2000; Tsigos & Chrousos, 2002). Stress hormones were originally thought to be an epiphenomenon of mood disorders but may provide an indication of genetic vulnerability factors to mood disorders (Modell et al, 1998). Similarly, certain personality traits are found to correlate with mood disorders, specifically dimensions such as neuroticism, extraversion and conscientiousness (Bienvenu et al, 2001, 2004; Samuels et al, 2002). Additionally, the personality dimension Openness was found to correlate with cortisol responses to an external stressor in a laboratory setting as well as gender related associations - Neurotism in females and Extraversion in males. (Oswald et al., 2006). Other personality traits such as anxiety, sensation seeking, extraversion and neuroticism correlating with abnormal cortisol dynamics were also investigated, however, with conflicting results (Pruessner et al, 1997).

Paralleling this, personality dimensions are known to correlate with dream recall studies. A complex set of relations therefore exist between these variables. No integrative research was found that investigates these three variables under a single study. An opportunity therefore exists to conduct dream sleep studies and find possible relations between dream recall, cortisol dynamics and personality dimensions. In this study, the NEO Five Factor Model (FFM) developed by Costa and McCrae, (1992) was used to investigate relationships between dream recall variables, cortisol salivary levels and personality dimensions.

Asthma, Alexithymia and Dreaming. Asthmatics may experience disrupted memory consolidation for two reasons. Firstly, physiological disturbances disrupt sleep patterns. Secondly, chronic asthmatics require medication (corticosteroids) that can influence natural cortisol circadian rhythms (Payne & Nadel, 2004). Cortisol has been implicated as a factor affecting the functioning of the hippocampus and is associated with memory deficits (Lupien et al., 1998). High levels of cortisol affecting hippocampal functioning will impede the memory consolidation process. Acute effects of corticosteroids are shown to cause deficits in cognition (Lupien & McEwen, 1997). Asthmatics experiencing altered cortisol levels over extended periods might then experience deficits in cognitive organization. It has been previously shown that memory consolidation also involves the processing of affect. Therefore long-term effects of poor memory consolidation in the asthmatic population could extend cognition and affect regulation irregularities.

Some evidence already points us in this direction. The asthmatic population seems to have above average diagnosis rates of alexithymia (Neilsen et al., 1997). People diagnosed with alexithymia experience difficulty in describing feelings and distinguishing between different states of physical arousal. Further, they tend to have an externally orientated cognitive style, limited imagination and have difficulty recognizing verbal and non-verbal emotional stimuli (Gennaro et al., 2003; James et al., 2000).

Of further interest, is that dream recall studies have also been conducted on alexithymic individuals: Results show experiences of diminished dream recall frequency (Gennaro et al., 2003) and dream recall fantasy (James et al., 2000). Further, some cases of ‘contentless’ called white dreams have been reported (Nielsen et al., 1997). The above could be explained by the theory that dreams illustrate the memory consolidation process and that asthmatics are vulnerable to poor and diminished memory consolidation.

The asthmatic population can therefore be differentiated from the general healthy population in two ways regarding disrupted memory consolidation processes. Firstly, through disrupted sleep patterns and secondly, due to altered cortisol levels which impact on the functioning of the hippocampus. Memory consolidation is therefore disturbed from two different perspectives. Clearly, this is a population well suited to investigate the long-term effects of memory consolidation dysfunction. This could be done for example by

comparing proportions of preferred cognitive processing styles between the asthmatic population and that of the general population.

RATIONALE

The literature reviewed broadly focused on (1) personality dynamics as viewed from a social cognitive and biological perspective within an ecosystemic framework, (2) the SRS as a subsystem within the ecosystemic framework, (3) memory subsystems and the memory consolidation process, (4) dreams as a byproduct of the memory consolidation process, (5) alternative dream theories related to dreaming which highlight the importance of personality as confounding factors in dream recall aspects with focus on DRF and DRC. Gender and arousal states (e.g. stress) were further noted to interact together with personality dimensions and lastly, (6) cortisol, psychopathology and asthmatic groups in relation to points (1) through to (5).

This review highlights the following: Personality can be viewed as a set of interacting biological, cognitive, psychological systems. The SRS and memory systems can be considered in this context. Memory consolidation can be observed and measured using dream studies based on the proposed simplified dream analysis model. Personality, gender and stress need to be considered as confounding factors when interpreting and analyzing dream data for the purpose of studies using dream recall as a measure of memory consolidation. Chronic asthmatics experience altered sleep patterns and abnormal cortisol levels suggesting a high risk for abnormal memory consolidation. Further, abnormal cortisol levels are associated with abnormal functioning of the SRS which influences a person's behaviour and cognitive development. Lastly, diminished dream recall aspects regarding content and frequency have been recorded in the asthmatic population which may suggest indicate poor memory consolidation.

An opportunity therefore existed to conduct a controlled study on the asthmatic population which observed and measured the memory consolidation process using variables that are commonly applied in dream studies, namely DRF and DRC. The approach adopted was to measure any long-term effects of chronic memory consolidation dysfunction in the asthmatic population by comparing differences between the asthmatic

population and the general population. The potential also existed to make efficient use of the same personality scale for measuring personality as moderating variable in dream recall to better characterize memory consolidation in relation to dream studies.

SPECIFIC AIMS AND HYPOTHESES

A broad aim of this study was to add to the body of knowledge relevant to an emerging set of complex relations between the stress hormone cortisol, personality dimensions, dreaming and memory consolidation and how behaviour and personality could relate to such influences. The study may provide support for expanded areas of research including the following: Firstly, provide some evidence for an asthmatic personality profile and secondly, better characterize relationships between personality, cortisol, dream recall and memory consolidation. Lastly, analyze dream recall studies while controlling for or factoring out personality dimensions and gender that are known to be associated with DRC and DRF such as neuroticism and extraversion. This will in turn help more accurately characterize the relationship between memory consolidation and dream recall.

The following hypotheses were therefore tested: Firstly, based on the evidence reported thus far, abnormal cortisol levels and personality dimensions (moderated by gender) are associated with dream recall and memory consolidation. It is suggested that temporary elevated cortisol levels (induced through the administration of an acute dosage of prednisone) will show effects on DRF, DRC and MC. Secondly, after partialing out effects of personality dimensions and gender, DRF and DRC will correlate with MC. Thirdly, the asthmatic population who have been shown to suffer from chronically altered cortisol stress hormone levels should exhibit a different distribution of personality profiles compared to that of the general population.

METHOD

The research formed part of a larger study and was similarly divided into two controlled experiments, referred to below as Study 1 and Study 2.

Study 1 – Acute Effects of Cortisol on Dream Recall Frequency and Content

Study 1 essentially focused on the combined effects of personality and temporary induced elevated cortisol levels on dream recall variables DRF, DRC as well as the MC process. A measure of the quantity and quality of memory consolidation could therefore be observed after taking into account all dream recall factors.

Design and Setting. A quantitative, quasi-experimental approach was adopted using a double-blind, placebo controlled experiment. Recruitment of students, the signing of the consent forms, screening process and administration of the personality tests took place at the University of Cape Town (UCT) psychology department.

The sleep-dream study was conducted at the Vincent Pallotti private hospital and sleep clinic in Pinelands. Participants were randomly assigned to either the placebo control group or the prednisone group by allowing them to choose between two differently colored boxes which either contained the prednisone pill or a placebo pill. The experimenter was not aware of which box contained the placebo or prednisone pill.

Participants. The participants were recruited from the UCT community using pre-approved posters placed at official points on the university campus. Both the placebo-control group and the treatment group were required to be equally represented, however, due to an odd number of participants in each group, the placebo group consisted of three females and two males while the prednisone group consisted of three females and four males.

The following exclusion criteria applied: An age restriction 18 to 45 was necessary due to the fact that older adults exhibiting altered cortisol circadian rhythms and sleep cycles. Additionally, children's dreams have been shown to be different to that of adults (Kales et al., 1970). IQ scores greater than 85 were required to control for any between-subject differences regarding general information processing ability.

Participants with any psychiatric disorders were excluded as some psychopathologies are known to affect dreaming and cortisol dysfunction. Lastly, any respiratory illnesses such as influenza were also excluded.

Screening Instruments. The following instruments controlled for exclusion criteria:

The *Mini International Neuropsychiatric Interview* (English version 5.0.0; *MINI*; Sheehan et al., 1998) is a structured diagnostic interview that assesses the major DSM-IV Axis I psychiatric disorders. It has proven psychometric properties, and can be administered within 25 minutes. The interview can either be administered by a clinician or by a lay interviewer who has undergone the appropriate training (Sheehan et al., 1998).

The *Wechsler Abbreviated Scale of Intelligence* (*WASI;* Wechsler, 1999) is a standardized measure of intellectual functioning that is frequently used in both research and clinical settings (Psychological Corporation, 2002). It was used to exclude any major between-subject differences in terms of general intellectual functioning.

The *Beck Depression Inventory-Second Edition* (*BDI-II*; Beck, Steer & Brown, 1996) is a standardized 21-item self-report questionnaire that assesses current presence and severity of depression in adults. It is used both in clinical settings and as a research tool and has achieved adequate reliability and validity (Beck et al., 1996). It was used to screen for depression which is known to alter cortisol levels. A cut off score of 19 was used.

Instruments - Personality Dimensions and Dream Recall. The following instruments measured information processing styles and personality dimensions:

The *NEO Five Factor Inventory* (Costa & McCrae, 1992) is a 60-item version of the NEO-PI (Costa & McCrae, 1985b) that measures the ‘big five’ dimensions of personality (neuroticism, extraversion, openness, agreeableness and conscientiousness). The NEO-FFI is a well known personality measuring instrument and has been used extensively in clinical and research settings (Costa & McCrae, 1991).

Sleep laboratory equipped with a polysomnograph (PSG) that records and plots sleep architecture at the Vincent Pallotti sleep clinic was used. PSG’s are electroencephalograph (EEG) equipment adapted for sleep research. They are equipped with EEG electrodes, electrooculograph (EOG) electrodes and electromyograph (EMG) that measure brain activity, eye movement and muscle tone respectively. This is required for identifying REM sleep (Lovallo & Thomas, 2000).

Dream Inventory. The dream reports were recorded using a simple questionnaire (see *Appendix C.)* that categorized dream recall according to frequency (i.e. did the participant report a dream or not for each awakening) and according to the detail or richness of reported which served as a measure DRC. The DRC was further differentiated into memory sources by a group of questions relating to 'episodic' and 'other' memory systems. The questionnaire is based on Antrobus et al.'s (1976) psycholinguistic coding manual for reports of sleep experiences. To help categorize the type of DRC, participants were asked to provide sources for their dream content to help differentiate between the two groups, namely, episodic memory including self-referential content and semantic memory (Baylor & Cavallero, 2001).

Memory Consolidation: The *Logical Memory Test (LMT)* was used to test memory recall. The LMT is a subtest of the Wechsler Memory Scale (WMS; Wechsler, 1987, 1997). Two stories (A and B) are read to the participant. The participant then attempts to recall as much detail as possible. The participant is requested to recall them before and after sleep thus providing a measure of memory consolidation. Only Story B's results were used.

Procedure. After making an appointment with a fellow researcher, participants volunteering were requested to fill out and sign the consent form. Thereafter, the battery of screening tests were administered (accept for the BDI II questionnaire due to the fact that onset of depression is diagnosed within a two week period and that the dream-sleep studies could be scheduled several weeks after the initial screening). Screening was done by a fellow researcher in office 4.30, Department of Psychology.

Along with the screening tests, the potential participants were required to fill out 'the participant information sheet' capturing contact and demographic information as well as medical histories. All data was treated with the strictest confidence and stored safely to ensure no unauthorized access was possible. Thereafter, potential participants were told that they will be contacted at a later date to inform them of the outcome of the screening process.

After a participant was found to pass all the screening requirements, a second appointment was made and a date agreed upon for the participant to spend a night in the

sleep lab. The participant was requested to arrive between 19h30 and 20h00. The remaining screening test (BDI-II measuring depression) was administered along with the personality test and TAS 20 questionnaire. Thereafter, the participant was given the opportunity to select from two different colored boxes, each containing a tablet that was either the placebo or a 25mg dose of Prednisone. The researcher did not know which box had the placebo. The participant was requested to complete the required memory tests and then connected to the sleep lab equipment. They were briefed that they will be woken three times during the night for cortisol measurements.

REM awakenings were conducted according to the Rechtschaffen and Kales's (1968) criteria of defining sleep stages, that is the participant will be awakened 2.5 minutes into REM sleep which is an acceptable amount of time required to confirm transition into that stage of sleep (as cited in Antrobus et al., 1995). The participant's cortisol levels were also sampled using salivettes which were placed in their mouth during each awakening. This procedure has been approved by the UCT chemical pathology laboratory.

In the morning, the participants completed the second part of the memory test (LM 2)which measured if any learning or memory consolidation took place through the night. A debriefing session was then conducted and the participants given the opportunity to ask any questions about the experiment after which they were paid R150 for there time.

The participants were later contacted by email or phone and requested to complete the NEO FFM personality questionnaire. This was in the Psychology departments postgraduate room at UCT.

Ethical Considerations. The participants were informed that the current study related to a broader study but was considered separate and therefore required to fill out and sign separate consent forms. It was emphasized that participation in the study was completely voluntary and that all results would be only used for research purposes. Their details (names or any form of personal identification) would not be disclosed further and would be removed from the data set when required. The ethics regarding the larger study such as the clearance for administration of prednisone and administering of psychiatric tests were

had already been approved by the UCT Ethics Committee prior to the commencement of this study.

Data Analysis. Between-group differences in terms of personality and cortisol (the IV's) and DRF, DRC and MC (the DV's) were assessed. Correlation between cortisol parameters (cortisol levels, average of readings and peak differences), personality dimensions, DRF, DRC (including episodic content (DRC_E) as a subcategory) and gender were investigated across groups using simple regression techniques. Multiple-regression was used to detect any effect modifiers on the dependent variables.

Lastly, ANCOVA and MANCOVA tests were applied to control for personality dimensions, cortisol parameters and gender effects while investigating the relationships between DRF, DRC and MC.

Statistica Version.8 was used to complete the analysis. Missing data was deleted pair-wise and a 95% confidence interval was used to indicate significant effects.

Results and Discussion. *Table 1.* in *Appendix A.* provides demographic information and personality profiles of the participants. The participants were relatively well balanced on gender. Groups consisted of 5 and 7 participants for the placebo and prednisone respectively. No significant differences were found between the personality dimensions of the two groups.

Table 1. Demographic information of the Prednisone and Placebo groups.

Demographic Information	Placebo (n=5)	Prednisone (n=7)
Age (Years)		
Mean (SD)	20.25 (1.71)	22.71 (5.38)
Sex		
Male: Female	2:3	4:3
Personality Dimensions		
Neuroticism	21.60 (7.50)	20.57 (9.09)
Extraversion	29.20 (11.21)	28.57 (10.67)
Openness	28.80 (2.95)	31.57 (7.81)
Agreeableness	31.00 (7.35)	29.42 (6.05)
Conscientiousness	30.20 (5.63)	31.71(7.39)

Independent *t*-tests were conducted to investigate differences between the placebo and prednisone groups (See *Figure 1.* and *Figure 2.* in Appendix A for graph of cortisol readings and average/peak values of all readings respectively). Significant differences were found between cortisol reading one $t(10) = -2.49$, $p = 0.032$), reading two $t(10) = -2.59$, $p = 0.027$, cortisol average value $t(10) = -4.10$, $p = 0.002$ and peak differences $t(8) = -3.48$, $p = 0.006$. No other between-group differences were found on the dependent and independent variables using t-tests.

Using simple linear regression on the data set showed a relationship between the personality dimension neuroticism and DRF $F(1,10) = -3.37$, $p = 0.007$, $R = 0.73$ as well as DRC $F(10) = -3.33$, $p = 0.008$, $R = 0.73$. This supports previous findings in dream studies (Blagrove & Akehurst, 2000; 1998; Schredl et al., 1999). No significant combined effects were found when applying multiple regression models that included additional gender or cortisol variables.

ANCOVA was used to investigate personality dimensions neuroticism (N), agreeableness (A) and cortisol parameters (average values and peak difference values) as covariates. DRF, DRC, DRC_E (episodic content part score only) and MC were separately assigned as the dependent variable. No differences between the groups were significant after controlling for all three variables separately.

Although no significant differences were found, the prednisone group consistently showed increased dream recall on DRF, DRC and DRC_E (see *Figure 3.* and *Figure 4.* and

Figure 5. in *Appendix A.* respectively*)* indicating a trend that dream recall is influenced by a state-trait model. No evidence of memory consolidation differences could be observed (see *Figure 6.* in Appendix A*)* or be related to dreaming even after controlling for differences in personality dimensions or cortisol parameters.

Study 2

Study 2 focused on a sample from an asthmatic population who were exposed to long-term effects of cortisol abnormalities and disrupted sleep patterns. Again, quantity and quality of memory consolidation was considered by means of dream analysis while controlling for the effects of personality and gender.

Design and Setting. A quantitative, quasi-experimental approach was adopted using a controlled experiment. Recruitment, signing of the consent form, screening process and administration of the personality tests took place at the University of Cape Town. The sleep-dream study was conducted at the Vincent Pallotti sleep clinic in Pinelands

Participants. Ten participants, consisting of 5 moderate-to-severe asthmatics and 5 healthy control participants took part . They were recruited predominantly from UCT (students) but included non-students as well. Participants were classified as moderate-to-severe if they used corticosteroids of dosage higher than 500 mcg/day for a period of at least 3 months or experienced daily or weekly wheezing and coughing or shortness of breath. All participants were fluent in English. Males and females were not equally distributed across the two groups with four males and 1 female in the asthmatic group and 2 males and 3 females in the control group. Exclusion criteria applied in Study 1 was also applied in Study 2 for identical reasons accept for respiratory illnesses specific to asthma with regards to the experimental group.

Materials. Both screening and data collecting instruments were identical to those used in Study 1. Note that the FFM personality questionnaire would be used to compare the asthmatic population to the general population in addition to controlling for personality factors.

Procedure. The procedure is the same as in Study 1 except for the following changes: No acute administration of corticosteroids or placebos were given to participants. . Participants kept to their usual treatment regimes during the course of the experiment. Their oxygen desaturation was monitored throughout the night and a safety protocol was put in place with the collaboration of the Vincent Pallotti Hospital staff.

Data Analysis. Analyses were completed using the same approach as Study 1. In addition, Personality dimensions measured from the asthmatic groups were compared to normalized values taken for the general student population as well as the adult population using t-tests for each scale.

Results and Discussion. *Table 2.* provides a demographic information and personality profile of the participants. Although participants were better represented on gender in the control, the asthmatic group consisted primarily of males with only 1 female in the group. No between-group differences were found to be significant on any of the personality dimensions.

Table 2. Demographic information of the Control and Asthmatic groups.

Demographic Information	Control (n=5)	Asthmatic (n=5)
Age (Years)		
Mean (SD)	18.6 (0.89)	23.6 (7.02)
Sex		
Male: Female	2:3	4:1
Personality Dimensions		
Neuroticism	13.4 (8.99)	21.40 (6.50)
Extraversion	28.4 (3.78)	32.00 (9.30)
Openness	30.80 (6.26)	27.80 (5.45)
Agreeableness	31.60 (2.41)	31.20 (1.64)
Conscientiousness	26.40 (6.80)	20.80 (12.74)

Independent *t*-tests were conducted to investigate differences between the asthmatic and control groups. No significant differences were found between cortisol readings, cortisol average values or peak difference (See *Figure 7.* and *Figure 8.* in *Appendix B.* respectively). Although the means differed substantially, when removing outliers (one case in the control group), smaller standard deviation and a more normal cortisol curve for the control group was achieved. No between-group differences were significant after removing the outliers. Similarly, no significant differences were found between the two groups on personality scales (See *Figure 9*. in *Appendix B.*).

A significant difference between the two groups was found on DRC $t(8) = 2.45$, $p = 0.040$ with $Mean_{\text{Control}} = 93.60$ $Mean_{Asthmatic} = 33.4$. Furthermore, differences between DRC for episodic content was found on the 3rd awakening $t(8) = 5.13$, $p < 0.001$ with

$Mean_{\text{Control}} = 27.00$ and $Mean_{Asthmatic} = 3.20$. ANCOVA was done using personality dimension neuroticism as a covariate with independent variable DRC. Differences between the groups remained significant $F(1) = 7.31$, $p = 0.030$ although the covariate was not. The difference between the group and adjusted Means were $Mean_{\text{Control}} = 93.60$, $Mean_{Asthmatic} = 33.40$ and $Mean_{\text{Control}}$ (Adj) = 101.24 and $Mean_{Asthmatic}$ (Adj) = 25.76 after controlling for neuroticism.

Simple regression produced no significant relationships between the dependent and independent variables when analyzing the dataset. Multiple regression with DRC as the dependent variable showed suppression effects between gender and neuroticism $t(7) = -2.40$, $p = 0.048$) although the overall model was not statistically significant. This supports previous research done (Wolcott & Strapp, 2002).

The extraversion personality dimension on its own showed no significant relation to DRF or DRC. However, gender and extraversion again showed suppression effects with DRC on the gender variable. The regression model was not significant but gender showed a significance of $t(7) = -2.56$, $p < 0.038$ within the extraversion-gender model. Although not directly supporting previous findings, Wolcott & Strapp, (2002) found interaction effects between extraversion and males which positively correlated with increased DRF.

Finally, a MANCOVA was done controlling for gender groups and N for DV DRC. The between-group differences were not significant ($p = 0.23$). The asthmatic

group therefore showed no decreased dream recall after controlling for gender and personality in DRC. The average means showed DRF was reduced for this group in comparison to the control (See *Figure 9.* in *Appendix B.).* No evidence of memory consolidation could be observed (see *Figure 12.* in *Appendix B.)* or be related to dreaming before or after controlling for differences in personality dimensions or cortisol parameters.

No significant differences for a specific personality profile was found in the asthmatic group after comparing all personality dimensions with the FFM standardized values of a student population (Costa & McCrae, 1992, p.78). The global dimension conscientiousness produced the greatest difference in mean scores (Mean $_{FFM}$ = 30.71 compared to Mean $_{ASTHMATIC}$ = 20.80 with $t = 1.74$, $p = 0.157$. When compared to the standardized adult population, there was a trend towards significance ($t = 2.42$, $p = 0.073$*).* The asthmatic group scored lower on average by 10 points. See *Table 3.* for means and standard deviations for all personality dimensions.

Table 3. Comparison of Asthmatic groups to Standardized Student Population (Gender Combined)

Global Scales	FFM (N/A)	Asthmatic (n=5)
Personality Dimensions		
Neuroticism (N)	24.56 (7.87)	21.40 (6.50)
Extraversion(E)	30.49 (5.84)	32.00 (9.30)
Openness (O)	27.82 (5.85)	27.80 (5.55)
Agreeableness (A)	30.14 (5.40)	31.20 (1.64)
Conscientiousness (C)	30.71 (6.79)	20.80 (12.74)

GENERAL RESULTS AND DISCUSSION

Hypothesis One

The broad aim of this study was to investigate the complex set of relations between the stress hormone cortisol, personality dimensions, dreaming and memory consolidation: The first hypothesis states that elevated cortisol levels, personality and gender will influence dream recall: Study 1 provided significant results for the correlation of DRC

with neuroticism. Study 2 two showed interaction effects between gender and extraversion as well as gender and neuroticism. Additionally, multiple regression models of the global data set produced significant effects for neuroticism with $F(1,20) = 5.21$, $p = 0.034$, $R = 0.45$ as well as interaction effects between gender ($p = 0.035$) and agreeableness ($p = 0.08$) with a regression model of all three variables being significant $F(3,18) = 4.03$, $p = 0.024$, $R = 0.40$. The first hypothesis is therefore supported with respect to these variables and is congruent with existing research findings (Wolcott & Strapp, 2002).

Cortisol as a confounding variable remains inconclusive. No between-group differences were found in dream recall including episodic content even though cortisol levels were significantly different on Study 1. This was the case even after controlling for personality dimensions and gender using MANOVA tests to control for personality and gender influences.

Study 2 showed differences in DRC and DRC_E (episodic content) between the asthmatic and control groups even though no significant differences in cortisol readings were observed. The asthmatic group did however consistently showed lower average cortisol readings and averages. DRC was not significant after controlling for gender and neuroticism. Controlling for neuroticism alone still produced significant between-group results implicating gender as the primary covariate. Both groups were not balanced in terms of gender with the control group containing two female participants and the asthmatic group containing one female participant. Differences in DRC between the two groups could be attributed to the gender interaction effects or simply due to the relatively small sample size affecting the outcome of the MANCOVA. The literature reviewed indicated that asthmatics have a high incidence of alexithymia and are reported to experience ‘contentless’ or ‘white’ dreams. This supports previous findings of diminished dream content in asthmatics (Nielsen et al., 1997) and in individuals with alexithymia which is frequently diagnosed in asthmatics (Gennaro et al., 2003; James et al., 2000). Although significant effects were removed, the covariance effects should be verified with a larger sample size – it remains an interesting observation that asthmatic participants almost always reported dreaming but could not describe the content, mentioned they were just about to start dreaming or reported a dream without knowing what it was about.

Further, DRF was not reduced highlighting differences between DRF and DRC measurements.

The difference in mean values found in DRC and DRF between the groups in Study 1 requires further discussion: The prednisone group consistently reported more dreams and more dream content indicating a trend that could support the state-trait interaction theory that is, prednisone acts to induce a stress states with personality dimensions such as neuroticism modulating dream work (Schredl & Montasser, 1997). There is also the argument for the activation-synthesis model which would also predict increased dream work due to increased arousal (e.g. elevated cortisol levels acting as the arousal mechanism) thus producing richer dreams with more content (Hobson & McCarley, 1977). It would therefore be of interest to have a larger sample size to see if this trend has any significance, especially considering the theory that episodic content should be reduced (Payne & Nadel, 2004) while increased arousal predicts more dream work. The paradoxical prediction of these two theories should be explored further as evidence for cortisol influencing dream recall and content is inconclusive.

Hypothesis Two

The second hypotheses stated that dream recall frequency and dream recall content will correlate with memory consolidation after factoring out personality dimensions and gender which were previously shown to correlate with dream recall. A multiple regression model applied to the global dataset showed DRF positively correlated with MC $F(1,20) = 5.63$, $p = 0.028$, $R = 0.47$. Combining DRC with DRF produced an overall significant regression model $F(2,19) = 5.79$, $p = 0.011$, $R = 0.62$, however adding gender to that model resulted in DRC becoming insignificant. Gender alone correlated with MC $F(1,20) = 5.53$, $p = 0.029$, $R = 0.47$ thus showing a similar interaction of DRC and gender found in Study 2 - DRC differences became insignificant after controlling for gender in Study 2 and DRC became insignificant after partialing out gender effects in the regression model. It therefore seems reasonable to conclude that DRF is a better variable to associate with MC rather than DRC in this experiment due to gender acting as an effect modifier. This has implications for research investigating memory consolidation using dream analysis. This interpretation should however be viewed with caution as this

research used a simplified definition for the DRC. The reader is referred to *Appendix 3.* which includes the dream report inventory used. Total scores of the questionnaire provided values for DRC while items 1 – 4 and 10 provided episodic content. No correlations between DRC_E and MC nor personality and MC were found. Furthermore, no correlations were found between cortisol parameters (average & peak differences) and MC. In this experiment, DRF proved to be the best indicator associated with MC. This presents interesting prospects for future research based on the state-trait and activation-synthesis theories such as the idea of increasing DRF using induced arousal mechanisms to investigate effects on memory consolidation.

Hypothesis Three

The third hypothesis remains inconclusive. On most dimensions no statistical differences between the asthmatic group and standardized student population was observed. However, almost 30% difference in average scores was measured on the global dimension conscientiousness with the asthmatic group scoring lower than the standardized FFM values for both student and adult populations. Trends towards significance were observed when compared to the adult standardized populations ($p = 0.073$).

The conscientiousness construct is concerned with control and regulating our direct impulses. Low scores suggest impulsivity and less inhibition in delaying gratification for long-term goals (Costa & McCrae, 1992). An important memory system associated with impulsivity is that of *executive neurocognition* which involves the postponement or termination of behavior in order to achieve more long-term goals and rewards. Poor functioning of the system leads to impulsive behavior (Fertuck, Lenzenweger, Clarkin, Hoermann, & Stanley, 2006). The development of executive neurocognition is linked to personality development (Posner & Rothbart, 2000). Neural correlates of executive neurocognition involve the prefrontal lobes which are also affected by cortisol levels (Wolf, 2003). Although, the sample size was too small to draw any conclusions, the cortisol effects on neurocognition indicate further exploration is required. The NEO-Personality Inventory could also be used to explore subscales of the

dimension such as self-efficacy, achievement-striving and self-discipline. Self-efficacy is central to Bandura's social cognitive model with low levels predicting pathology.

CONCLUSION

Although not all hypotheses were supported with statistical significance, several few interesting trends are observable: Positive findings with regard to personality and gender influencing dream recall were in line with previous dream studies. More importantly, the relationship between dream recall and memory consolidation was better quantified by taking into account confounding factors such as gender and personality. Additionally, the importance of differentiating dream recall rates and dream recall content was highlighted suggesting caution when selecting and defining variables to monitor dreams in memory consolidation research. After these confounding factors have been considered, the proposition of investigating cognitive processers in memory consolidation through dream analysis is remarkable and provides an interesting opportunity for future research. It may help us better understand the mechanisms behind such processes - Perhaps even further our understanding of more complex constructs like personality and 'the Self'.

REFERENCES

Antrobus, J., Toshiaki, K., & Reinsel, R. (1995). Dreaming in the late morning: Summation of REM and diurnal cortical activation. *Consciousness and Cognition, 4,* 275-299.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Beck Depression Inventory-Second Edition Manual*. San Antonio: The Psychological Corporation.

Bandura, A., & Walters, R. H. (1963). Social learning and personality development. *Abnormal and Social Psychology, 67,* 601-607.

Baylor, G. W., & Cavallero, C. (2001). Memory sources associated with REM and NREM dream reports throughout the night: A new look at the data. *Sleep, 24,* 165-170.

Blagrove, M., & Akehurst, L. (2000). Personality and dream recall frequency: Further negative findings. *Dreaming, 10,* 139-148.

Bouchard, T. J. (1994). Genes, environment and personality. *Science, 264,* 1700-1701 (pp.15-18). Johannesburg, S.A. *Health (5th ed.).* USA:Wadsworth.

Cahill, L., & McGaugh, J., L. (1998). Mechanisms of emotional arousal and lasting declarative memory. *Trends in Neuroscience, 7,* 294-299.

Charmandari, E., Kino, T., Souvatzoglou, E., & Chrousos G. P. (2003). Pediatric stress: Hormonal Mediators and human development. *Hormone Research, 59,* 161-179.

Cohen, D. B., &Wolfe, G. (1973). Dream recall and repression: evidence for an alternative hypothesis. *Journal of Consulting Clinical Psychologists, 41*, 349–355.

Constatine, A., Stratakis, A., & Chrousos, G. P. (2007). Neuroendocrinology and pathophysiology of the stress system. *Annals New York Academy Society.*

Costa, P., & McCrae, R. R. (1992). *Professional manual: revised NEO personality Inventory*. USA:PAR

Eichenbaum, H. (1999). The hippocampus and mechanisms of declarative memory, *Behaviour brain research,* 103, 123-133.

Eichenbaum, H. (2000). The hippocampus and declarative memory: cognitive mechanisms and neural codes, *Behaviour Brain Research*, 127, 199-207.

Erikson, K., Drevets, W., & Schulkin, J. (2003). Glucocorticoid regulation of diverse cognitive functions in normal and pathological emotional states. *Neuroscience and Behavioral Reviews, 27,* 233-246.

Eustache, F., & Desgranges, B. (2008). MNESIS: towards the integration of current multisystem models of memory. *Neuropsychology Review*, 18, 53-69.

Fosse, M. J., Fosse, R., Hobson, J. A., & Stickgold, R. J. (2003). Dreaming and episodic memory: A functional dissociation? *Journal of Cognition Neuroscience*, 15, 1–9.

Fourie, D. P. (1991). The development of ecosystemic thinking. Unpublished manuscript. University of South africa

Fertuck, E. A., Lenzenweger, M. F., Clarkin, J. F., Hoermann, S., & Stanely, B. (2006). Excutive neurocognition, memory systems, and borderline personality disorder. *Clinical Psychology Review, 26,* 346-375.

Gennaro, L. Ferrara, M., Cristiani, R., & Curcio, G. (2003). Alexithymia and dream recall upon spontaneous morning awakening. *Psychosomatic Medicine, 65,* 301-306.

Giovanello, K. S., Schnyer, D., & Verfaekkie, M. (2009). Distinct hippocampul regions make unique contributions to relational memory. *Hippocampus, 19,* 111-117.

Goodenough, D. R. (1991). Dream recall: history and current status of the field. In S. J. Ellman, & J. S. Antrobus (Eds.), *The mind in sleep* (2nd ed.) (pp. 143–171). New York: Wiley.

Hancock, T. (1985). The mandala of health : Amodel of the human ecosystem. *Family and Community Health, 8,* 1-10.

Hartmann, E. (1991). *Boundaries in the Mind: A New Psychology of Personality.* New York: Basic Books.Hartmann, E. (1996). We do not dream of the Three "R"s. *Sleep Research, 25,* 336

Hartmann, E., Rosen, R., & Rand, W. (1998). Personality and dreaming : boundary structure and dream content. *Dreaming, 8,* 31-39.

Heim, C., Ehlert, U., & Hellhammer, D.H. (2000). The potential role of hypocortisolism in the pathophysiology of stress-related bodily disorders. *Psychoneuroendocrinology, 25,* 1-35.

James, D., Parker, A. Bauermann H., & Smith C. T. (2000). Alexithymia and impoverished dream content: Evidence from rapid eye movement sleep awakenings. *Psychosomatic Medicine, 62,* 486-491.

Janoski, M. L. (1984). In conversation with Carl Rogers. *Odyssey, 6,* 12-15.

Johnson, D. J. (2004). Episodic memory and the hippocampus: another view. *Medical Hypotheses,* 63, 963-967.

Johnson, D. J. (2005). REM sleep and the development of context memory. *Medical Hypotheses, 64,* 499-504.

Jordaan, W., & Jordan, J. (1998). *People in Context*. Sandton:Heinemann

Kales, A., Beall, G. N., Bajor, G.F., Jacobson, A., & Kales, J. D. (1968). Sleep studies in asthmatic adults: Relationship of attacks to sleep stage and time of night. Journal of Allergy, 41, 164-173.

Koukkou, M., & Lehmann, D. (1983). Dreaming: The functional state shift hypothesis. A neuropsychological model. *The British Journal of Psychiatry, 142,* 221-231

Lah, S., & Miller, L. (2008) Effects of Temporal Lobe Lesions on Retrograde Memory: A Critical Review. *Neuropsychology Review,* 18, 24-52.

Lovallo, W. R., & Thomas, T. L. (2000). Stress hormones in psychophysiological research: Emotional, behavioral, and cognitive implications. In J. T. Cacioppo, L. G. Tassinary, & G. G. Bernston (Eds.), *Handbook of psychophysiology* (pp. 342-367). New York: Cambridge University Press.

Nielsen, T. A., Ouellet, L., Warnes, H., Cartier, A., Malo, J. L., & Montplaisir, J. (1997). Alexithymia and impoverished dream recall in asthmatic patients: Evidence from self-report measures. *Journal of Psychosomatic Research, 42*, 53-59.

Masaki, N., Jori, Pearsal, Randy, L., Buckner, Matthew P., & Walker. (2009) REM sleep, prefrontal theta, and the consolidation of human emotional memory. *Cerebral Cortex,* 19, 1158-1166.

Meeter, M., & Murre J., M. (2004). Consolidation of long-term memory: evidence and alternatives. *Psychological Bulletin,* 130, 843-857.

Meyer, W., Moore, C., & Viljoen H. (2003). *Personology.* Sandown:Heinemann.

Oswald, L. M., Zandi, P., nestadt, G., Potash, J. B., Kalaydjian, A. E., & Wand, G. S. (2006). Relationship between cortisol responses to stress and personality. *Neuropsychopharmocology, 31,* 1583-1591.

Parker, E. S., Eaton, E. M., Whipple, S. C., Heseltine, P. N. R., & Bridge, T. P. (1995). University of Southern California Repeatable Episodic Memory Test. *Journal of Clinical and experimental Neuropsychology, 17*, 926-936.

Payne, J. D., & Nadel, L. (2004). Sleep, dreams, and memory consolidation: The role of the stress hormone cortisol. *Learning and Memory, 11,* 671-678.

Plomin, R., Owen, M. J., & McGuffin, P. (1994). The genetic basis of complex human behaviors. *Science, 264,* 1733-1739.

Posner, M. I., & Rothbart, M. K. (2000). Developing mechanism of self-regulation. *Development and Psychpathology, 12,* 427-441.

Rasch, B., & Born, J. (2008). Reactivation and consolidation of memory during sleep. *Association for Psychological Science,* 17, 188-192

Ribot, T. (1882). *The diseases of memory: An essay in the positive psychology* (W. H. Smith, Trans.). London: Kegan Paul, Trench, & Co.

Schredl, M., Wittmann, L., Ciric, P., & Goetz, S. (2003). Factors of dream recall: a structural equation model. *Journal of Sleep Research, 12,* 133-141.

Schredl, M., Schaefer, G., Hofmann, F., & Jacob, S. (1999). Dream content and personality: thick vs. thin boundaries. *Dreaming, 9,* 257-264.

Schredl, M., Montasser, A. (1997). Dream recall: state or trait variable. *Imagination, Cognition and Personality*, 16, 239–261.

Schredl, M., Nuernberg, C., &Weiler, S. (1996). Dream recall, attitude towards dreams, and personality, *Personality Individual Differences., 20,* 613-618.

Sheehan, D. V., Lecrubier, Y., Sheehan, K.H., Amorim, P., Janavs, J., Weiller, E., et al. (1998). The Mini-International Neuropsychiatric Interview (M.I.N.I.): The development and validation of a structured diagnostic psychiatric interview for DSM-IV and ICD-10. *Journal of Clinical Psychiatry, 59*, 22-33.

Solms, M., & Turnbull, O. (2002). *The Brain and the Inner World.* New York: Other Press.

Squire, L. R., & Alvarez, P. (1995). Retrograde amnesia and memory consolidation: A neurobiological perspective. *Current Opinion in Neurobiology*, 5, 169–177.

Stickgold, R., Hobson, J. A., Fosse, R., & Fosse, M. (2001). Sleep,learning, and dreams: Off.-line memory reprocessing. *Science*, 294, 1052–1057.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of memory* (pp. 381–403). New York:Academic Press.

Tulving, E., & Markowitsch, H. J. (1998). Episodic and declarative memory: role of the hippocampus, *Hippocampus*, 8, 198-204.

Walker, M.P., & Stickgold, R. (2006). Sleep, memory and plasticity. *Annual Review of Psychology*, 10, 139–166.

Wechsler, D. (1999). *Wechsler Abbreviated Scale of Intelligence*. San Antonio: The Psychological Corporation, Harcourt Assessment.

Wolcott, S., & Strapp, C. M. (2002). Dream recall frequency and dream detail as mediated by personality, behaviour, and attitude. *Dreaming, 12,* 27-44.

Zhang, Q. (2008). A computational account of dreaming: Learning and memory consolidation. *Cognitive Systems Research*, 10, 91–101.

APPENDIX A

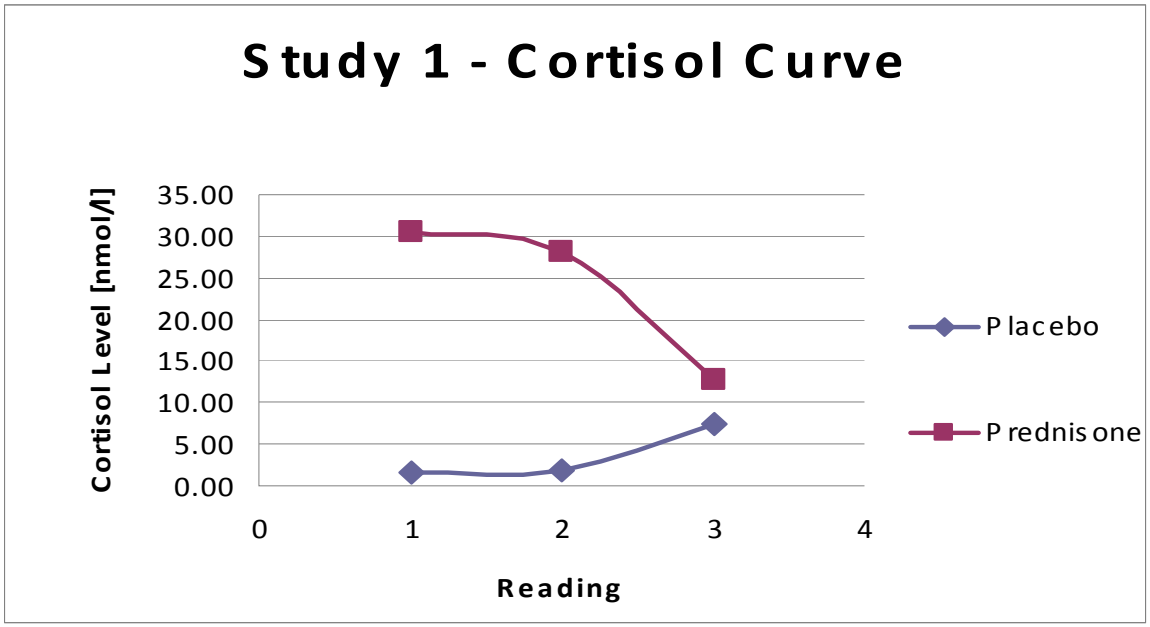

Figure 1. Placebo versus Prednisone characteristic curve for cortisol reading.

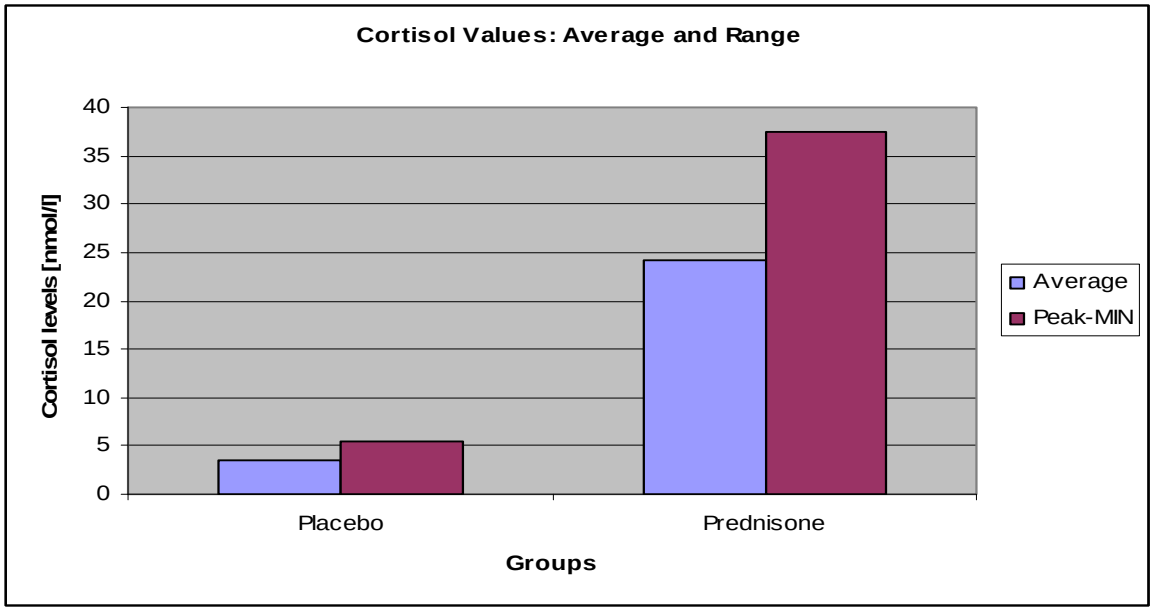

Figure 2. Placebo versus Prednisone for total average and peak difference cortisol levels.

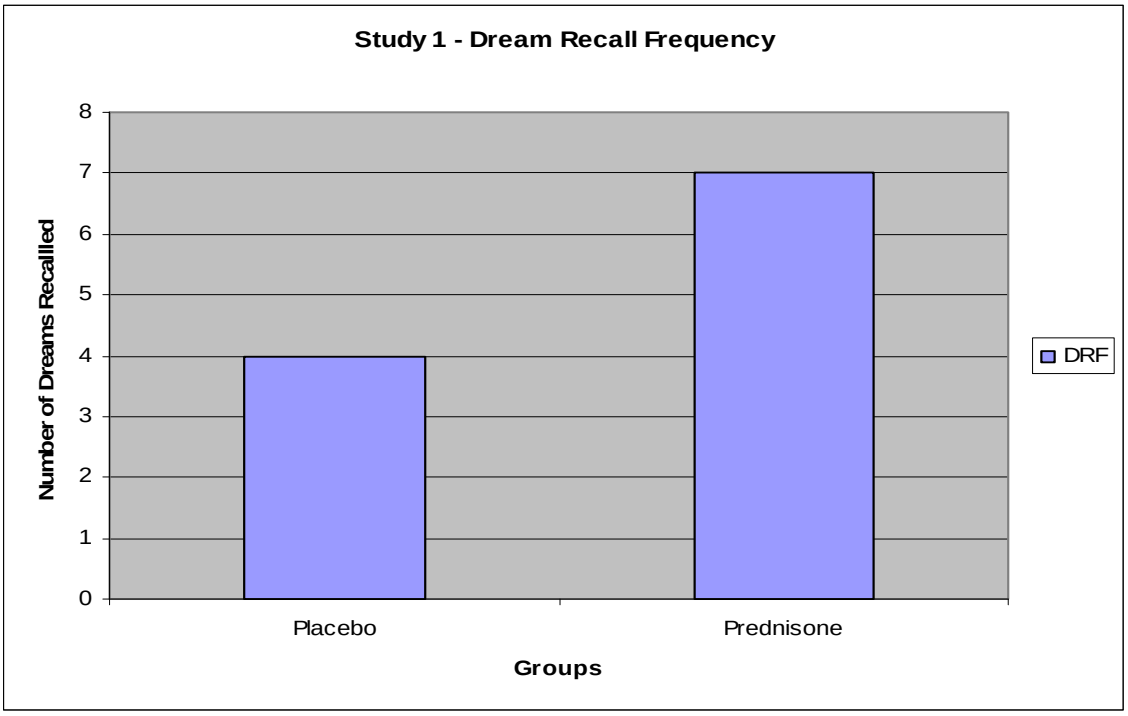

Figure 3. Placebo versus Prednisone for total dream recall frequency.

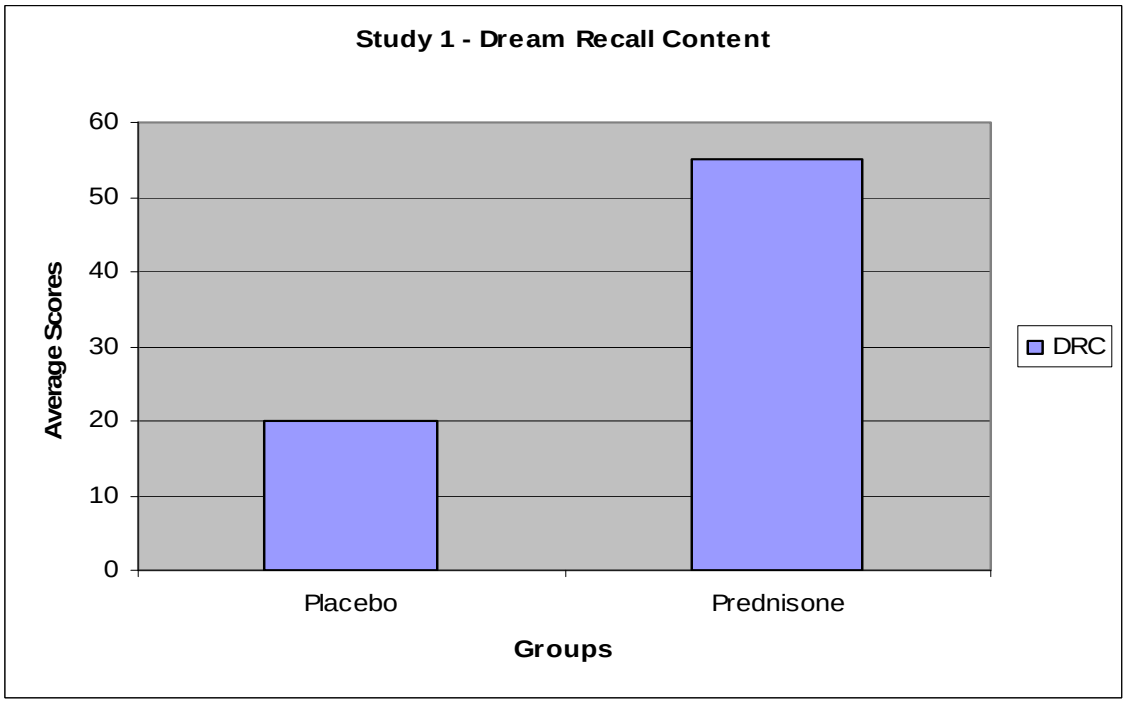

Figure 4. Placebo versus Prednisone for total dream recall content.

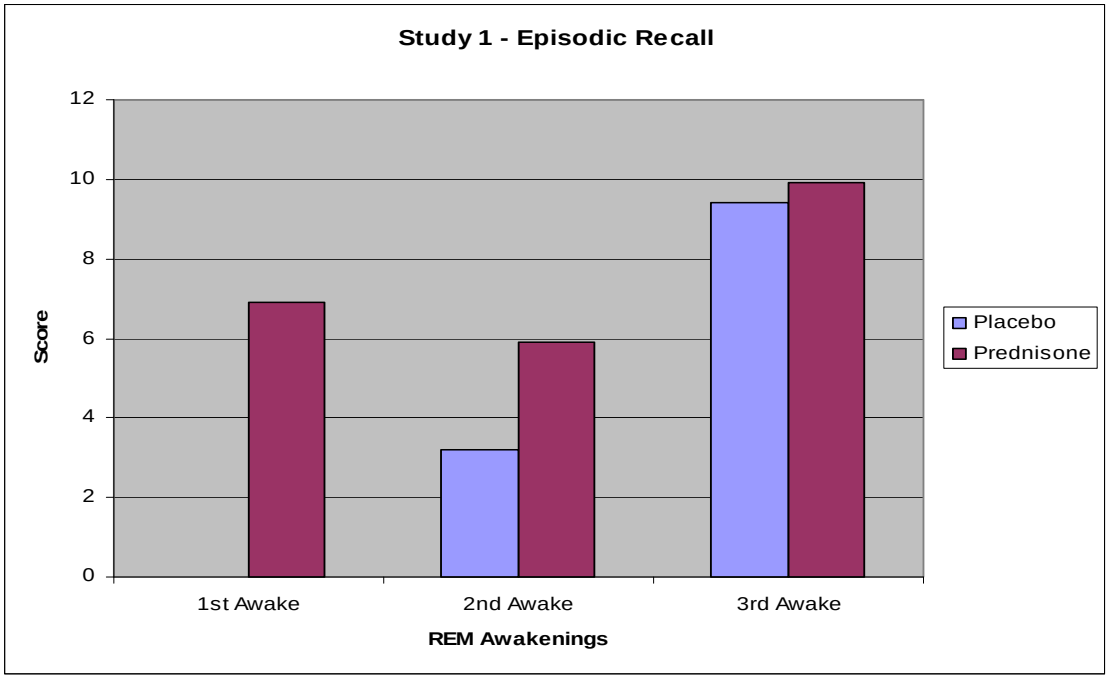

Figure 5. Placebo versus Prednisone for Episodic dream recall content.

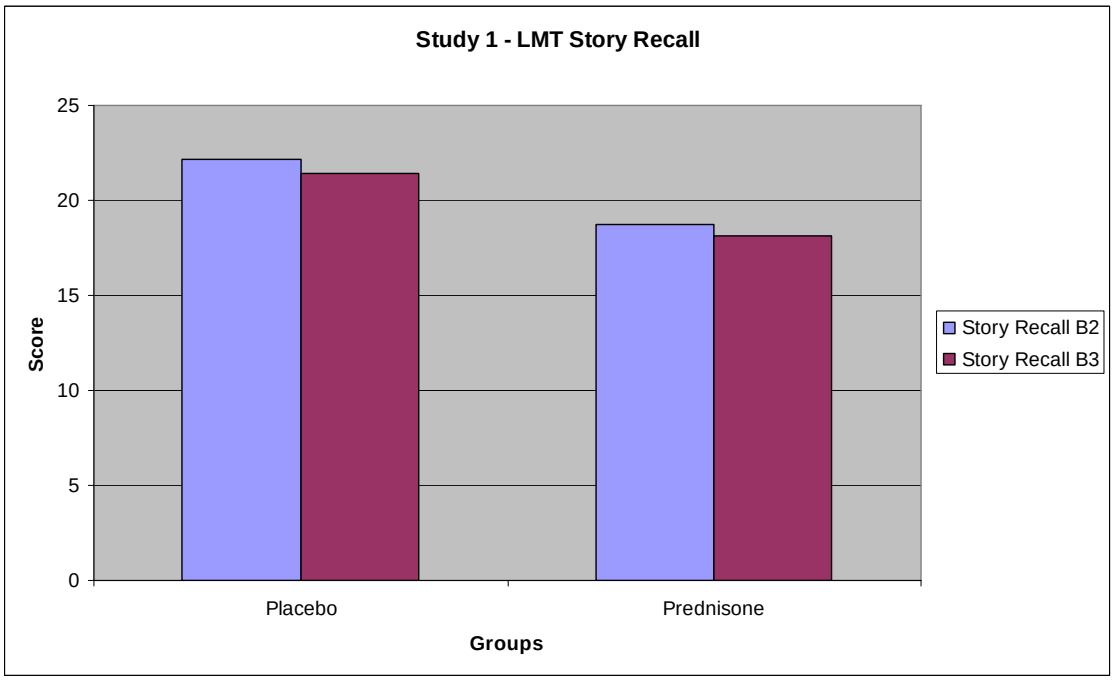

Figure 6. Placebo versus Prednisone for LM2 story recall representing memory consolidation performance.

APPENDIX B

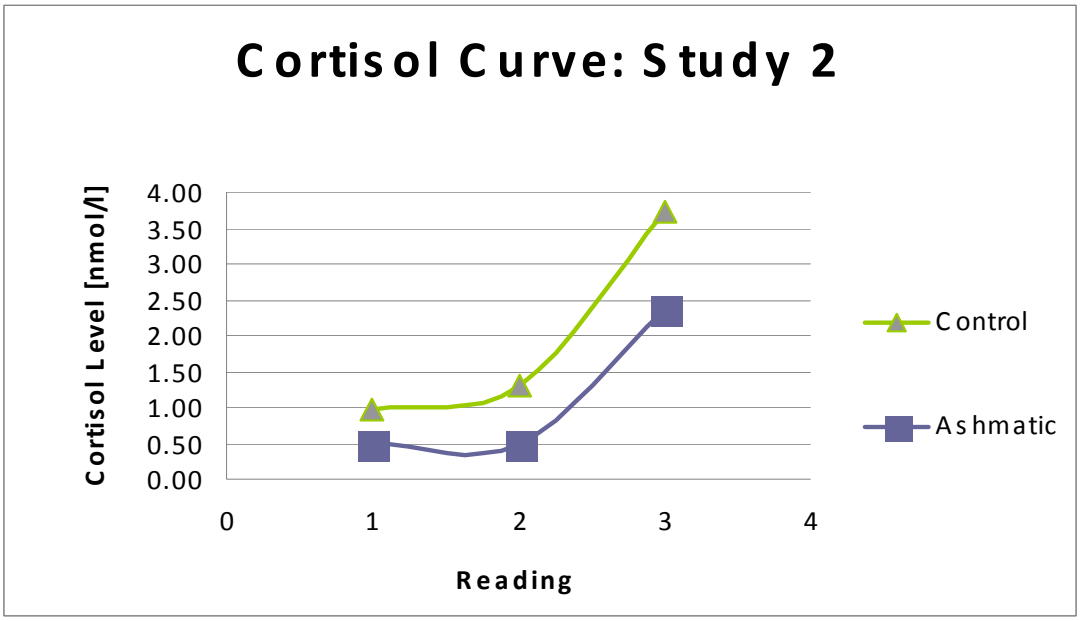

Figure 7. Control versus Asthmatic characteristic curve for cortisol reading.

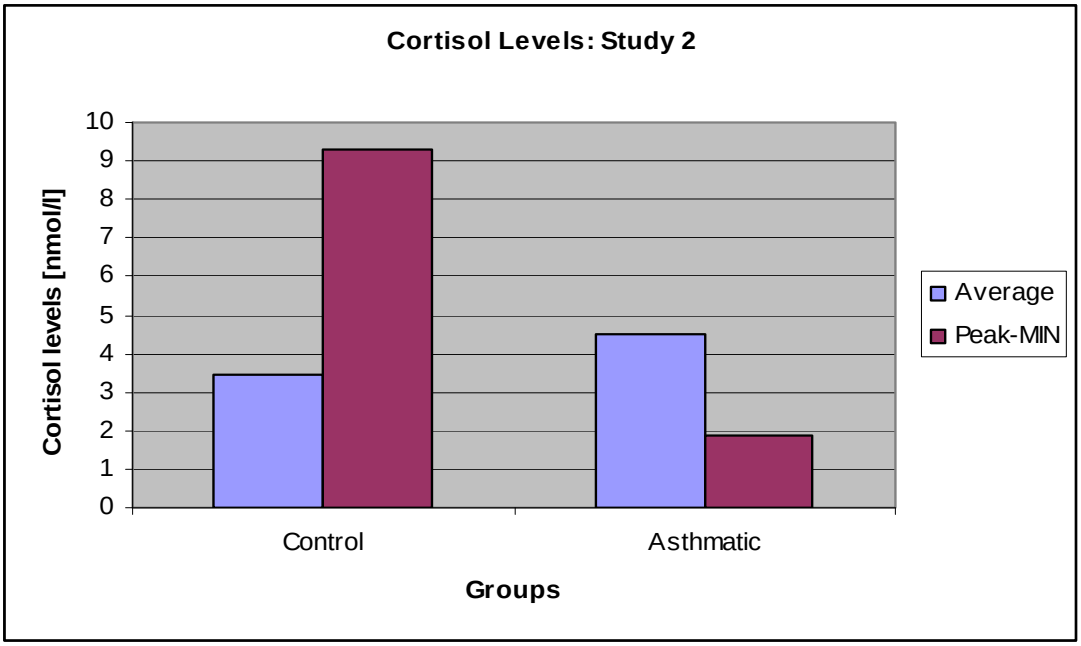

Figure 8. Control versus Asthmatic average and peak difference values.

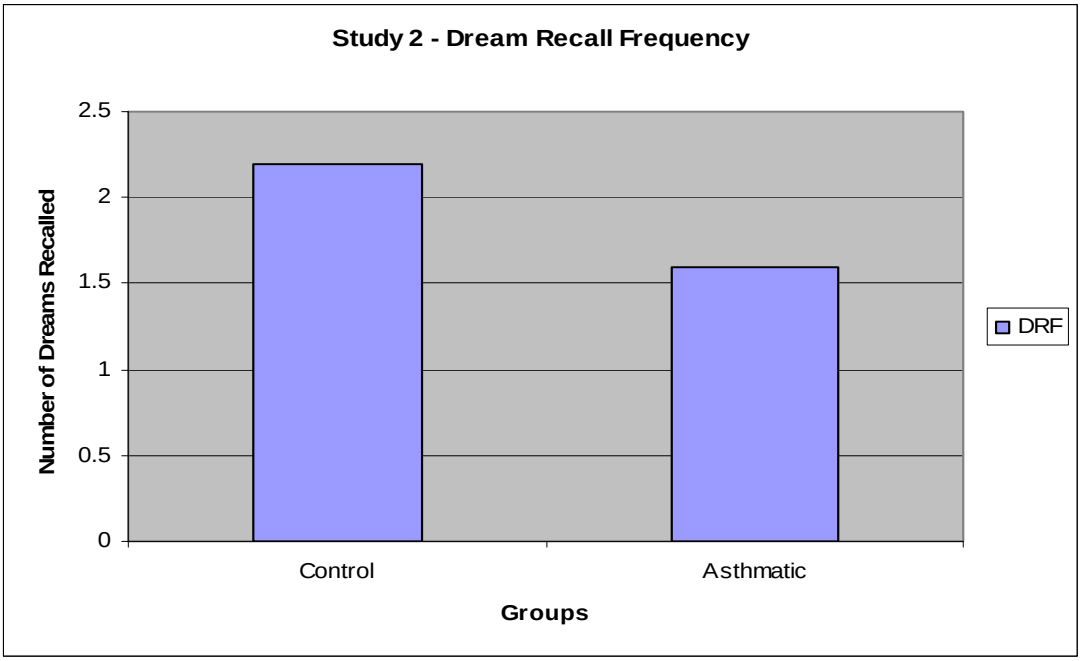

Figure 9. Control versus Asthmatic DRF variables

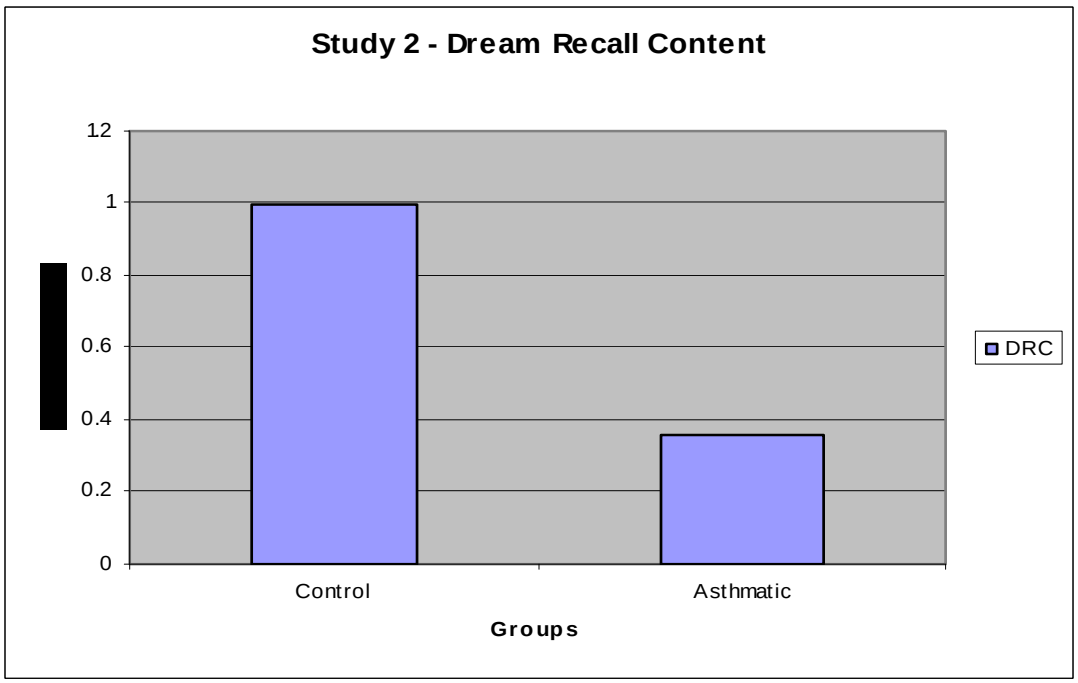

Figure 10. Control versus Asthmatic dream recall variables (uncontrolled)

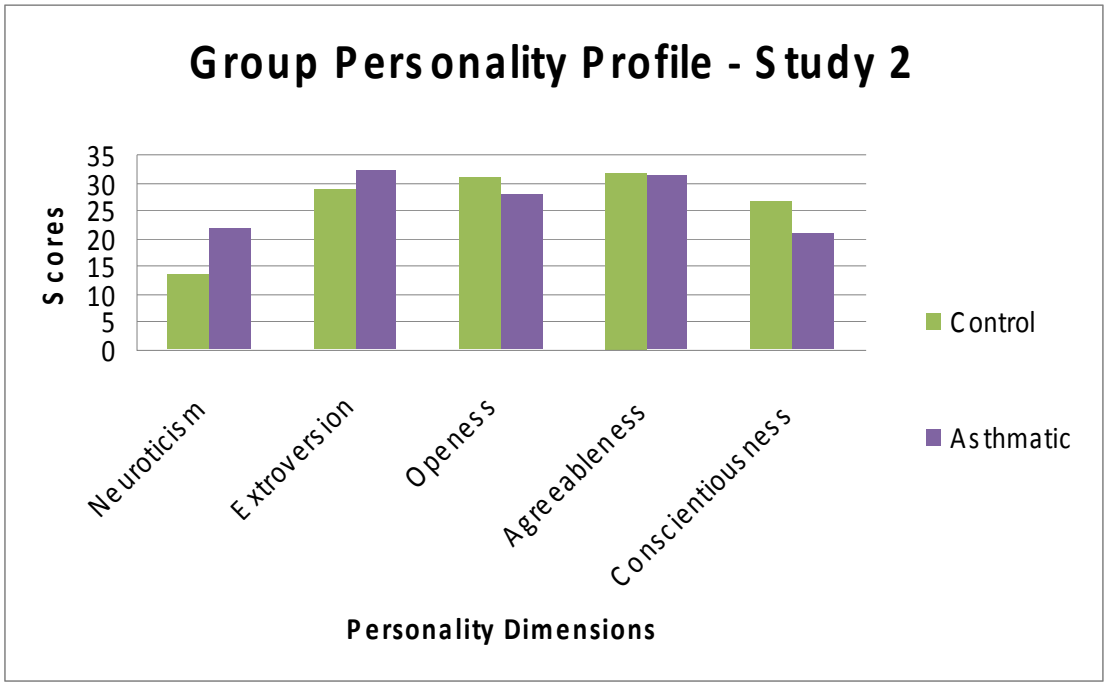

Figure 11. Personality profile comparison between asthmatic and control group.

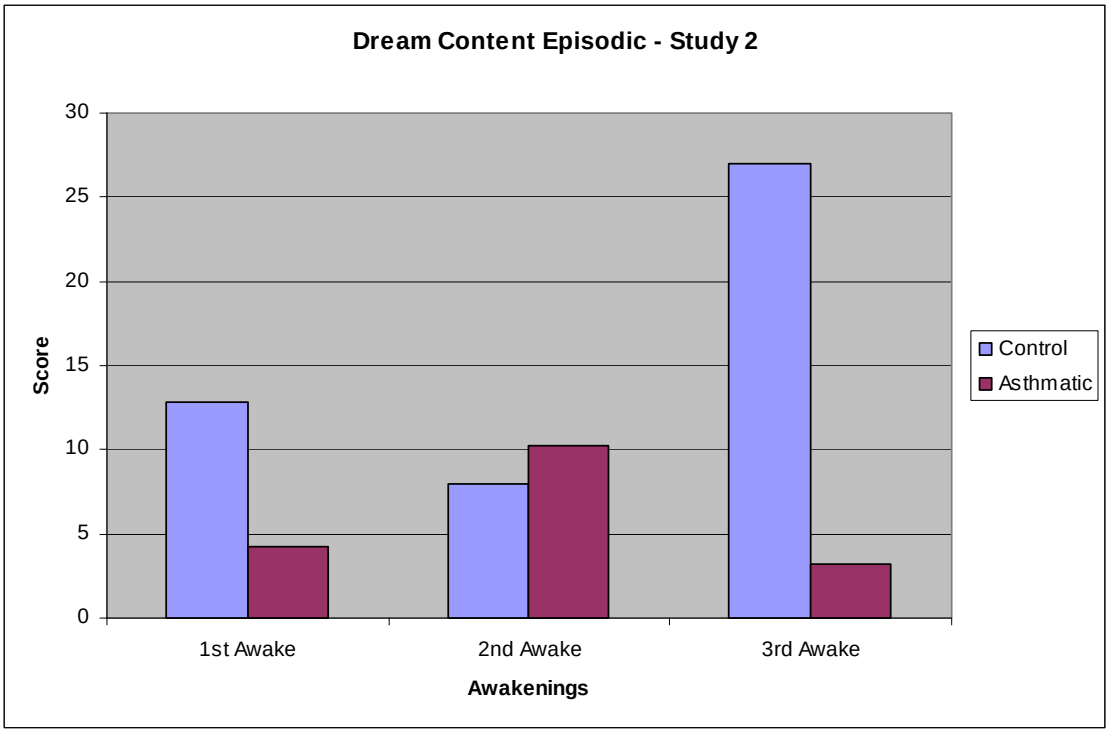

Figure 12. Control versus Asthmatic episodic content for REM awakenings.

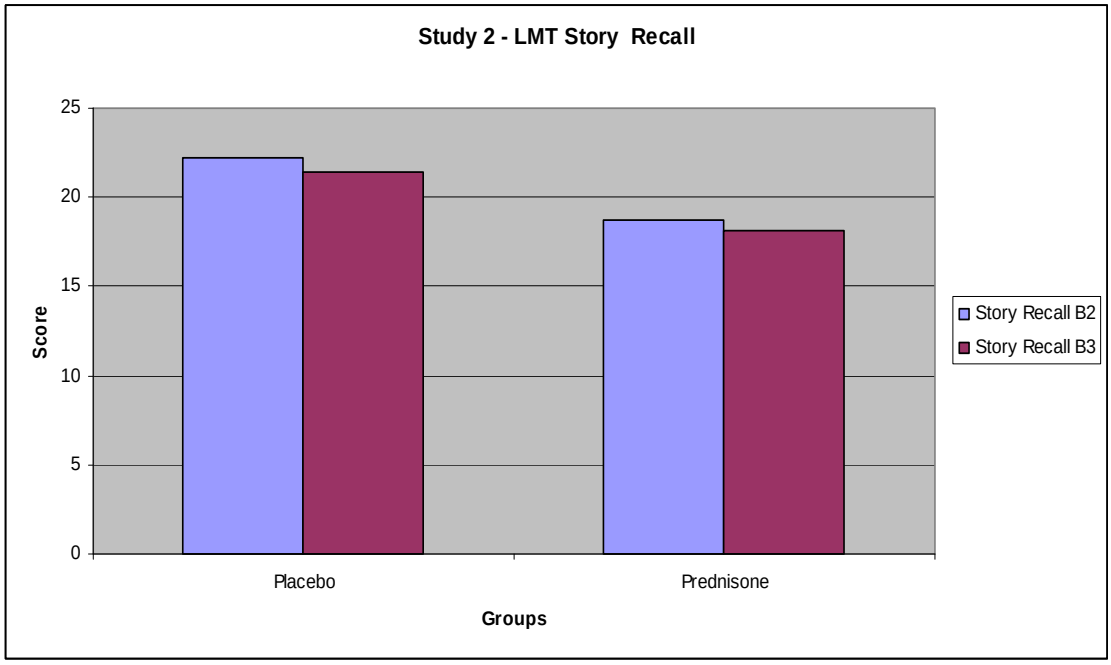

Figure 13. Control versus Asthmatic LMT story recall for memory consolidation.

APPENDIX 3

Dream Inventory

Use a scale of 0 to 10 to rate the contents of your dream, where 1 indicates = very little, 10 = a lot of and 0 indicates = the absence of a particular criterion.

My dream contained:

A. A person or people I know or used to know =

B. Places familiar to me =

C. An event I am currently experiencing =

D. An event from my past =

E. Total strangers =

F. Places I've never seen or been to before =

G. A situation that I've never experienced before =

H. Bizarre elements =

I. Vivid images =

J. Thoughts =

K. Emotions =