

A Re-Examination of the Interference Hypothesis on Dream Recall and Dream Saliency

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Summary. The interference hypothesis (Cohen, 1974; Cohen & Wolfe, 1973) was proposed to account for the difficulties in remembering dreams. Stimuli perceived on waking can either encourage activation of the waking brain or impair the transition from sleep to wake. The objective of the present study was to assess the validity of the interference hypothesis by discriminating between the natural decay of dream memories, and enforced interference on dream recall and dream saliency. Participants (N=42) were assigned to one of three groups: control, interference or demanding interference ("interference/task"). Each participant completed a dream template and questionnaire to assess their dream recallability. The interference group recalled significantly more words and reported higher saliency compared to the interference/task and control groups. Interference was thus demonstrated to influence dream recall failure. We propose that interference may interact with dream saliency in accounting for much variance within dream recall.

Keywords: Dream recall; Interference; Autobiographical Memory; Dream Saliency

1. Introduction

While most of us can recall dreams at least occasionally, there is a sizable minority who claim never to dream. Experiments have been conducted with dreamers and supposed non-dreamers only to find that there is little difference between these groups in terms of brain activity during sleep (Antrobus, Dement & Fisher, 1964). A number of theories of why we can and indeed cannot recall dreams have been proposed. We will first review these theories, with particular emphasis upon interference. We will then go on to present our own evidence involving an interference manipulation.

1.1. Theories of Dream Recall

A number of cognitive, biological and psychodynamic ideas attempt to explain why such difficulties in dream recall exist. They range from relating to the content of the dream (Freud's repression (1900) and Cohen & MacNeilage's (1974) saliency hypotheses) to accounting for the cognitive and physiological processes (arousal-retrieval and functional state-shift models). These theories reflect the changing focuses within dream research over the decades. Freud (1900) attempted to explain this type of forgetting in terms of the defense mechanism, repression - an inability to recall the content of dreams as a result of the threatening nature of the dream. Schonbar (1965) proposed a "Lifestyle Hypothesis", which essentially noted that the traits held in common across dream recallers concern overcoming repression as a means

of inhibiting dream recall. Around this time, interest in the biological measures of dreaming and sleep was mounting. The discovery that individuals often reported a dream when woken from Rapid Eye Movement (REM as opposed to non-REM sleep; Aserinsky & Kleitman, 1953) contributed greatly to this appeal. Researchers investigating dreaming began to employ increasingly experimental methods accounting for the widespread variance in dream recall. In particular, there was a drive to utilize neutral, non-psychodynamically operationalised measures when investigating dreams.

Cohen and Wolfe's (1973) work exemplify this tendency. They directly disputed the role of repression in remembering dreams and offered an alternative explanation: the interference hypothesis. They believed that stimuli perceived on waking displace dream material thus inhibiting its recallability. Their idea was based upon experiments conducted by Shapiro, Goodenough, Lewis and Sleser (1965), who demonstrated that there was a slight increase in dream recall when participants - particularly infrequent recallers - were abruptly, rather than gradually awakened. This provides subjects with very little time to displace their dream material due to the rapid form of awakening. This method of waking causes distinct changes in brain activity and it is this cognitive profile that has also been proposed to account for dream recall failure. The displacement however could be explained in terms of short term memory too. Zimmerman (1970) supported these ideas and proposed that habitual lightness of REM sleep is close to that of natural waking and therefore less interference is a result.

1.2. Interference and Dream Recall

Cohen and Wolfe's (1973) investigations provided a direct test of interference. Participants within an experimental group were asked to make a phone call to a weather number and then record the predicted temperature for that day, before reporting their dream material; whilst the control group remained in their beds for a comparable amount of time. The task set for the experimental group appears to have encouraged activation of waking brain, whilst remaining in a sleepy

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state (control group) may have impaired this transition into waking activation, thus perhaps facilitating state dependant recall benefits. The neutral intervening task appears to impact dramatically on dream recallability. Quickly alerting the brain to a waking style of processing may seem advantageous. Indeed it is, so long as there is no interference of the memory trace. Distraction during waking is acknowledged as an important factor. However, this need not be a task, for example, if you had a lot on your mind upon waking, to forget your dream quickly serves as a function to maximize your memory capacity needed for the day ahead. Cohen and Wolfe's work shows a clear distinction between interference and natural decay; nevertheless it fails to incorporate demanding interference. This research has shown how the slightest distraction on waking, or brief delay before the recall attempt, is enough to disrupt the memory.

The processes involved in interference have been defined and documented in the cognitive psychology literature. Proactive interference refers to the ability for previously acquired knowledge, memories or experience to affect the learning and retention of a newly acquired piece of information. This has been demonstrated in numerous experiments (e.g. Peterson & Peterson, 1959; Roediger & Karpicke, 2006). Retroactive interference describes the process whereby newly acquired information disrupts memories for previously acquired memories. Finally, output interference concerns the process whereby the act of retrieving a memory may use up cognitive resources and thus interfere with retrieval. Cohen and Wolfe's (1973) notion of interference does not define which of these specific processes would be involved in the displacement of dreams over waking, however it may be that an element of output interference is at work as the act of retrieving is too demanding for the brain whilst changing from a sleeping to waking state.

1.3. Interference and Salience

After Cohen and Wolfe's work was published, the concept of interference did not remain a focus of dream research. Research appeared to shift to incorporate other factors into the hypothesis so that the focus on interference became diluted and other alternative variables that were thought to be more important were emphasized. Cohen & MacNeilage (1974) together extended Cohen's initial ideas (Cohen, 1974; Cohen & Wolfe, 1973) on the phenomenology of dreams by emphasizing their characteristics. The combination of their vividness, emotionality (both positive and negative), bizarreness and activity (pace of events) produced a score of salience: a measure of the "subjected impact of the generated dream" (p699). Whilst salience may be a product of the dream generation process (an opinion that Cohen & MacNeilage emphasize) it may also result from processes of dream retrieval. That is, some dream reports may be more characteristically detailed than others. It is assumed that high dream recallers tend to produce such dreams, resulting in their advanced skills of recallability. However high dream recallers may engage in different retrieval processes, perhaps drawing upon more information from a dream memory, thus recalling more salient dreams. It is not surprising that more salient dreams are likely to be better recalled, even though this proposition stands in direct contrast with repression hypotheses, but Cohen and MacNeilage demonstrate that salience may be a cognitive style or individual differences trend. Their results do not allow for the result to be further explained, however, in terms of whether the

relationship between salience and dream recallability lies at the stage of encoding or retrieval. Correlating specific kinds of memory abilities with dream recallability (as an individual differences trait) may shed light on this.

Cohen and MacNeilage (1974) operationalised salience as the strength of a memory trace, however many distinguish it differently. Linton (1982) simply describes salience as the personal importance one attaches to a memory. Wagenaar (1986) defines saliency as how often such an event might be expected to occur, therefore unique events such as dreams would be considered highly salient. Alternatively, it can be seen to refer to the strength of a memory trace in terms of it attributes such as bizarreness (Cipolli et al, 1993) and emotionality (Schredl & Doll, 1998). This is how the present study measures salience, referring to its characteristics. Future investigations could assess the different ways of operationalising this as a variable.

Overall the more salient a dream, the more likely it is to be recalled. It is well documented in the literature that particularly bizarreness (Cipolli, Bolzani, Cornoldi, DeBenedictis & Fagioli, 1993) and emotionality (Schredl & Doll, 1998) increase memorability. Such characteristics could also contribute to, or even be a measure of, underlying salience of a dream. Cohen (1974b) believes that the combination of salience and interference principles appear capable in accounting for all of the phenomena of dream recall.

1.4. Replication: the Present Investigation

Since the 1970's, this phenomenon of interference has not been subsequently tested and therefore a much needed replication is sought. The literature reviewed is often dated and therefore uncertainty arises about the implications of such findings in light of the current body of literature and understanding within the field. The present study attempts to investigate both interference and salience together, for the first time; assessing the validity of the hypotheses in a systematic experiment. In modifying specific aspects of the study carried out by Cohen and Wolfe (1973); the design itself aimed to distinguish between natural decay of dream memories (control group) from interference (interference group) and demanding interference (interference/task group). An important aspect that remained the same is the use of an intervening act. This is because it has such a strong impact on dream recall which remains consistent with the initial interference hypothesis. However manipulating interference in this way allowed for any general effects on dream recall as a dependent variable to be ascertained. Previous studies (Cohen & MacNeilage, 1974; Cohen & Wolfe, 1973) compared groups (frequent and non-frequent dream recallers). Whilst we acknowledge that interference may interact with individual differences variables, it was deemed more appropriate to investigate interference with other closely linked variables. It was postulated that the interference group would still have access to their dream memories as a result of being sharply brought into waking consciousness without displacing these traces. This in turn minimizes the interference effects of waking stimuli usually perceived upon waking naturally. It was therefore predicted that we would see better recallability from this experimental group as opposed to the interference/task group as such participants are likely to displace their dream memory traces quicker as a result of completing the unrelated task. We also predicted that those who display high dream recallability for their current dream would also score highly on salience measurements. The

pertinent events of the dream would override the intrusion of distracting events making it distinctly more memorable to the individual. The investigation aimed to discriminate between dream memory decay and actual displacement of the memory thus contextualizing these ideas within modern memory research. The present experiment thus aimed to test the validity of the interference hypothesis in a systematic experiment.

Two clear hypotheses were developed; firstly, an interference/task group woken by a phone call and then asked to complete a cognitive task would be more likely to have impaired dream recall than an interference group, who would not have completed a task after being woken by a phone call. Secondly, those participants who woke up naturally (control group) would have the poorest dream recall. Furthermore it is predicted that salience would have an effect on recall across all three groups.

2. Method

Both experimental groups were woken from their sleeping state half an hour prior to their usual estimated waking time by a phone call. However, the interference/task group was provided with instructions to carry out a further task (text provided by the researcher - circling all the 'e's in that passage) before filling out their dream materials. Salience was also scored by six salience measurements, with the aim of identifying whether dream salience was affected by interference and, if so, whether this would be in the same way as for dream recall. The present study thus combined both a diary style design with a self-report questionnaire.

2.1. Participants and Design

Participants were gathered using a volunteer sampling method. The study was advertised around Leeds Metropolitan University. Participants were assigned a group based on the order in which they volunteered; the first participant was assigned to the control group, the second, to the interference group, the third, to the interference/task group and so on ($N = 42$, 14 in each of the three groups). The age range was 18-28 years and 15 males and 27 females were recruited. The task occurred over just one night of sleep and the following morning.

Stimuli perceived upon waking (interference) were manipulated via group membership, producing a between-groups design. The interference/task group consisted of being presented with demanding stimuli on waking by being awoken by a phone call and completing an unrelated task straight after. The interference group involved being woken by a phone call only and the control woke naturally, without additional demanding stimuli, over and above natural day-to-day functioning.

Three measures were collected. The first dependent variable was the total of number of words recalled in a dream narrative (word count). The second was the salience of the dream assessed by six items on the dream template and the third was general recallability, measured using a questionnaire (see below).

2.2. Measures and Materials

A dream template was constructed to collect the data from participants (see Appendix 1). This consisted of three general questions that could provide the researcher with an

indication of the dream recall context, such as the date, time and setting (home/hotel/friends house etc). This was followed by a blank text box (15.5x12.5cm) where the participant was able to record a narrative of their dream. Participants were instructed to fill in the template while trying to recall as much information as possible, and if they felt there was not enough space to record their dream, they could use supplementary paper if required. A set of brief questions were included, providing information about the dream. Questions related to bizarreness, vividness, activity, positive emotionality, negative emotionality and narrative coherence because current literature suggested these as important measurements when accounting for salience. A conventional five-point response scale was given to each item ranging from "minor" to "dominant". Salience was investigated with the question, "How would you rate this dream in terms of personal importance?" The 5-point response scale ranged from "insignificant" to "significant". Each response was given a score from 1-6. The six salience responses were added together to produce a score ranging from 6-35.

The investigators also constructed a brief questionnaire to assess general dream recallability (see appendix 2). This consisted of six multiple choice questions, again with a five point response scale. An example of an item in the questionnaire was 'On average, how often do you experience a dream?' The items were devised to reflect high face validity and the six questions together aim to produce a reliable overall measure of dream recall.

In accordance with Briggs and Cheek (1986) any scale with fewer than ten items suggests it is better to calculate and report the mean inter-item correlation for the items as opposed to the Cronbach's alpha coefficient. Nevertheless both are addressed in the results section as the analyses conducted rely on the collected data. In addition, other materials that were used include a short passage of text, which was used as a neutral distraction task for interference/task group. This was a short story written by Phil Shapiro (1995) called 'New World Vegetables'.

2.3. Procedure

Participants were informed that they were being recruited for a study on dreaming. While they knew they would be required to report a dream upon being woken they were not aware of the group comparisons that were being conducted and the specific hypotheses being investigated (interference and salience).

Participants provided a contact phone number (so the experimenter could remain in contact with them throughout the experiment) and their usual time of waking. Participants were then provided with the relevant materials needed in order to carry out the experiment at home. Participants were instructed to keep the relevant materials close to hand along with their phone before they went to sleep that night and requested not to use a device that aided waking (such as an alarm), while under experimental conditions. Nevertheless, this was applicable in the control group too, naturally meant the same instructions applied for this condition.

Half an hour prior to their usual estimated time of waking the next day each participant received a phone call from the researcher that gave them further instructions for completion of the experiment. For the interference/task group participants first had to follow instructions concerning an unrelated passage of text (circling all "e"s), then for all conditions participants were expected to record their dream on

the template provided (simply a narrative of their last dream) followed by filling in a brief questionnaire on the confidence of their recallability.

On completion of these tasks, materials were returned and participants debriefed.

3. Results

Performance trends across groups (interference, interference/task and control) were compared for general recallability, as measured by the sum of responses to the six-item questionnaire (scores could range from 6-30), dream length (word count of dream report) and reported salience.

A one-way between groups ANOVA was conducted to explore whether dream length varied according to the stimuli perceived on waking. (Participant 38 was removed from the analyses due to skewing the distribution positively.) The ANOVA revealed a significant effect of interference, $F(2, 38) = 5.45$, $p < 0.05$. Post-hoc comparisons using the Tukey HSD indicated that participants in the interference group ($M = 107.3$, $SD = 51.7$) recalled significantly more words than those in the interference/task group ($M = 45.5$, $SD = 47.8$). There were no other significant differences, that is, the dream report lengths from the interference/task group did not differ significantly from those of the interference or control groups.

A second one-way between groups ANOVA was conducted to explore whether reported salience varied across the same three groups. A similar trend was produced. The ANOVA revealed a significant effect upon salience according to the stimuli perceived on waking, $F(2, 38) = 14.24$, $p < 0.05$. Post-hoc comparisons using the Tukey HSD indicated that participants in the interference group ($M = 27.9$, $SD = 5.1$) reported significantly higher salience than those in the interference/task ($M = 17.4$, $SD = 5.3$) and control groups ($M = 19.5$, $SD = 6.2$). There were no other significant differences.

The general recallability scale displayed good internal consistency, with a Cronbach's alpha coefficient of 0.68. As this scale had fewer than 10 items the mean inter-item correlation for the items was also assessed. The scale produced what is considered to be an optimal inter-item correlation of 0.29 (Briggs & Cheek, 1986). Performance was similar across groups, with the interference group displaying slightly higher recall ($M = 20.7$, $SD = 4.7$) than the interference/task group ($M = 19.2$, $SD = 3.5$) and the control group ($M = 18.2$, $SD = 4.9$). A third one-way between groups ANOVA was conducted to explore whether general recallability was affected by group. The ANOVA revealed no significant effect, $F(2, 38) = 1.17$, $p > 0.05$.

In order to further investigate the relationships between variables, correlation coefficients were calculated. Table 1 conveys the relationships between each of the three variables. Highly significant positive correlations were found in each case, demonstrating shared variance between dream recall and salience measures.

4. Discussion

Participants who completed their dream materials immediately after an abrupt awakening recalled significantly longer dream reports and reported higher salience in relation to their dream than those who were set an interference task. Thus as predicted, the interference group maintained access to their dream memory trace as a result of being sharply

Table 1. Correlation coefficients of relationships between measures of salience, length and general recallability (N=42)

	Salience	General recall-ability
Dream length	0.56*	0.40*
Salience		0.61*

Note. Correlation significant at $p < .01$ level.

brought into waking consciousness. Those who completed the task displaced their dream memories more quickly due to the interference effects of the task, new stimuli pushed this memory out, supporting the initial hypothesis.

A reason as to why the demanding interference group displayed the poorest recall is likely due to the cognitive load requirements of the task imposed on the participant. Circling the 'e's in a passage of text is not a complex task yet it is time consuming and requires cognitive effort, particularly in terms of working memory. Working memory (see Baddeley, 2003, for a review) involves storing material in short-term memory whilst simultaneously manipulating it). Thus using cognitive resources upon waking in this way displaces a dream memory and prevents the rehearsal or maintenance of a dream memory, resulting in shorter dream reports from this group and lower salience scores of the reported dreams. Time could therefore be a factor contributing to the decreased dream length and reported salience after an interfering task upon waking as the increased cognitive load of the demanding interference task decayed the dream memory trace. Cohen (1974) illustrates this trend by describing how if an arousing stimulus is too noxious the dream may be lost because the subject focuses on the external irritant. As the control group in the present study were brought to waking rapidly, the dream memory trace was accessible in short-term memory, thus not affecting longer-term recall.

General dream recallability did not appear to be affected by interference. However, the interference effects upon both dream length and salience indicates: firstly, that interfering stimuli upon waking has an effect upon the strength of the dream memory trace, and secondly that the general recallability item may not have measured such memory strength in the same way. This finding serves as a reminder that dream length may differ from measures of dream detail, which by definition differ from dream recall frequency items by attempting to measure the characteristics of recalled dreams. A host of literature addresses the differences between the types of measures, and the autobiographical features of dream recall are addressed in a paper presenting a psychometrically validated questionnaire (see Horton & Conway, 2009).

It was seen that the longer the recalled dream report, the higher the rated salience of a dream. Salience thus appears to relate to dream length and dream recall but whether this is a factor in determining one's ability to recall a lengthy dream is not clearly disentangled. Dream salience may be a product of lengthy dreams, or indeed vice versa. Both variables likely represent the strength of a dream memory trace. One could infer that the lack of interfering stimuli present when woken under interference conditions enabled the par-

participant to report this increased subjective impact of their dream (salience) with ease, therefore the strength of the memory trace could be seen to improve memory recall. If new stimuli presented on waking removes the salience of a dream it could be argued that this factor may hinder recall.

Our findings provide direct support for the interference hypothesis (Cohen & Wolfe, 1973). Due to the very nature of awakening in this experiment interfering stimuli was minimum at the time of waking, which stopped dream material from being displaced; it is the stimuli argued to cause the interference. However, the direct test that was used to measure interference some what conflicts with the findings of the present study. Those in Cohen and Wolfe's (1973) experimental group made a phone call to a weather number and were asked to write down the predicted temperature for the day before reporting the dream material. This is argued to have encouraged activation of the waking brain, supposedly hindering recall. However the study only used two conditions to measure the effects of interference; an experimental condition and a control, therefore it was reported that waking consciousness hindered recall because of the interference effects of the task. If the present study has used only two comparable conditions, the control group would have out-performed the equivalent experimental group in terms of dream length and salience. It is more reasonable to assume that the activation of waking consciousness facilitates recall, because it is more closely related to the activation of the brain when dreaming. Shapiro et al.'s (1965) findings concerning gradual versus abrupt awakenings contribute to this assumption, whereby those abruptly awoken recalled more information about their dreams as opposed to those who were gradually awoken. Shapiro et al. describe their results as reflecting a slight difference, particularly in infrequent recallers. However, a more substantial difference was recognised in this study but not in terms of frequent or infrequent recallers.

4.1. Cognitive Implications of Interference

These transitions from sleep to wake, and indeed between the different stages of sleep, have been manipulated and investigated in cognitive terms. The present paper has presented evidence demonstrating the interference of a specific cognitive process (demanding task) with a dream memory, but there may be many ways in which such displacement may occur. To use the term "interference" in its strict sense, as understood within the field of Cognitive Psychology, concerns retrieval inhibition as outlined by Roediger and Karpicke (2006). However this topic could also be investigated in neuro-modulatory terms. That is, the neuro-modulation from cholinergic to aminergic functioning of the brain (Hobson, Stickgold & Pace-Schott, 1998) could account for the behavioural and cognitive changes in memory functioning whilst waking, specifically from REM sleep. Laboratory investigations involving EEG recordings of sleep stages would be helpful in ascertaining as to whether the same variable of interference would also interrupt memory encoding when waking from NREM dream sleep. Whilst there may be difference in the neuromodulation of the brain when waking from REM sleep compared to waking from NREM sleep, it would be inappropriate to assume that memory encoding processes operate differentially between REM and NREM stages without further evidence. It may be appropriate to think of the cognitive capabilities of the sleeping brain in comparison to the waking brain as well as during that tran-

sitional state. Badia (1990) reports on this process by comparing the functioning to anterograde amnesia whereby old memories are retained and accessible, whilst new information cannot be encoded into memories for subsequent retrieval. This if a new stimulus requires cognitive effort, some kind of displacement may occur. If one tries to encode the dream memory early in the waking process before encoding is possible, output interference may occur.

4.2. Memory and Interference

The cognitive processes of interference (Roediger & Karpicke, 2006) may not be easily dissociable. We may assume that proactive interference does not occur when a noxious stimulus or demanding, interfering task displaces a dream memory upon waking, as previously acquired knowledge, memories or experience are not seen to affect the learning and retention of the situation or stimulus to which attention is turned. We presume that waking tasks and stimuli are more easily attended to than dream memories, likely due in part to the modulation of the brain from sleep to wake as described above. In addition, reality monitoring frameworks (such as Johnson, Kahan & Raye, 1984) illustrate the usefulness of waking experiences being more memorable than imagined ones, such as dreams: if the two were comparable then we would confuse reality and this would presumably not be functional in everyday life. Rather than, the displacement of dream memories by waking experiences is more typical of retroactive interference processes. This may occur by the new, waking task being more memorable in itself than the dream memory, or output interference may occur if attending to the waking task displaces the dream memory. These two processes then are closely linked.

Theories of dream recall and dream recall failure developed from Cohen's work on interference and salience so to incorporate an increasing comprehension of brain activation over the stages of sleep. Koulack and Goodenough (1974) proposed a cognitive theory that reflected the difficulty of recalling dreams given the decreased brain activity whilst asleep. Whilst the model requires more specific testing, more recent experiments manipulating arousal have supported Koulack and Goodenough's claims (e.g. Domhoff, 2001; Hobson et al., 2000; Rosenlicht, Maloney & Feinberg, 1994; Solms, 1997; 2000). The model specifically proposed that given the difficulty for dream memories to be encoded beyond short-term memory and into long term memory, the context within which dreams are best recalled is immediately upon waking when the dream memory is still in short- as opposed to long term stores. As a result of the decreased processing of short-term memory, which may be the result of the central executive component of working memory (Baddeley & Hitch, 1974) allocating resources such as attention or repetition of material in order to facilitate encoding, dreams are not easily passed through this stage to reach long-term memory. Upon waking it is proposed that short-term memory processing becomes increasingly functional so new perceived material could be encoded more efficiently, thus accounting for interference effects (Cohen & Wolfe, 1973). Koulack and Goodenough state that short-term memory storage is assumed not to vary over different states of arousal, although such a claim may not be supported with recent empirical findings. Their model accounts for the recency effect whereby dreams generated later in the night are more recallable than older dreams (Cipolli, Calasso, Maccomlini, Pani & Salzarulo, 1984). Some early or

old dreams are encoded in some form and are recallable, however. Dream salience may be at work in those cases. However the model does not suffice as state dependent effects facilitate dream recall, and these cannot be accounted for by the model. That is, an overlapping of context between encoding and retrieval should lead to the more efficient recall of a memory. As Koulack and Goodenough imply that it is difficult for dreams to be encoded, an enhanced presence of cues at retrieval should not necessarily lead to enhanced recall. However maintaining the same context upon waking as was experienced during dreaming is frequently proposed as a method of facilitating dream recall. Whilst the arousal-retrieval model accounts for the difficulty for dreams to be encoded well, it is not explicitly concerned with cognitive processes of retrieval.

This arousal-retrieval model combines ideas from research on memory, learning and brain activation over the sleep-wake cycle. In addition it offers explanations for interference and salience effects. Individual differences may interact with arousal-retrieval effects (Hicks, Fortin & Brassington, 2002). Koukkou and Lehmann (1983) extended these arousal-based ideas in a framework focusing more upon the state dependent effects of dream recall as opposed to short-term memory.

For dream recall to be successful, the context in which it is retrieved should match the context in which it was encoded. This mirrors state and context dependent memory effects which are well documented in the memory literature. Koukkou and Lehmann (1983) extended these ideas to encompass arousal and change of brain activation across the sleep-wake cycle. They argue that different sleep stages reflect differential patterns of activation, with waking being the most aroused, REM slightly less aroused, and SWS the least. For a dream to be recallable in a waking state, the state in which it is generated should match that waking state as best it can. Therefore more arousal, for instance from REM sleep, should lead to better dream recall. Differences in recallability may result from their characteristics, such as REM dreams being coherent, narrative structures whilst NREM dreams are more transient and thought like. These theories may well refer to similar underlying cognitive processes that have been demonstrated by our findings in the present experiment. Brain activation over the sleep-wake cycle affects memory encoding processes. Changes in this activation between sleep stages, or between sleep and wake, results in difficulties with carrying over memories from particular periods. Thus any interruption to the cognitive system over these periods of change result in the dream memory being especially likely to be displaced or decayed. An interfering task or event may warrant attention from the cognitive system, displacing the dream memory and simultaneously encouraging the neuro-modulation to aminergic activity, or waking up. Once the brain functions in a manner typical of waking activity, state-dependent memory effects render the dream memory trace especially difficult to access.

Summary

In conclusion, the present experiment has re-established the importance of interference when considering dream recall failure. Nevertheless, the striking effect between interference and salience somewhat questions the current phenomenon. By combining these two principles into one

sound theory, it is likely that much variance within dream recall could be determined. Although this has been suggested previously, the results offer a consistent summary. Regardless that dreams appear to exhibit striking differences from waking cognition, such as lack of control and inclusion of bizarre and improbable events it is clear that much can be understood from existing cognitive theories.

The present study is the first experiment to combine interference and salience to establish whether a link exists and how this may operate. The findings suggest that a link is present, as the more interference experienced has tended to reduce the length of the dream recall in turn reducing the reported salience. Previous research has denoted these as separate entities. However, this research has questioned this view and has highlighted the importance of the two factors together and suggests that further research is needed to focus on this relationship in greater detail.

References

- Antrobus, J. S., Dement, W., & Fisher, C. (1964). Patterns of dreaming and dream recall: An EEG study. *Journal of Abnormal and Social Psychology*, 69, 244-252.
- Aserinsky, E., & Kleitman, N. (1953). Regularly occurring periods of eye motility and concomitant phenomena during sleep. *Science*, 118, 273-274.
- Baddeley, A. (2003) Working memory: Looking back and looking forward. *Nature Reviews Neuroscience*, 4, 829-839.
- Baddeley, A.D., & Hitch, G.J. (1974) Working Memory. In *The Psychology of Learning and Motivation*. Bower, G.A. (Ed) 47-89, Academic Press.
- Badia, P. (1990). Memories in sleep: Old and new. In R.R.Bootzin, J.F.Kihlstrom & D.L.Schachter (Eds.), *Sleep and Cognition*. Washington: American Psychological Association.
- Briggs, S. R., & Cheek, J. M. (1986). The role of factor analysis in the development and evaluation of personality scales. In J. Pallent (Ed.), *SPSS Survival Manual*. NY: McGraw-Hill.
- Cipolli, C., Bolzani, R., Cornoldi, C., DeBeni, R., & Fagioli, I. (1993). Bizarreness effects in dream recall. *Sleep*, 16(2), 163-170.
- Cohen, D. B. (1971). Dream recall and short term memory. *Perceptual and Motor Skills*, 33, 867-871.
- Cohen, D. B. (1974). Toward a theory of dream recall. *Psychological Bulletin*, 81, 138-154.
- Cohen, D. B., & MacNeilage, P. F. (1974). A test of the salience hypothesis of dream recall. *Journal of Consulting and Clinical Psychology*, 42, 699-703.
- Cohen, D. B., & Wolfe, G. (1973). Dream recall and repression: evidence for an alternative hypothesis. *Journal of Consulting and Clinical Psychology*, 41, 349-355.
- Domhoff, G. W. (2001). A new neurocognitive theory of dreams. *Dreaming*, 11(1), 13-33.
- Freud, S. (1958). The interpretation of dreams. In J. Strachey (Ed.), *The standard edition of the complete psychological works of Sigmund Freud (Vols 4 and 5)*. London: Hogarth. [Originally published in 1900].
- Goodenough, D. R., Shapiro, A., Holden, M., & Steinschriber, L. (1959). A comparison of "dreamers" and "non-dreamers". *Journal of Abnormal and Social Psychology*, 59, 295-302.
- Hicks, R. A., Fortin, E., & Brassington, G.S. (2002). Arousability and dreaming. *Dreaming*, 12(3), 135-139.
- Hobson, J.A., Stickgold, R., & Pace-Schott, E. (1998) The neuropsychology of REM sleep dreaming. *NeuroReport* 9, R1-14.
- Horton, C.L., & Conway, M.A. (2009) The Memory Experienc-

- es and Dreams Questionnaire: A Validated Measure of Dream Remembering. *Imagination, Cognition and Personality*, 29(1), 3-29.
- Johnson, M. K., Kahan, T.L., & Raye, C.L. (1984). Dreams and reality monitoring. *Journal of Experimental Psychology: General*, 113(3), 329-344.
- Linton, M. (1982). Transformations of memory in everyday life. In U. Neisser (Ed.), *Memory observed: Remembering in natural contexts*. San Francisco, CA: Freeman.
- Peterson, L. & Peterson, M.J. (1959) Short-term retention of individual verbal items. *Journal of Experimental Psychology*. 58(3), 193-198.
- Roediger, H. L. & Karpicke, J. D. (2006). The power of testing memory: Basic research and implications for educational practice. *Perspectives on Psychological Science*, 1, 181-210.
- Rosenlicht, N., Maloney, T., and Feimberg, I. (1994). Dream report length is more dependent on arousal level than prior REM duration. *Brain Research Bulletin*, 34(2), 99-101.
- Schredl, M., & Doll, E. (1998). Emotions in diary dreams. *Consciousness and Cognition*, 7, 634-646.
- Shapiro, A., Goodenough, D. R., Lewis, H. B., & Sleser, I. (1965). Gradual arousal from sleep: A determinant of thinking reports. *Psychosomatic Medicine*, 27, 342-349.
- Solms, M. (1997) *The Neuropsychology of Dreams: A Clinico-Anatomical Study*. Mahwah: LEA.
- Solms, M. (2000). Dreaming and REM sleep are controlled by difference brain mechanisms. *Behavioral and Brain Sciences*, 23, 793-1121.
- Wagenaar, W. A. (1986). My memory: A study of autobiographical memory over six years. *Cognitive Psychology*, 18, 225-252.
- Wolcott, S., & Strapp, C.M. (2002). Dream recall frequency and dream detail as mediated by personality, behaviour and attitude. *Dreaming*, 12(1), 27-44.
- Zimmerman, W. B. (1970). Sleep mentation and auditory awakening thresholds. *Psychophysiology*, 6, 540-549.

Appendix 1 – Dream Template

Please could you fill this template, recalling as much information as you can from your last dream.

Date:
Time:

Setting:

Dream Description

Last night I dreamt that...

(N.B If there is not enough space here, please feel free to continue on a separate piece of paper)

Now, please complete a few questions relating to your last dream.

1) Do you feel confident you have been able to remember the entirety of this dream? (please tick your response)

- A. Yes, I can remember all of the details of this dream
- B. I can remember all the events from the end of the dream, but the beginning is unclear
- C. I can remember most of the events, but not in detail
- D. I can remember only a little detail
- E. I can't remember anything about the dream, I only have a vague recollection that I did dream

Please circle your response

2) How would you rate this dream in terms of personal importance?

1	2	3	4	5
Insignificant				Important

3) To what degree would you rate the following aspects in relation to your dream?

A. Bizarreness (i.e. unfamiliar, strange, or incredible scenes and actors)

1	2	3	4	5
Minor				Dominant

B. Vividness (i.e. visual, descriptive, and experiential detail)

1	2	3	4	5
Minor				Dominant

C. Activity (i.e. whether the dreamer was observing, participating in, or dominating dream events)

1	2	3	4	5
Minor				Dominant

D. Positive emotionality (i.e. a pleasant or joyful dream atmosphere with happy endings)

1	2	3	4	5
Minor				Dominant

E. Negative emotionality (i.e. life-threats, persecution, and frightening characters)

1	2	3	4	5
Minor				Dominant

F. Narrative coherence (i.e. meaningfully related scenes without shifting actors and events)

1	2	3	4	5
Minor				Dominant

Appendix 2: Dream recall questionnaire (please tick your response)

1) On average, how often do you experience a dream?

- A. Daily
- B. Once or twice a week
- C. A few times a month
- D. A few times a year
- E. Never

2) How frequently do you remember your dreams?

- A. Daily
- B. Once or twice a week
- C. A few times a month
- D. A few times a year
- E. Never

3) How long after waking can you remember your dream?

- A. Only for a while, the memory of the dream fades rapidly
- B. An hour or two, I usually forget the dream by mid-morning
- C. Usually until late afternoon I have some recollection of my dream
- D. I can remember my dreams days after they have occurred
- E. I can still remember dreams weeks after they have occurred

4) How much of any particular dream do you think you remember?

I can remember...

- A. All of the details of my dreams
- B. All the events from the end of my dreams, but the beginning is usually unclear
- C. Most of the main events, but not in detail
- D. Only little detail
- E. Nothing about my dreams, I only have a vague recollection that I did dream

5) Do you tend to have dreams that are associated with extreme emotions?

- A. Yes, frequently
- B. Yes, occasionally
- C. A few times a month
- D. Once a Month
- E. A few times a year/never

6) Do you dream especially intense or clear dreams?

- A. Yes, frequently
- B. Yes, occasionally
- C. A few times a month
- D. Once a Month
- E. A few times a year/never