8014972

KUTE, SAM

INCORPORATION OF CONDITIONED STIMULI DURING REM SLEEP

City University of New York PH.D. 1980

University
Microfilms
International 300 N. Zeeb Road, Ann Arbor, MI 48106 18 Bedford Row, London WC1R 4EJ, England

INCORPORATION OF CONDITIONED STIMULI DURING REM SLEEP

by

SAM KUTE

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requrements for the degree of Doctor of Philosophy, The City University of New York.

1980

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

January 7, 1980
date

Chairman of Examining Committee

January 10 1980
date

Executive Officer

Prof. H. Krauss

Prof. A. Arkin

Prof. J. Antrobus

Supervisory Committee

The City University of New York

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Throughout the ages man has been interested in uncovering the meaning of his dreams. Beginning with the early Egyptians, various cultures have attempted to systematically derive a meaning for the relationships among people, objects, and events in the dream. Dream interpretation has been the domain of the soothsayer, priest, wise man, and more recently, clinician.

The most complete and creative system of dream interpretation grew out of the psychoanalytic framework of Freud (1900a). For Freud, the dream is a disguised fulfillment of a wish, and a product of the system Unconscious (Ibid., p. 160).

According to his theory wishes which are fulfilled in dreams have four possible origins; "namely, (a) wishes aroused during the day but left unfulfilled. . . ; (b) wishes which were aroused during the day but were repudiated and repressed, . . . ; (c) wishes belonging to the unconscious and incapable of passing beyond it; (d) wishes arising during the night stimulated by bodily needs"(Nagera, 1969, p. 23).

Independent of the origin of a wish, all wishes receive their motivating energy (psychic) from the system Unconscious, which Freud defines as never clearly revealed to the conscious mind. More specifically, the dream's surface structure, its manifest content, is a disguised elucidation of underlying, latent dream, wish fulfillments. The process by which latent dream wish fulfillments are transformed and combined to form the manifest dream content, is termed the "dream-work".

The Freudian system of analysis for dream interpretation processed the content of the dream within a unique cognitive processing framework. That is, the information stored in long term memory (LTM) that generated the content of a dream was analyzed and interpreted by processes which were uniquely operative for a subject while sleeping. Freud (1900 A) states it this way; "The dreamwork is not more careless, more irrational, more forgetful and more incomplete than waking thought, it is completely different from it qualitatively and for that reason not immediately comparable with it. It does not think, calculate or judge in any way at all; it restricts itself to giving things a new form." The assumption is that the same information, content, would be generated (and therefore interpreted) differently if the subject were awake. More specifically, the information processing systems of man were, for the psychoanalytic school, divided; one system analyzing and defining the mechanisms of experience for the wakeful subject, the other for the sleeping subject.

The proposed project is designed to test a new model being developed by Professor John Antrobus, in which thought and imagery are generated during stage-1 REM (Rapid Eye Movement) sleep. In information processing terms, it is a model which describes the cognitive processes which generate the "perception of a dream in the absence of an appropriate waking context" (Antrobus, 1977).

The following theoretical description is taken in large part from Professor Antrobus's works entitled "The Dream as Metaphor: An Information-Processing and Learning Model (1977)".

To begin, the model defines the content of the dream as standing as a metaphor for a similar set of attributes in a waking context. These attributes of events stored in LTM can be metaphorically transformed to be consistent with the context and therefore content of the ongoing dream.

For example, in the hypothetical dream mentation report: "My family was in the living room talking about our up-coming vacation. Then all of a sudden, my best friend Doris asked me when I was going on my honeymoon". Stimulation of common LTM attributes and features related to the word "family", in the first sentence, might include concepts such as "closeness, friendliness, confident" among others. Similarly, "talking" might activate concepts such as "asking, questioning, or speaking", while "vacation" might evoke "travel or leisure" among others. Therefore, within the context of the first sentences "family-talking-vacation" associative metaphors of common features and attributes could lead to the construction of the second sentences "best friend Doris-asking-honeymoon". In this case, "best friend Doris" shares common features with "family", "talking" with "asking", and "vacation" with "honeymoon".

The preceding example is an oversimplification of the complex processes involved in the dream-metaphor model and serves merely as an illustration. A more complete examination of the processes involved will follow.

Before defining and discussing the use of the metaphor in sleep, a discussion of information processing and learning models will follow.

The idea of nodal attribute storage for perception and memory is not a new one and can be seen in many contemporary theories of information processing (Norman &

Rummelhart, 1970; Anderson & Bower, 1973; Shiffrin & Schneider, 1977). It is the attempt of this dissertation to bring the REM sleep experience within the models designed to explain wakeful information processing.

As Antrobus (1977) states, it would be useful for the "dream-metaphor" model to be expanded within a current theory of information processing. For this reason, Norman and Rumelhart's (1970) System for Perception and Memory will serve especially well for conceptualizing the information processing mechanisms which generate stage-1 REM sleep.

The process of perception is begun with the transformation of physical energy into a neuronal sensory signal of some form. That sensory signal is scanned for pertinent features or attributes and compared with stored LTM sets of relevant features and attributes. As in the Deutsch and Deutsch (1963) approach these sets of relevant features and attributes are selected for further processing by a mechanism called "pertinence", which assigns a value and designates the order of further processing. Finally, the systems derive an identification, "name", for the original stimulus. Selfridge's (1959) Pandemonium model is an earlier more simplistic, feature recognition theory. In the Selfridge model cognitive demons, conceptual demons, and data or image demons recognize patterns of weighted visual features for eventual identification. The LTM-concept sets of features and attributes which comprise the list to be scanned, naming dictionary, have been learned through a history of discriminative learning situations in the individuals' life. The concept sets refer to the pool of shared features and attributes which any and all members of that concept have in common. The "name" response implies the concept class label given to that specific attribute concept set.

Norman and Rumelhart (1975) describe the system as " . . . an active 'structural' network. The word 'active' means that the structures are both data and process. The knowledge structures are represented by a labeled, connected network or graph that consists of a set of 'nodes' interconnected by a set of relations. Each relation is an association between two nodes and has two important properties: it is labeled and it is directed"(Ibid., p. 35). For the purpose of the dream-metaphor model and the "name" (node) response label includes both verbal and nonverbal descriptors of both physical and or affective stimulus properties.

As Antrobus (1977) states:

> In order to expedite this complex feature extraction process, the operations may be 'conceptually driven' (Norman, 1976). That is, features and attributes which are compatible with the 'expectations' of the central processor are given higher priority for processing. Within sleep, this conceptually driven process would presumably run free of any constraints from external stimuli and the sensory features portion of the perceptual system.

This "expectation", pertinence rating relationship is prescribed in large part by the context in which a stimulus is presented. The term "context", though, "is a rather arbitrary word which may describe an external stimulus in spatial or temporal proximity to the stimulus to be named" (Antrobus, 1977). Context, however, may also designate an ongoing perceptual event, as a batter in baseball being called "out" after missing a pitch, only if he has two strikes already. In this case, the perceptual stimulus, a batter swinging at and missing the ball, could be virtually the same on each preceeding swing. Each swing and miss would serve as the context from which the meaning (name) of the next swing could be understood (strike one, two, or three).

The dream-metaphor model relies heavily upon the effects of context and expectancy which have been demonstrated for waking perception.

The question of how the recent past affects the organization of visual stimuli was first answered in two classic studies. First, Carmichael, Hogan, and Walter (1932) demonstrated that subjects would reproduce ambiguous visual stimuli so that they would be consistent with the verbal context in which they were initially presented.

Second, Leeper (1935), using his famous "wife/mother-in-law" figure, demonstrated that he could easily influence his subjects' perception of his ambiguous figure by first showing a biased version of it. This occurred after he had not been able to influence their perception by a preliminary verbal description.

Following in the same line Bugelski and Alampay (1961), using their ambiguous "rat-man" figure (which without special pretraining is generally seen as "the man") showed several pictures of animals to their subjects before exposing the "rat-man" figure. The subjects who had received this preliminary exposure generally then saw the rat.

A direct influence of context and expectancy upon attribute or feature selection can be observed in the work on computer analysis of handwritten letters and words devised by Eden (1962), and Eden and Halle (1961). Inherent in the grammatical rules of language, "a knowledge of possible or probable words can be used to control the order in which various tentative synthesis will be explored. Having already constructed coi-, the program would try N rather than M, or L rather than K" (Neisser, 1966, p. 102).

A fifth finding on the importance of context and expectancy on the perception of words was demonstrated by Tulving and Gold (1963). Their subjects would complete sentences like: "Far too many people today confuse Communism with _ _ _ _"; with "Socialism", more often than "raspberry", when shown possible solution words tachistoscopically.

Bransford and Johnson (1973) demonstrated that the meaning of a visual stimulus is transformed by changing the context in which it was seen. "One stimulus shows a young woman running for all she is worth; the next shows the same stimulus in the context of a man running after her -- apparently with amorous intent; the third picture adds a large bear running immediately behind the man" (Antrobus, 1977).

Although I have stressed the effects of visual context and expectancy on perception there is ample evidence demonstrating similarly significant effects for audition, as the following review demonstrates.

Miller, Heise, and Lichten (1951) reported on the importance of auditory context, when within a noisy background, their subjects were able to identify whole sentences with much greater accuracy than separate words. Also, when their subjects were given a list of possible words (a knowledge of the restrictive pool) their performance was again improved.

Indeed, the expectations for particular words or phrases following a given context are significant contributors for the listener as Denes (1963, p. 892) emphasized:

> . . . the acoustic characteristics of the sound to be produced do not identify a particular phoneme uniquely and the listener resolves the ambiguities of the acoustic signal by making use of his own knowledge of the various linguistic and contextual constraints mentioned above. The large part that is played by these nonacoustical factors in the recognition of speech is best shown by the remarkably small loss of intelligibility produced by quite serious distortions of the speech wave.

This point is well known by anyone who has traveled through the various regions of the United States. Regional dialects which initially sound almost undecipherable become understandable after a short period of exposure. This could be due to the above mentioned (Denes, 1963) ability of the individual in the "making use of his own knowledge of the various linguistic and contextual restraints" of the language.

Interesting to note, is Miller *et al.*'s (1950) classic demonstration that higher-order approximations to English are more easily identifiable (tachistoscopically) than lower order ones. Approximation to English is a phrase used to describe word-to-word contextual determination. If the word-to-word relationship was a zero order approximation the contextual determination would be random. Alternately, second order approximations are created when one word serves as a context for which the next word is chosen. Obviously, the higher the order of approximations to English the more closely the relationship between the words resembles the English language. Finally, Reynolds and Flagg, (1977, p. 243) note that "grammar gives an organization to language that is not present in a string of unrelated words". Thus, the context and structure of language offer both visual and auditory cues to understanding.

Having briefly described some of the effects of context and expectancy on waking perception, the dream-metaphor model incorporates several of these findings. It suggests that when some features or attributes in one context are preserved in the next, the new event may be seen as metaphor of the original event.

A metaphor can be defined simply as, taking a word that usually denotes one thing and using it to describe another that it literally does not describe, as in "Juliet is the sun" (Skinner, 1957, p. 97). For a complete review of the psychological literature on metaphors see Billow (1977).

The relationship between a metaphor and word or phrase it substitutes for "is not arbitrary but based on a point of resemblance between the substituted word or phrase and its reference which is either stated or implied by the sentnece as a whole" (Billow, 1977, p. 82).

Metaphoric extension though is not limited to similar "physical" properties of stimuli alone. Skinner

(1957) believes that the relationship between a metaphor and that which it is substituting for, can be physical, affective, or ideational. For example, in the sentence "He was a skyscraper"; the physical stimulus property of great size or height is the associative metaphoric link between the person and a building.

Skinner (1957) writes:

> Sometimes a genuine extension seems to occur when no similarity between stimuli expressible in the terms of physical science can be demonstrated. There are several possible explanations. Two stimuli may have a common effect upon the responding organism, which mediates the extension of the response. In the example JULIET IS THE SUN, it is possible that a physical similarity could not be plausibly established. Only to Romeo did Juliet glow with the light of dawn. The metaphorical extension might have been mediated by, say, an emotional response which both the sun and Juliet evoked in him.

It would be plausible then, that if while Romeo dreamt, the sun appeared, so too might Juliet. In the context of sun, nodal activation of Juliet would also take place, for in the learning history of Romeo, "Juliet is the sun".

Following in the logic of metaphorical extension, Romeo while dreaming of "day time", might produce Juliet and not the sun in the sky; as they both share the similar features and attributes of warmth and "the light of dawn" (above). During waking perception it would indeed seem bizarre to Romeo to see Juliet floating in the sky defying the laws of Newton. Within the confines of REM sleep metaphorical extension allows for seemingly implausible relationships to be created in sequential dream episodes within particular contextual stimulation of common features and attributes. More will be said about this property of metaphorical extension shortly.

Brown (1968) has suggested a response or reaction similarity as a basis for metaphor. A similar sensory experience (response) "COLD" might occur from ice, certain faces, and a kind of voice. If someone is "hot on your trail", their emotional stimulation might cause an increase in heart rate and blood flow, and an increase in body temperature. The proprioceptive cues might not become apparent to the central processor during the "heat of pursuit" as the demands of catching the adversary receive greater nodal stimulation, but may, during REM sleep, serve as metaphoric extensions in the appropriate context. As Skinner (1957) states, the extended metaphorical tract "frees the properties of objects one from another, and thus makes possible a recombination which is not restricted by the exigencies of the physical world". Thus, the metaphor could find greater expression during REM sleep.

Brown (1968) pointed to the intersensory capacity of the metaphor, as in the opera was "dry". Billow (1977) states that similar "to the learning theorists, psychoanalysts stress the hypothetical, empirical or experiential bases of the metaphoric transference. A live metaphor reveals a past forgotten experience and . . . this was originally a psycho-physical one" (Sharpe, 1968, p. 156).

Finally, Skinner (1957) states "Metaphorical extension is most useful when no other response is available. In a novel situation to which no generic term can be extended, the only effective behavior may be metaphorical". If then Romeo dreamed of Juliet "floating" in the sky, this "novel situation" serving as a contextual base for which the succeeding dream episode evolves would, according to Skinner, make use of metaphorical extension in the construction of the subsequent dream episode based upon common features and attributes. The new dream episode could possibly depict Romeo flying hand in hand with Juliet in the sky.

Returning more specifically to the dream-metaphor model Antrobus (1977), citing Bransford and Johnson's (1973) study, suggests: "To say that the young woman was 'running for her life' would be an accurate interpretation of her behavior in the 'bear' context, but a metaphoric interpretation in the 'man' context."

It is important to note that the metaphorical extension is not abstracted through some obscure cognitive process but instead, "the attribute model says that the features, attributes, and higher order characteristics have already been employed in the original perception and in memory storage of the event represented in the dream" (Antrobus, 1977). That is, the discriminative pertinent features and attributes of the original waking perception are the pool of nodes employed for the metaphor. As mentioned in the previous discussion of the metaphor, the discriminative pertinent features and attributes of the waking perception are not limited to the physical characteristics of the original stimulus. They include affective, physiognomic, and various ideational notions relating to the particular experience. In this way the metaphor can be constructed from either the encoded LTM dictionary or an episodic feature, attribute, event list, depending upon the mechanisms employed by the central processor during the initial stimulus evaluation.

Antrobus (1977) makes this point clearly.

> . . . the salient attributes of an event may be stored in episodic memory. A patient awaiting surgery may identify surgery primarily in terms of a few, personally relevant attributes such as fixing something which is malfunctioning, avoiding death, or simply, cutting. In these cases, the most salient attributes may, in effect, function as alternated names for surgery, especially so when the context makes additional attributes unnecessary. In the hospital context, cutting can mean only one thing!

Situational specificity creates unique opportunities for metaphoric construction. As stated by Skinner (1957) previously, "In a novel situation to which no generic term can be extended, the only effective behavior can be metaphorical". The metaphor may also serve as the most precise attribute descriptor of a waking perception as "a language without polysemy would require mental storage of a tremendous stock of words, with separate names for each possible subject. From a semantic point of view, then, the verbal device supplies a language with flexibility and expressibility" (Billow, 1977). For example, the concept "running", is excited differentially for the politician and a drill press operator, a golfer putting, or a stocking worn by a woman, each having its own specific affectional and ideational associative connections. The sudden anguish of a woman, having discovered a "run" in her stocking, or the golfers anticipatory anxiety as he contemplates "running" the ball up to the cup, share in the metaphor according to their individual learning histories. Each therefore would have a different set of associative nodes stimulated to "running".

As Antrobus (1977) stated, the memory storage units for attribute, feature, or episodic events, for the dream-metaphor model, can be subsumed within several contemporary models of memory. "Simple associative connections between features may be represented by a node, several such nodes may, in turn, be connected to other nodes in increasingly complex networks to represent attributes, concepts, events, and episodes (Kaneff, 1972; Norman & Rumelhart, 1970; Rumelhart, Lindsay & Norman, 1972; Shiffrin & Schneider, 1977)".

The following from Antrobus is illustrative:

> Consider the front door of your apartment or house. It may be represented by a single node connecting the two nodes, door and front, and is in turn, connected to such nodes as house, indoors, outside, etc. Although the nodes door and front may stand alone as concepts, they function as attributes for the purpose of creating the concept front door. Similarly, a node connecting door and back defines the back door. Thus, house stands as a context for front and back; front and back are contexts for door. Additional attributes such as public and visitors are connected to the front door node, but not to the front node. By contrast, the back door has become a pejorative metaphor for private and undesirable. A given node, then, may function as attribute, context, concept and so forth according to its relation to other nodes. Within this model, a node is active when its immediate connections to other nodes are active. Being active says that the node information is in short-term memory, has a short retrieval latency and is in that sense available for processing. Further if its perceptual feature nodes are active, the node has the properties of 'consciousness' (Shiffrin & Schneider, 1977). If its sensory nodes are active, it has the properties of sensory imagery.

The learned responses to stimuli in the environment activate appropriate stored nodal connections based upon the features, attributes and episodic events in the particular contextual setting.

The central processor chooses from the variety of "potential" responses (through either a "pertinence", Norman, 1968, 1969; "focal attention", Neisser, 1967; "filtering", Broadbent, 1958, 1971; or "short-term store", Shiffrin, 1975) that node response which fits the demand characteristics.

Antrobus, Singer, and Fortgang (1970) have shown that when the demands on the central processor are low, the processor continuously generates images, fantasies, and thought; "Since the context of the original event may be available less often during REM sleep than during wakefulness or other sleep stages, metaphors should be constructed more frequently in that sleep stage" (Antrobus, 1977).

During REM sleep the neuronal source for which new information is processed, are the nodes which have been stimulated by the ongoing dream context. As there are extremely lowered levels of motor activity during REM sleep the central processor chooses from the dream activated nodes, those which are contextually relevant to form the next dream episode. Antrobus (1977) sums it up this way:

> Because of the high sensory thresholds during REM sleep (Williams, Hammack, Daly, Dement, and Lubin, 1964), the only context available to the system is the preceding dream itself. That is, any new information is processed against the background of what is currently going on in the dream.

It is not necessary, as is also the case in "waking" perceptual models, for all features and attributes, of activated nodes, to become fully imagerized, or recognized. During waking perception only those nodes which are relevant to the needs of the central processor become highly activated to form images, or recognition. Other stimuli in the perceptual field are either filtered out or ignored, based upon the information processing constructs previously mentioned, i.e., "pertinence", "focal attention", and the rest. Faced with the problem of adding 2 + 2 = ?, one need not recall other interconnective nodal mathematical strategies, although they no doubt receive some associative stimulation.

Antrobus's (1977) dream-metaphor model makes the point as follows:

> Since, in perception, the context may strongly imply the item, the item node may be activated even before the feature nodes. Similarly, in dreaming one may generate a vivid visual image of a person or object before establishing its identity. In some cases the image and identity do not even match: 'my sister, but she was a boy.' From the viewpoint of this model, the initiating stimulus for the dream image could come from a node at any level from feature to

> complex concept including those interpersonal and situational patterns which are the subject matter of the clinical interpretation of dreams. The ability to interpret significant personal characteristics from the dream obviously implies the latter stimulus source, but this remains an empirical question.

Interestingly, what have been called bizarre or illogical dream mentations can be understood within the broader dream-metaphor model which allows for a greater use of metaphorical extension than would occur during waking perceptual processing.

During sequential node activation, lowered demands upon the central processor (as compared to waking perceptual processes) allow for the greater use of the metaphor in constructing new dream episodes, possessing some of the features and attributes from the previous, or ongoing dream context. For example, if while I am awake and lying in bed, I decide to get something to drink, I would have to get up from bed and walk into my kitchen. This, of course, would take time. I might not be able to find my slippers, the telephone might ring, or I could be out of vodka. The wakeful demands upon the central processor are well known to many a thirsty sleep researcher.

Instead, if I were dreaming this same desire, I need not, as the dictates of time and space demand while awake, find my slippers or walk to the kitchen, for as

Skinner (1957) has already stated the metaphorical tract "frees the properties of objects one from another, and thus makes possible a recombination which is not restricted by the exigencies of the physical world." With activation of the "thirst" node, while lying in bed, I might suddenly find myself in my favorite bar in Paris drinking to my heart's content. As this would not be possible while awake, the central processor would reject it (drinking in Paris) as a possible solution to "thirst" node activation and therefore "Paris" might not reach recognition threshold. During REM sleep though my favorite "thirst" reducing place (Paris bar) would become imaginable due to its high affectual associative node relationship. In this way seemingly incongruous (in terms of waking perceptual processing) combinations of features, attributes, and events can be formed during REM sleep.

The oftimes cited dream experience of "flying" could be explained as a metaphoric node activation of feeling "high" or "powerful" in an appropriate context, or as already hypothetically derived in our example of "Juliet is the sun". Such drastic alterations of wakeful time/space experience may be resultant from metaphoric associative node stimulation and not confined to the limitations of wakeful time/space relationships. I need (and can) not take a six,-clock,-hour, plane ride to be in Paris during REM sleep.

Issues such as the above just mentioned, obviously await a great deal of experimental validation. They served as a demonstration of the theoretical capacity of the dream-metaphor model to encompass the varied aspects of the REM sleep information processing activities.

My experience of the logical order of dream mentation reports is that they fit more closely to the order of events in waking perception than to the bizarre or improbable combinations previously stated. This is consistent with both the dream-metaphor model and the theoretical information processing models previously discussed. The distance between interconnective nodes would be a function of the frequency of experience, in the discriminative learning history of the individual. Frequent nodal activation would decrease the internodal distance and increase that internodal activation. The contextual effects on the central processor would stimulate various interconnective nodes as a probability function, determined by the forementioned learning history. A precise elucidation of the internodal space among concepts has been devised by Shepard (1962). Her system "showed that (1) if concepts in memory are stored in a multidimensional metric space and (2) if similarity judgments are made on the basis of Euclidian distance in such a space, then the space can be accurately reconstructed from a set of similarity judgments" (Rumelhart, 1977, p. 224). Henley (1969), applying the system developed by Shepard, deduced the varying distances among common animal terms.

Incorporation of External Stimuli Into Sleep

In an interesting work, McKensie (1965) cites numerous examples of early dream research containing evidence of external stimulus incorporation into dreams. These reports of incorporation are fascinating and have maintained the curiosity of researchers for many years. Unfortunately, they do not meet the criteria defined by today's scientific methodology, specifically those of experimental validation of REM sleep. An extensive review of experimental literature pertaining to incorporation can be found in Ramsay (1953), with a more contemporary review to be found in Arkin, Antrobus, and Ellman, (1978).

Dement and Wolpert (1958) were the first researchers to utilize electroencephalographic technology to systematically study the effects of external stimuli on REM sleep. Subjects were presented with either a 1000 Hz. tone, a series of flashing lights, or a spray of water to the skin during stage REM. The researchers attempted to apply the stimuli below waking threshold, in which case the subjects would then be awakened by a loud bell. Mentation reports would be elicited and evaluated for evidence of: (1) unambiguous incorporation of the prewakening stimulus to an ongoing dream; and (2) modification of ongoing dream content in some recognizable manner. Following the spray of water, which was the most effective stimulus for incorporation, a subject reported that someone was "squirting him". An example of a modification of ongoing dream content is apparent in subjects reportings of a "leaking roof" or "sudden rainfall". To the 1000 Hz. stimulus tone, a subject reported being frightened by a roaring sound. To the flashing lights stimulus, subjects reported modifications such as seeing shooting stars, a sudden fire, or a flashlight shining into his eyes.

Although the overall percentage of stimulus incorporations, 24% of 98 tests, with an additional 12% for modified incorporations, was not very high, this initial study demonstrated that external stimuli can be incorporated during REM sleep without the subject awakening. Also, that the stimuli to be incorporated were perceived by the subject as similar to the waking perception of the same stimuli (similar node activation) or that perceptions were transformed to fit into the context of the ongoing dream. This would be consistent with the dream-metaphor model.

Citing work of his students, Dement (1972), has summarized the following results on the effects of external stimuli on dreams. Tape recordings of 12 familiar and evocative sounds such as a locomotive, a dog barking, a rooster crowing, a bugle playing reveille, and a speech by Martin Luther King, Jr., were played to subjects about 10 seconds after REM onset (at a subawakening threshold level). The locomotive stimuli was the most effective stimuli for incorporation (proportion unknown). In contrast with his previous study, 56% of the auditory stimuli produced incorporation of some kind.

Baldridge *et al.*, (1965, 1966) have published preliminary findings on the effects of thermal stimulation on dreams: Incorporations occurred on 25% of the stimulus presentations. Examples include a dream containing a reference to getting food from a refrigerator following cold skin contact, and a dream referring to a warm day following a warm stimulus. In addition, the effects of kinesthetic stimuli produced incorporation of motion into sleep mentation. More specifically, the mentation reports included dreams of falling, flying and riding a motor scooter. Once again, though, the percentage of incorporations was relatively low.

Koulack (1969) utilized percutaneous electrical stimulation of the wrist during sleep in order to monitor stimulus incorporation. He excluded from the main analysis all stimuli associated with any index of possible awakening, such as EEG alpha frequencies or body movements. Stimulation was applied during REM sleep under various temporal conditions followed by awakenings for mentation reports. Electrical stimulation of the wrist was performed under various time intervals into REM and awakenings were made after various predetermined time intervals after stimulation.

The focus of interest was whether the somatosensory electrical stimulus would produce direct and/or indirect stimulus incorporations into the ongoing dream. Koulack defined direct incorporation as "some sort of direct representation of the stimulus situation in the dream;" whereas indirect incorporation included events suggestive of the stimulus situation. He found that each stimulation situation occasioned significantly more direct and indirect incorporation than occurred in the control condition (without stimulation). Various stimulation conditions did not produce differential outcomes, which suggests that neither time into REM for stimulation, nor time of awakening after stimulation significantly alter incorporation rates. However, direct incorporation was more likely when associated with alpha bursts.

Berger (1963) performed one of the most significant studies on the experimental modification of dream content by meaningful stimuli. He attempted to determine whether verbal stimuli, tape recordings of four personal first names, would be incorporated into ongoing dream content. Also, whether the frequency of incorporation was related to the level of emotional significance of the auditory (semantic) stimulus to the subject. Two stimuli were predetermined to possess high emotional content. The other two stimuli were designed for emotional neutrality, being matched for number of syllables but having high phonetic contrast (so as to be highly discriminable).

Berger (1963) concluded the following. First, that "perception of the external world, be it impaired, does occur during REM periods associated with dreaming." Second, that a stimulus name incorporated into a dream event, "frequently occurred as a series of words composed of assonant vowels and consonants," and "as a type of auditory Gestalt of parts or whole words spoken in succession." Finally, when a stimulus is incorporated, varying degrees of transformation can take place.

Several years later, Castaldo and Holtzman (1967, 1969), employing a technique similar to Berger's, reported that subjects after incorporating recordings of their own voice, contained dream content in which they were active, assertive, and independent. Stimulus intensity was sufficiently high to produce EEG evidence of registration, but not intense enough for awakening. An interesting aspect of the study was the types of incorporations made by the subjects. "The dreams contained varying degrees and kinds of stimulus incorporation in which repetition of content elements, condensation, and assonance were common forms of response" (Arkin, Antrobus, and Ellman, 1978).

The above mentioned studies have established that external information can be incorporated into REM sleep, and that the external information may be transformed while being incorporated into the ongoing context of the dream. Also, that the type of incorporation that takes place may either be direct, preserving the attributes and features of the original stimulus, or indirect, transforming the original stimulus so as to be consistent with the ongoing dream content. These findings offer further support for the dream-metaphor model insofar as the external stimuli were often transformed and incorporated within the contexts of the ongoing dream episode.

A serious methodological issue concerns the low and variable percentage of incorporations of the foremen- tioned studies. The present study is designed to improve the rate of incorporation by the use of an avoidance con- ditioning procedure. Given the success of avoidance con- ditioning in experimental studies it is expected that an increase in incorporation of conditioned stimuli will oc- cur through the use of an aversive condition. Also, that the incorporated stimulus will have a "magnified resis- tance to extinction" (D'amato, 1970, p. 359) which is a phenomenon that has been demonstrated on numerous occa- sions (Solomon and Wayne, 1964, and Underwood, 1966, p. 441).

The following studies lend support to this ap- proach.

Conditioned Incorporation of Stimuli

Weinberg (1964) has shown that "responses of a simiple unitary nature may be conditioned during sleep". A manual switch closure response was discriminatively conditioned to a correct tone.

Beh and Barratt (1965) "attempted to build in" stimulus significance during wakefulness by means of conditioning, and to test for discrimination of the stimulus during sleep." Subjects were to make a differential response to two (2) tonal stimuli, one of which was paired with a painful electric shock. After a learned response to the significant tone had been accomplished, Ss were then tested for discrimination between the two tones during Stage II sleep. Statistical analysis revealed a significant differential level of response to the learned stimuli. In the second part of the experiment the authors demonstrated, using a similar conditioning technique, the ability of Ss to make learned responses to tones (during Stage 2 sleep) which had previously held little significance for them. Also of interest to note was the ability of the Ss to make the learned response upon awakening. This demonstrated that stimulus significance "built in" during sleep appears to carry over to the wakening state and serves to demonstrate the effectiveness of learned responses in resisting extinction.

Williams, Morlock & Morlock (1966), using an operant avoidance technique, found a significant increase in responding to a critical tone (that tone, for which a response failure produced the aversive consequences) during sleep. One aspect of the experiment employed the use of two tones, each tone serving as the neutral or critical stimulus, depending upon presleep instructions. Conversion of a neutral to a critical tone produced the largest significant increase in responding during stage REM. Williams et al. (1964)

also demonstrated that although Ss are sometimes quite unresponsive to stimuli during stage REM, the application of an operant avoidance technique to the stimuli can alter the meaning of those stimuli so that a significant increase in the level of response takes place.

Finally, results from our own pilot experimentation seem to further demonstrate the usefulness of an operant avoidance technique for the incorporation of meaningful stimuli during stage REM sleep, as evidenced by our resulting REM mentation reports.

Subjects were instructed to select one out of eight possible classes of visual stimuli in the presence of an appropriate auditory stimuli. The eight sets of visual stimuli were pictures depicting combinations of three binary elements: i.e., knife-rope, help-harm, person-tree, (knife helping person, one combination). Each of the eight pictures was presented by a series of three tones, each tone representing one of the three elements. Subjects were asked to identify the proper visual stimulus (by manually advancing a carousel slide projector) within 15 seconds of the binary auditory tones presentation. An incorrect selection of the visual stimuli produced the aversive condition, a continuous white noise blast of 85 decibels, which remained on until the S selected a correct visual stimulus. During stage

REM one of the three binary tone combinations was presented. This occurred without the subject awakening. Upon experimental awakening, a significant level of stimulus incorporation was found to exist appropriate to the particular binary tone presented during the preceding stage REM.

Although no S received all conditions in the pilot, several examples of the types of incorporation by Ss during the pilot experiment were: To the stimuli "knife help object", a S reported, "I was cutting a pie with a knife". To the stimuli "knife harm person", a S reported, "Somebody stabbed and killed somebody to get insurance. This man was going after his wife because of the insurance". To the stimuli "rope hurt person", a S reported, "...it was hanging a person. He said you're not going to be using it anymore because you're not going to remember those dreams. So I said that what else are you going to use? He said we're going to use a tone and a color and I'm going to have three things".

The operant avoidance technique seems best suited for the incorporation of external stimuli into REM sleep. It offers the experimental control of particular content, specific node activation, into ongoing dream processes. Also, the high motivational components of avoidance conditioning can be maintained while the subject remains sleeping.

This would offer a significant advantage over a positive reinforcement paradigm. If a positive reinforcement paradigm were employed, the presentation of a reinforcing stimulus following the subjects response (incorporation of condition stimuli) would be essential in order to offset the effects of extinction. The operant avoidance technique does not require the presentation of a reinforcing stimulus in order to maintain its high motivational components.

The present study seeks to incorporate two particular concepts, namely, "running" and "in need of help", by means of an operant avoidance procedure. Then, alterations in ongoing dream content will be examined for either direct or indirect (metaphorical) incorporation from the obtained REM mentation reports.

The concepts "running" and "in need of help" were chosen for conditioning-incorporation for the following reasons. First, a pilot study, demonstrated their practibility. Second, and more importantly, the particular methodological approach employed will allow for a more complete examination of metaphorical, indirect, incorporation. More specifically, the concept of "running" will be chosen to include only those attributes and features of the motor behavior "running" (to go steadily by springing steps so that both feet leave the ground for an instant in each step, Webster's, 1969). The concept "in need of help" will include a variety of situations and events that depict someone or something "needing help" (for a more complete description see Method section). Nodal associative strength should be more specific in the "running" condition than the "in need of help" condition. Therefore, there should be fewer metaphoric transformations in the "running" condition than in the "in need of help" condition, but more direct incorporations.

Finally, as this dissertation seeks to offer validation for the dream-metaphor model, it seems appropriate to include a summation from Antrobus (1977).

> "If this model finds empirical support as a description of one form of information processing in dreaming, it may help us to formulate a more explicit model of the function of dreaming, and in turn, suggest a more complete model of information processing in dreaming. Within this concept of dreaming, it is the processing of the salient attribute which, if anything, might have functional value to the individual. Imbedded in a new context as a metaphor, an attribute may be processed by a different set of operations such as problem solving strategies which are free of the circular paths and dead ends associated with the processing of the event in its original context."

In conclusion, this dissertation attempts to offer a generalizable technique, in which experimental modification of dream processing can be used to help identify the cognitive activities involved in dreaming with the hope of formulating a more complete model of its function.

Method

Subjects

Five female and one male subject between the ages of 23 and 33 years participated in the study. All subjects received a preliminary interview so that a general determination of their verbal ability and sleeping habits could be made. A general description of the experiment and requirements for participation were discussed during the interview. All subjects were college graduates and were either receiving or had received graduate training of some kind. None of the subjects was presently under any medication.

One female subject dropped out of the study after the first night in the laboratory. This subject complained of difficulty sleeping with "wires attached to my head". No REM awakenings were performed on this subject who requested and was allowed to end her participation.

The remaining five subjects fully participated in all aspects of the study which included pretraining and four nights of REM awakenings. The experimentor attempted to perform four REM awakenings per night for all subjects.

Procedure

This experiment trains subjects to associate two classes of visual stimuli with specific auditory cues (two different tones). This training is achieved by an operant avoidance technique in daytime conditioning sessions. Then, during REM sleep, the auditory stimuli are presented and the subject is awakened shortly thereafter (45 seconds to 3 minutes) for a mentation report. This time interval is employed to allow each subject to emit 45 seconds of REM sleep subsequent to the presentation of the auditory stimulus which may effect the ongoing REM activity (This time interval was determined during pilot experimentation where S's post stimulus REM state activity varied within this range). It is assumed that the presentation of the tone stimulus will elicit the specific goal state for the subject who will, in turn, generate the images which satisfy the goal criterion.

I. Daytime Avoidance Conditioning Procedure

Each of the five (5) subjects received the following instructions:

I am going to play one of two tones, a high pitch tone and a low pitch tone, (the E demonstrates by playing each tone). When you hear the high tone I want you to advance the carousel projector, by pressing this manual switch to a slide depicting the concept represented by this group of slides (the E demonstrates by advancing the carousel through the series of five slides designated "training group H," which all depict the concept of "running"). As you can see every time you press the manual switch the projector advances the carousel one slide.

When you hear the low tone I want you to advance the carousel to a slide depicting the concept represented by this group of slides (the E demonstrates by advancing the carousel through the series of five slides designated, "training group L" which all depict the concept "In need of help"). Is that clear? When all questions are resolved the E continues: You will have fifteen (15) seconds, from the onset of the tone, in which to advance the carousel and find the appropriate slide class. The tone will continue playing as you are searching. Once you think you have found the correct slide concept match you will stop advancing the carousel. If you have matched the correct concept with the tone, and, have stopped advancing the carousel, a new tone will appear either high or low and the projector will automatically advance to the next slide.

You will then continue following the same procedure, with a new fifteen (15) seconds to find this new tone/slide concept match. Is that clear? (If the subject is confused the E may run through the procedure again starting with the presentation of the tones and slide training groups "H" and "L"). If, though, you are incorrect, that is, if you have either stopped at a slide which did not depict the correct tone/slide concept match, or if you have not found the correct tone/slide concept match in the alloted fifteen (15) seconds, this sound will appear (E presents 95 db. aversive white noise blast for ten (10) seconds) and remain on. If the sound appears it signals you are incorrect and you should continue searching until you come upon the next correct tone/slide concept match, and stop. If you are now correct the sound will stop, and a new tone will appear with a new fifteen seconds to find the correct tone/slide concept match. If, though, the sound does not cease after five (5) seconds of your most recent search choice it signals that you are still incorrect and should continue to search until you come upon the next correct tone/slide concept match, and stop. You will continue this procedure until I instruct you to stop. Are there any questions? The E will answer any questions pertaining to the understanding of the procedure.

For this daytime conditioning procedure, the subject layed supine in bed in the same room which was used for subsequent REM awakenings. The carousel projected the slides onto a screen placed at the foot of the subject's bed. In this way the slide image could be seen with the subject lying in bed. The room lights were turned off during the conditioning trials and the setting made to approximate as closely as possible the same conditions for which REM awakenings took place.

Each subject viewed 400 different slides from the carousel projector. Within the 400 slide sequence the two classes of conditioned stimuli, "running" and "in need of help," were randomly placed once within every ten (10) slides but no more than twelve (12) slides apart within each class. Also, the two concepts for conditioning never appeared consecutively either within or between class. Each subject then received 40 presentations of a "running" slide and 40 presentations of an "in need of help" slide within a 400 slide sequence. The remaining 320 filler slides depicted a broad range of concepts excluding "running" and "in need of help." The conditioning procedure continued for the entire set of 400 slides. Each subject was required to perform at least 20 consecutive correct (error free) searches on each of the conditioned concept classes on three separate sittings preceding REM awakening days and once on each REM awakening day. Each subject then received seven (7) conditioning sessions and perform at least 20 consecutive error free matches at each session.

A) STIMULUS SLIDES FOR CONDITIONING

The slides for the two concept classes "running" and "in need of help" were selected to represent a broad range of examples within each class. The "running" slides depicted people, young and old, alone and in groups, male and female; along with professional athletes running. Also included were various animals running such as horses, wolves, rhinoceros and lions. To ensure that each slide used in the conditioning procedure clearly illustrated the correct concept class five judges were asked to rank, on a scale from 0-5, where "0" indicated a poor, or no example of the concept, and "5" indicated an excellent example of the concept depicted in the slide. The five judges rated approximately 75 "running" slides and 75 "in need of help" slides. Only those slides which had a mean scale score of "4" or above and no individual score below "4" were accepted for inclusion into the conditioned slide group. The selection of the five slides used in the training groups "L" and "H" were also selected in this manner.

The slide condition "in need of help" depicted examples such as a man trying to push a stalled automobile, a woman not quite being able to reach a book on a shelf which causes others to topple, a man losing his balance on a table, an extremely malnourished child, and a man clutching his side in obvious pain and anguish, among others. The "in need of help" condition portrayed a broader range of features and attributes within the defined concept class. As opposed to "running," which could be defined by a relatively few number of features and attributes (to go steadily by springing steps so that both feet leave the ground for an instant in each step, Webster's, 1969) the "in need of help" concept class, being more abstract in nature, was defined by limiting the concept category to situations where the individual is "needing help" and not "being helped." For example, the slides illustrated individuals suffering obvious physical or emotional pain, individuals facing a problem or task that cannot be resolved or completed without assistance, and individuals either overtly or covertly asking for help. The set of features and attributes which defined the "in need of help" category can be viewed as implicit, while the "running" concept class, as explicit.

The remaining 320 filler slides were selected to control for all intervening and irrelevant variables portrayed in the conditioned stimuli slides of "running" and "in need of help." An effort was made to include in this group of slides the same persons, animals, places, and events as depicted in the conditioned set, excluding the concepts "running" and "in need of help." More specifically, if a slide used in the "running" condition illustrated an old man running across a field, a "filler" slide might include this same old man sitting or walking across the same field. In this way, the conditioning procedure could more specifically isolate those attributes and features which define "running" or "in need of help" and not any particular person, place or event related to the conditioned concepts for incorporation by the use of the aversive white noise blast to any "filler" slide selection.

The "filler" slides were selected from a larger pool of slides. Judges were asked to rate this pool of approximately 650 slides for the absence of "running" and, or "in need of help." Only those slides which received a score of "0," total absence of either conditioned concept, were accepted for possible inclusion into the "filler" set. The E then attempted to match all irrelevant, intervening variables appearing in the two conditioned concept slide sets with the "judged absence" filler set to form the 320 slide total.

B) AUDITORY STIMULI

The auditory stimuli associated with "running" consisted of a single high pitch tone of 750 hertz. The auditory stimuli associated with "in need of help" consisted of a single low pitch tone of 200 hertz. Both tones had one second duration and an inter-tone interval of 500 milliseconds. Both tones remained at a constant amplitude of 70 dB throughout the daytime conditioning session. There was a five second tone-off interval between each correct tone/slide concept match the subject makes. A logic relay programmed tape randomly presented the tone series and automatically advanced the tone when the subject made a correct tone/slide concept match.

II. Sleep-Awakening Procedure

The subjects were instructed to arrive at the sleep lab approximately one and one half hours before their usual bed time. Once they arrived the *E* proceeded to place recording electrodes. For the purpose of scoring sleep stages standard EEG placements, (Rechtschaffen and Kales, 1968): a left control and right occipital placements (C3, and 02) were used. Standard right and left outer canthi locations referred to linked ears were used for EOG recordings, and to each other for bipolar EOG. Submental electrodes were used to aid the scoring of stage REM sleep (Rechtschaffen and Kales, 1968). An additional mastoid electrode on the left side was employed as a safeguard for an additional reference site. After electrode emplacements the subject was taken to a sound attenuated sleep room where a presleep conditioning session of at least 20 error free tone/slide concept matches took place as described in the "Day Time Conditioning" section.

The sleep room, approximately 10 x 15 feet, is adjacent to the experimental room and employs a two way intercom system for communication. An 8 ohm microphone is above the head of the subjects bed along with a ohm speaker. The projector screen at the foot of the subjects bed remained throughout the night. A 45 dB background white noise was generated throughout the night.

All awakenings were made in Stage REM and employed the following procedure. At least 30 seconds after the onset of Stage REM, determined by standard two-out-of-three criterion system (Rechtschaffen and Kales, 1968) the E randomly presented one of the conditioned auditory stimuli at a below waking threshold of 55 db (previously determined through pilot experimentation), then, gradually increased the amplitude of the tones, in 0.5-dB steps allowing for two, one second duration tones with a 0.5-second inter-tone interval, until a change of physiological state could be determined.

The determination of change of state was accomplished with the use of a specially constructed EEG and EMG integration system which monitored 8-12 hertz alpha output and 30-40 microvolt EMG output on separate channels on the Beekman polygraph, Type R. Also, an additional EEG channel counted both EMG and EEG output by a left/right pen deflection. When the filtered EMG and EEG output on these channels approached twice that of the subject's REM onset level a change of state determination was made and the auditory stimulus was turned off. The subject was then required to emit 45 seconds of additional REM sleep (within five minutes of "tone off") at which time the experimenter would awaken the subject, by asking; "Wake up ______ (Subjects name), tell me everything that was going through your mind." If no reply was given by the subject within 15 seconds, the question was repeated. After the subject responded the experimenter asked, "Was there anything else?" and then followed with the question, "Did you hear any tones and if so what was it?" if the subject had not previously made mention of the auditory stimuli.

If the subject did not return to Stage REM within 5 minutes of the "tone off" no awakening was made for that trial, and the subject received the next random tone on the following REM awakening trial.

All reports were tape recorded on cassettes and typed transcripts were made from the recorded tapes.

No awakenings were made in the first 90 minutes of sleep. Recall is poorest at this time and depth of sleep, the greatest. Also, stage REM is infrequent in this period.

The experimenter attempted to record four awakenings per night per subject, with approximately eight awakenings on each tone condition for the total of the four nights.

Scoring Procedure

IV. Instruction To Judges

GROUP A) We are asking you to make some judgments about typewritten reports that have been obtained from persons awakened from their sleep. Carefully read each mentation report and identify those reports which contain the words "run" or "running" or the words "help" or "helping." Write down the code number which appears on the upper right hand corner of these reports. Scoring sheets were provided so that judges can write down their responses.

All reports were randomized and given an undecipherable code which determined subject, night in lab, awakening that evening, date, which auditory stimuli was presented on that awakening, and whether or not the subject recalled a tone, which tone recalled, and whether the recalled tone was correct or incorrect.

GROUP B) We are asking you to make some judgments about typewritten reports that have been obtained from persons awakened from their sleep. Carefully read each report and then determine which of the following categories that report would most closely be subsumed under. Then write down the code number of that report, which appears in the upper left hand corner, under the appropriate category. You will follow this procedure for each report. Is that clear?

All reports were randomized before the judges sorted them, and each judge received the category sorting sheet with a randomized listing of the category placement. The following is a list of the various categories for mentation sorting by each of the four judges in group B:

Mentation Category List

Subject or person in report directly asks for help.
Subject or person in report asked to help someone else.
Subject or person suffering psychological stress or pain and is in need of help.
Subject or person in report suffering physical pain or is in apparent physical danger is in need of help.
Subject or person in report facing a problem or task that cannot be resolved alone and where there is an apparent need for someone or something else that would be helpful.
All reports with no recall.
All reports with none of the above "in need of help" concept categories portrayed.

The above categories for mentation sorting were used to help define the slides chosen for the "in need of help" condition, and served as the criterion for slide selection.

All data sheets were collected and served as the basis for further data analysis.

GROUP C) We are asking you to make some counts of physiological responses of subjects while sleeping. You will carefully examine each of the designated pages (selected by the E which depict a REM awakening) and make counts of the number of pen deflections on this channel, E demonstrates, under three separate conditions. Each condition is designated by a magic marker black line running perpendicular to the recording.

Condition 1, Preceding tone on) You will carefully count the number of pen deflections to the right that took place for each of two (2), five (5), second intervals. You will record the total number of deflections on the scoring sheet provided for each of the five second intervals. You will note that five seconds has elapsed by counting out a total of five successive square boxes on the scoring record. Is that clear? The E demonstrated and answered any questions. You will then follow in the same procedure count the number of pen deflections to the left.

Condition 2, Preceding tone off) A similar scoring procedure as utilized in "condition 1" was employed.

Condition 3, Preceding REM awakening) A similar scoring procedure as utilized in "condition 1" was employed.

The E made a randomly selected check of 25 different scoring counts made by the Judges in "Group C", to determine the accuracy of the counts. If any serious errors appeared for a particular judge their entire scoring counts were reviewed by an additional judge.

The entire conditioning procedure was operated by a logic relay system in the E's room. When the S informed the E that he was ready, the E began the conditioning procedure by pressing a button which set in motion the entire system. This procedure was utilized for all S's.

RESULTS

The mentation reports scored as containing appropriate stimulus attribute inclusion were selected by independent (blind) agreement of three judges. One group of three judges was asked to select mentation reports containing any grammatical form of the words "run" or "help," or a synonym of either. The results of this analysis are contained in Table 1. Interjudge reliability for selection of reports containing the words "run" or "help" was r = 1.00. A second set of three judges was asked to sort mentation reports into a variety of predetermined categories, some of which portrayed features and attributes of the concept class "in need of help." The results illustrated in Table 1A show the number of mentation reports selected by this set of judges as containing an appropriate "in need of help" category attribute. A total of 23 mentation reports were unanimously selected by each of the three judges as residing in one of the "in need of help" concept class categories. Of the 23 mentation reports, 17 were unanimously selected as residing in a particular "in need of help" concept category. In the remaining six mentation reports two out of three judges identified a similar concept class category while one of the three judges sorted the mentation report into a differing "in need of help" concept class category.

The mentation reports judged as possessing stimulus attribute inclusion by the above preliminary screening methods were utilized in further analysis.

To examine to what extent the conditioned auditory signals facilitated appropriate stimulus attribute inclusion into REM (high tone "run" condition--- "run" attribute inclusion; low tone"in need of help" condition--- "in need of help" attribute inclusion) it was necessary to compare the total number of judged attribute inclusions of each signal (high or low tone) to its appropriate stimulus condition ("run" or "in need of help"). A two by two Fisher exact test was performed to determine whether the responses to the two stimulus conditions differed "in the proportion with which they fall into the two" judged attribute inclusion categories (Siegal, 1956, p. 97). The results illustrated in Table 2 show the exact response probabilities for each subject. A total of four out of the five subjects performed appropriate stimulus attribute inclusion at a much higher level than expected by chance.

In order to determine the combined probability of all subjects, a Fisher natural log transformation (Winer, 1971, pg. 49) was performed. These results appear in Table 3. The calculated Chi-square of 37.07 ($P \leq .01$ Chi-square=23.2) was clearly higher than would be expected by chance.

Considering that only three out of a total of forty-one (41) judged attribute inclusions occurred in an inappropriate stimulus condition (two "run" inclusions in "help" condition, one "help" inclusion in "run" condition) it is possible to assume that the discriminative stimuli were in fact "incorporated" into the ongoing REM.

The results of the Fisher exact (Table 2) and subsequent Chisquare (Table 3) analysis now allows for a more definitive statement concerning the judged attribute appearance of appropriate conditioned stimuli in the REM mentation reports. For this reason the term incorporation may now be used in place of the more general phrase judged attribute inclusion.

The above analyses have demonstrated the effectiveness of the avoidance conditioning procedure in eliciting stimulus appropriate incorporation. Along these same lines, the dream-metaphor model would predict that a simple unitary concept such as "running" (defined by a relatively few number of features and attributes) would more likely be incorporated into REM directly than a more complex, abstract concept such as "in need of help." Conversely, the concept "in need of help" would more likely be incorporated indirectly (and probably more often metaphorically). The results of this analysis are illustrated in Table 4. Consistent with the predictions of the dream-metaphor model, the number of direct incorporations in the relatively simple, unitary concept category of "running" (17), outnumbered those for the more complex, abstract concept category of "in need of help" (9). Conversely, the number of "indirect" incorporations within the "in need of help" condition (14) far outnumbered the total in the "run" condition (1). A Phi coefficient was computed yielding a Chi square transformation of 13.25 ($p \leq .01$ Chi-square = 6.64) which is significantly higher than would be expected by chance.

To gain some further insight into variables affecting incorporation, an analysis of the incidence of incorporation by nights and awakenings was performed and the results illustrated in Table 5. Both the first night for each subject and the first awakening of each night provided the lowest number of incorporations, with each receiving a total for all subjects of four incorporations. By contrast, the third night incorporation total increased to 14, translating to 34% of all incorporations. The third awakening also increased, to a total of 15, or 36.6% of all incorporations. A possible explanation of the subjects improved incorporation ability, over awakenings and nights two, and three may be the effects of practice and learning. The decrease in the number of incorporations between awakenings three and four (from 15 to 10), may be the result of an artifact on the first night, where no judged incorporations took place.

Consistent with the increase in the incidence of incorporation after the first night and first awakening of each night is a similar increase in REM mentation content. An analysis of total REM mentation content (based upon the Antrobus (1977) scoring manual) was performed. As can be seen in Figure 1, the mean content count for all subjects on the first REM awakening of 28 criteria words is tripled by the third REM awakening (84 criteria words). The third nights average of 67.21 criteria words is almost twice that of the first two nights 38.

A further analysis of relationship between mentation report length and rate of incorporation is clearly displayed in figures 2 and 3. Figure 2 portrays transformed Chi-square scores in relation to the total number of "visual action" verbs (Antrobus 1977, scoring manual) for "run" condition (incorporation) mentation reports. The rate of stimulus incorporation is clearly above the level expected by chance for all reports having five or fewer verbs. Reports containing six or more verbs do not reflect results differing from chance alone. It seems that beyond a certain level, in this case at least five verbs, report length alone does not account for the incidence of incorporation. A possible explanation is, that with reports containing a large amount of information to be processed and then recalled, the subject may either forget to report an incorporation (retrieval problem), or, the incorporation may not receive a sufficient amount of cognitive processing (competition for limited capacity) to reach a more permanent memory store. A complete review of storage and retrieval difficulties of REM sleep has been compiled by Goodenough (see Arkin, Antrobus, and Ellman, 1978).

The results portrayed in Figure 3 "in need of help" incorporations, follows a similar patter as those illustrated above for Figure 2.

The experimental procedure whereby the auditory stimuli were increased at .50 decibel increments, separated by a two second interstimulus interval (until a change in the physiological state of the subject was detected) was thought to be a possible variable affecting the incidence of incorporation. Table 6 shows the time intervals for awakening with incorporation, and awakenings without incorporation. A t test was performed and the results displayed no significant findings between the incidence of incorporation and the auditory time intervals. This phenomenon has been previously reported by Koulack (1969).

A similar insignificant finding was obtained when the interval between tone off and the subsequent awakening was compared to the incidence of incorporation.

In a related issue an analysis of the decibel amplitude levels of the auditory stimuli in relation to the incidence of stimulus incorporation was examined. The results shown in Table 7 portray the mean decibel levels and variance by night for incorporation versus non-incorporation mentation awakenings. A comparison of the two conditions reveals virtually no difference between the auditory threshold levels by night.

A similar analysis was performed to determine whether the order of REM awakenings differed in their stimulus amplitude level. This analysis is illustrated in

Table 8. The first REM awakening of each condition received the lowest decibel levels of 61.98 and 62.84 along with the largest amount of variance (.44 dbs and .48 dbs respectively). A possible explanation for the lower db level and higher level of variance may be that the first REM period is shorter and less stable than the subsequent REM periods.

A subject by subject mean decibel level over all awakenings was derived to determine whether any differences exist between the S's change of state auditory threshold levels and the incidence of incorporation. As Table 9 illustrates, the particularly small decibel range of 1.06 dbs (s=1.73) points to the fairly consistent, change of state auditory threshold level among subjects.

The determination of a particular subjects' change of physiological state from REM was made when arbitrary units of EEG alpha and submental EMG output (standard placements, Rechtshaffen and Kales, 1968) increased to two times their REM onset level. The results displayed in Tables 10 and 11 depict the average unit outputs for EEG and EMG within three time intervals, ten seconds preceding tone on, ten seconds preceding tone off, and ten seconds preceding REM awakening. This experimental procedure whereby the auditory stimuli were increased to a common physiological criterion (EEG and EMG twice their REM onset levels) could help explain the consistency among the subject's auditory threshold levels discussed in Table 9.

Table 1

Mentation Report Numbers of
Direct Incorporations

"Help" or Synonym		"Run" or Synonym
113B12P2CN		147314K4HN
22BC1563LN		135B16P2HN
214C2J3LN		129B13L2HN
348C1P2LN		224C13T2HN
347C133LY		236C28S1HN
424D11P2LN		236C28P4HN
434D12P3LN		248D6D1HN
439D12T2LN		339P28T3HN
529E15P4LN		347C1T4HN
		423D11P3HR
		413D16T3HN
		437D12P4HN
		443D13T3HN
		543E17T2HN
		549E14P4HN
		539E16P2HN
		537E17P4HN
Total	9	17

Table 1A

"In need of help" Incorporation Sort by Category

Category	Report Number	Number of Judges Agreeing out of 3
1) Subject or person in report directly asks for help himself	529E15d41N	3
2) Subject or person in report facing a problem or task that cannot be resolved alone and where there is an apparent need for someone or something else that would be helpful	113B12T4LN	3
	129B13K3LR	3
	134B16J1LN	3
	147B14L3LN	3
	326B26P2LN	3
	424D11K4LN	3
	547E17J1LN	3
3) Subject or person in report asked to help someone else	113B12P2LN	2*
	228C15G3LN	3
	214C2J3LR	3
	347C1P1LN	3
	347C1J3LX	3
	424D11P2LN	2*
	434D12P3LN	3
	439D12T2LN	2*
	348C1P2LN	3
4) Subject or person in report suffering psychological stress or pain and is in need of help	329B20J3LR	3
	529E153LN	2*
	537E16P3LN	3
	247D63LR	3
	527E1503LN	2*
5) Subject or person in report suffering physical pain or is in apparent physical danger and is in need of help	114B12P3LN	2*

*One of three judges sorted this mentation report in a different category.

Table 2

Fisher Exact Probabilities

Subject 1 — P = .033

stimulus	Response Condition: run	Response Condition: help
run	3	0
help	1	6

Subject 2 — P = .004

stimulus	Response Condition: run	Response Condition: help
run	5	0
help	0	5

Subject 3 — P = .048

stimulus	Response Condition: run	Response Condition: help
run	2	0
help	0	5

Subject 4 — P = .039

stimulus	Response Condition: run	Response Condition: help
run	4	1
help	0	4

Table 2 - continued

			Response Condition run	help
Subject 5	stimulus	run	4	1
P = 0.71		help	0	3

Table 3

Combined (Fisher Exact Probability) Chi Square Test

Subject #	Fisher Exact Probabilities	Natural Logs
1	.033	3.411
2	.004	5.521
3	.048	3.063
4	.0397	3.226
5	.0714	2.639
		Sum = 17.86

Chi Square = 2(17.86) = 35.72

Chi Square .99(10) = 23.2

Table 4

Direct vs. Indirect Incorporation
by Stimulus Condition

		Response Incorporation		
		Direct	Indirect	Total
Stimulus	Run	17	1	18
Condition	Help	9	14	23
	Total	26	15	41

Phi = .570 Chi Square = 13.325 $p \leq .01$

Table 5

Incorporations by Night and Awakening

	Awakenings					
Night	1	2	3	4	Total	Total %
1	0	1	3	0	4	9.7
2	0	4	4	2	10	24.4
3	2	4	4	4	14	34.7
4	2	3	4	4	13	31.2
Total	4	12	15	10	41	100.0%
Total %	9.7	29.3	36.6	24.4	100.0%	

Table 6

Mean Time Intervals for Auditory Stimulation and Awakenings

Condition	Tone On/ Tone Off[1]	Tone Off/ REM Awakening[2]
Incorporation	42.9 sec. SD. 3.4 sec.	2 min. 21 sec. SD. 15.6 sec.
Non Incorporation	45.1 sec. SD. 3.9 sec.	2 min. 15 sec. SD. 15.9 sec.
Total	43.5 sec. SD. 3.7 sec.	2 min. 18 sec. SD. 15.7 sec.

1. Tone Off Criterion = Two times EEG & EMG tone "on" Levels

2. REM Awakening Criterion = Minimum of 45 sec. of REM from tone off through 5 min. after tone off

Table 7

Mean Decibel Levels by Night Comparing Incorporation and Non-incorporation Awakenings

Condition	Nights				
Incorporation	1	2	3	4	Total
Mean dB	63.65	62.72	62.28	63.00	62.85
s^2	.43	.39	.34	.35	.38
Non-incorporation					
Mean dB	63.55	63.14	62.76	62.85	63.07
s^2	.46	.44	.43	.43	.44

Table 8

Mean Decibel Levels by Awakening Comparing Incorporation and Non-incorporation Awakenings

	Awakenings				
Condition Incorporation	1	2	3	4	Total
Mean dB	61.98	62.75	63.57	63.24	62.85
s^2	.44	.36	.34	.39	.38
Non-incorporation					
Mean dB	62.84	63.15	62.25	63.28	63.05
s^2	.48	.40	.42	.43	.44

Table 9

Mean Decibel Level by Subject over All Awakenings

Subject #		Mean Decibel Level
1		63.01
2		62.26
3		62.68
4		63.32
5		63.05
S = 1.73 dBs.	Total Average	62.88

Table 10

Average EEG Alpha Output* Based on 19 Awakenings

	Preceding tone on			Preceding tone off			Preceding REM Awakening		
Seconds	10-6	5-0	Aver. Total	10-6	5-0	Aver. Total	10-6	5-0	Aver. Total
Unit EEG	2.16	2.26	2.21	3.58	4.63	4.10	2.32	2.32	2.31

*Arbitrary Units based upon Analogue Filtered Output of 8-12 cycles Alpha

Table 11

Average EMG Output* 30-40 Microvolts based on 19 Awakenings

	Preceding tone on			Preceding tone off			Preceding REM Awakening		
Seconds	10-6	5-0	Aver. Total	10-6	5-0	Aver. Total	10-6	5-0	Aver. Total
Unit EMG	.195	1.89	3.84	2.63	3.32	5.95	1.84	2.10	3.94

*Arbitrary Units based upon Analogue Filtered Output of 30-40 microvolt EMG

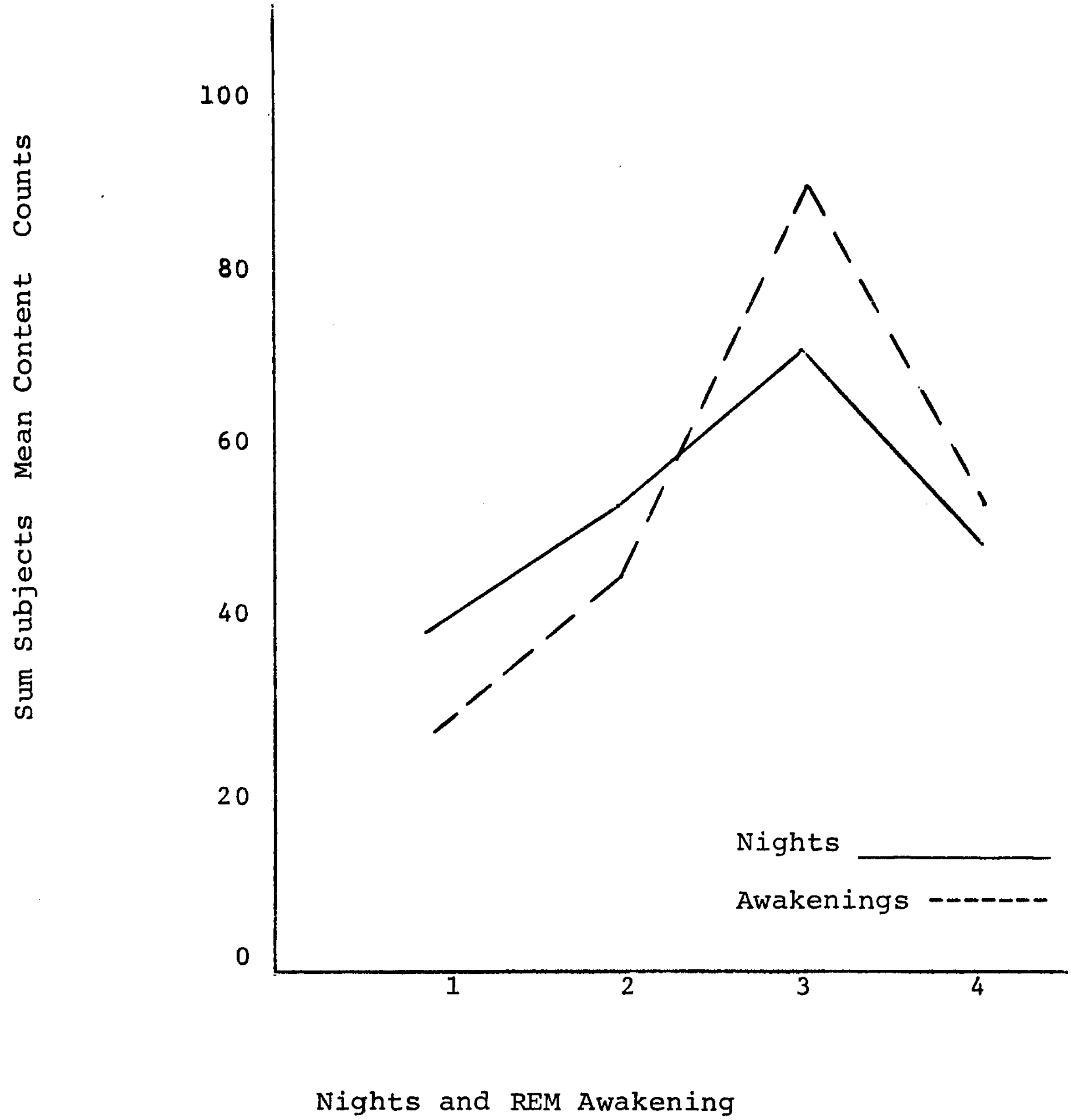
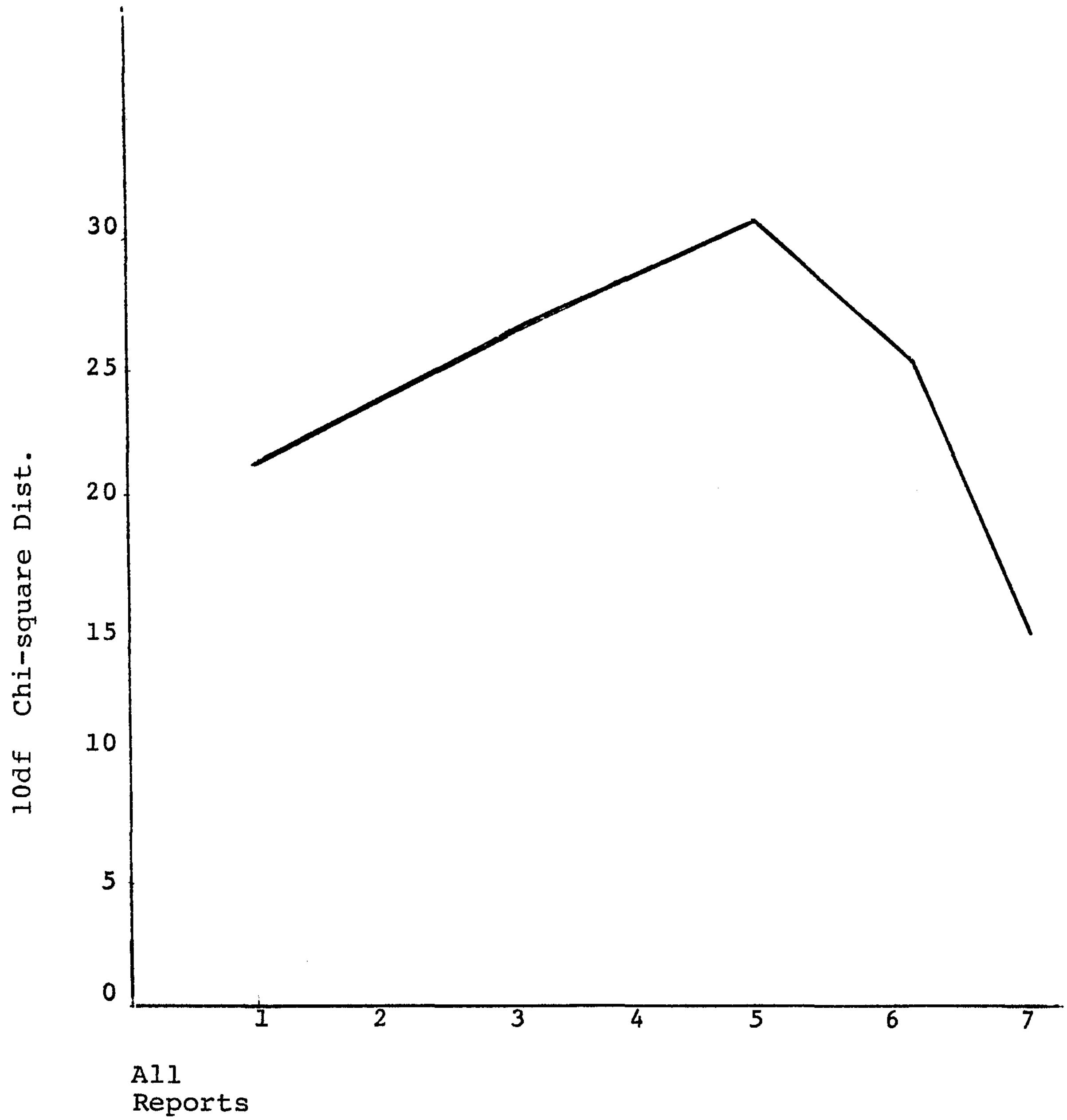


Fig. 1. Mean Content Count[1] Sum Subjects

[1]Based upon Antrobus (1977) Scoring Manual.



Mentation Reports having at least "x" number of verbs[2]

Fig. 2. Transformed Chi-square for "Run" Condition Incorporations by Number of Verbs per Mentation Report

[1]Winer, 1979, p. 49.

[2]Verbs are "visual action" descriptors based upon Antrobus Scoring Manual (1977).

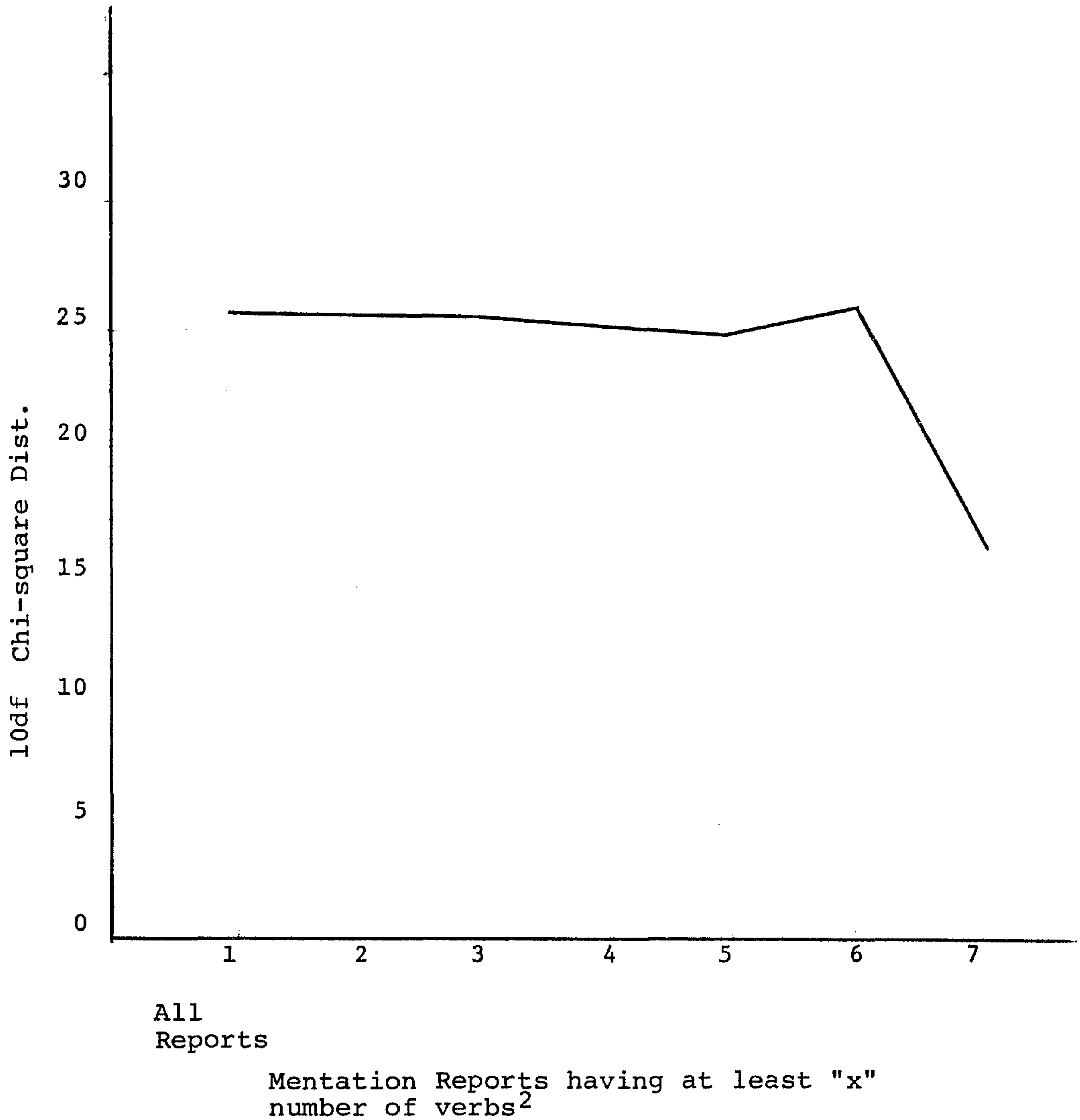


Fig. 3. Transformed Chi-square for "help" Condition Incorporations by Number of Verbs per Mentation Report

[1]Winer, 1979, p. 49.

[2]Verbs are "visual action" descriptors based upon Antrobus Scroing Manual (1977).

DISCUSSION

The present study was designed to test two related theoretical issues. First, whether an operant avoidance paradigm, employing auditory stimuli to condition visual content, would be a successful technique for stimulus incorporation into REM sleep. The second aim was to gain some validation for the dream-metaphor model proposed by Antrobus (1978).

Insofar as the first hypothesis is concerned, the results of tables 1, 2, and 3 are consistent with the data obtained by Weinberg (1964); Williams *et al.*, (1964); and Williams, Morlock and Morlock (1966); who successfully employed an operant technique to incorporate information into REM sleep. Furthermore, the ability of subjects to make discriminative responses during sleep (in this case differential stimulus incorporation) is consistent with the finding of Beh and Barratt (1965).

In the past researchers (Dement and Wolpert, 1958 Berger, 1963 Baldrige *et al.*, 1965 and Koulack, 1969 among others) have reported stimulus incorporation into REM sleep whenever a mentation report was suggestive, a modification or a direct resemblance to the original stimulus. A major advance of the present design is the comparison (Fisher exact probabilities Table 2) of particular stimulus attribute inclusion within all awakening conditions. The percent rate of stimulus attribute inclusion (deemed incorporation) cited by the above researches (rate of incorporation generally ranged from 15-56%) is a somewhat misleading statistic as their techniques did not examine the probability of stimulus inclusion of each of the stimuli presented for incorporation within all response conditions.

In regards to the second aim of this dissertation, the complex cognitive processes involved in the theories of nodal attribute storage, feature extraction, and contextual effects (Norman and Rumelhart, 1970, 1975; Anderson and Bower, 1973; Bransford and Johnson, 1973; Shiffron and Schneider, 1977, among others) from which the dream-metaphor model has been derived, has created an enormous information gap which no one study can bridge. Fortunately some evidence for the model was obtained and seems appropriate for elucidation.

An analysis of the results of table 4 reveals that the concept "running" occurred at a significantly higher rate within the "direct" incorporation category than the concept class "in need of help." The concept class "in need of help" occurred at a significantly higher rate within the indirect, metaphoric category. These results are consistent with the prediction proposed by the dream-metaphor model insofar as "running" can be defined by a relatively few number of features and attributes (to go steadily by springing steps so that both feet leave the ground for an instant in each step,(Websters, 1967) while the "in need of help" condition portrays a broader range of features and attributes within its nodal attribute storage. The present study is consistent with Dement and Wolpert's (1958) demonstration that stimuli to be incorporated were perceived by the subject as similar to the waking perception of the same stimuli.

The large proportion of direct incorporations, 66% of all incorporations (Table 4), is both a function of the experimental procedure employed and the nature of the stimuli chosen for conditioning, as previously mentioned.

In the first instance, Koulack (1969) demonstrated that direct incorporations were more likely to occur when associated with alpha bursts. Similarly, Costaldo and Holtzman (1969) introduced recordings of names, at a stimulus intensity sufficiently high to produce EEG evidence of registration. Following in the same line the present study increased the auditory stimulus amplitude levels of EEG and EMG until they reached two times that of their REM onset level. This may account for the high percentage of direct incorporations.

The dream-metaphor model relies heavily upon the demonstrated effects of context on perception. In reviewing the mentation reports within the "in need of help" condition, of which 61% were indirect metaphoric incorporations, the conditioned stimuli were often incorporated so as to be consistent with the ongoing REM context. The following examples illustrate: (1) " . . . it was an elevated subway and I was like a little nervous because I didn't know where I was and I was trying to retrace the steps I took before I got there and umh all of a sudden I heard people yelling and screaming the train couldn't get through like the tunnel . . ."; (2) " . . . I was driving on a road along a mountain then I came along there was somebody on the road I think they were hitch-hiking but I'm not sure. Fortunately I wasn't going very fast he was just walking along the road it was a very black and white dream (pause) umh he was hitch-hiking at night ah yeah I stopped to see what he looked like uh he said he had a flat but I didn't believe him I kept driving . . ."; and finally (3) ". . . Umh ah okay there was uh first it started out like on the M.A.S.H., T.V. show. Charles Winchester Smith talking to Klinger huh and Klinger is talking about his family how everybody died people died in the war and other people died from this and that and finally Klinger ends up with a sword threw his middle I don't know if it's a plastic sword and he's just faking it or what. Anyway than it switches to a funeral it's a black family and I guess it's a young mother ah one of her children died or something and uh she happens to be an opera singer so umh there was this guy there her agent or something and he wants her to go and audition for the part of Catherine deMedici right after the funeral and shy says no, no I refuse it's too much my kid just died I want to go home and cry. And he says no no no no your career and everything and then there's a whole bunch of opera singing . . . strange huh!

The above examples offer evidence that the incorporation of conditioned stimuli are metaphoric transformations of previously stimulated feature and attribute associative nodes from earlier REM context.

In the first illustration, activation of associative nodes related to the concept "subway" stimulated relations such as "train", "passengers" and "tunnel" among others.

With the incorporation of the conditioned stimuli "in need of help", a (hypothetical) metaphorization of the excited associative nodes resulted in the mentation report "people yelling and screaming" and "the train couldn't get through the tunnel".

In the third illustration (M.A.S.H. mentation report) the early REM context excited concept nodes such as "dying", "family", "Klinger", "war" and "sword" among others. The subject then reports "then it switches" which may possibly indicate the "in need of help" stimulus incorporation, resulting in associative node activation of the previously stimulated concepts. Metaphoric transformation of "dying" in the earlier context elicits "funeral", "family" elicits "mother" and "son", and "Klinger" (a television character in the Mobile Army Surgical Hospital, who wears womens clothing seeking to thereby be given a section 8), is metaphorically transformed to the woman who states "no, no, I refuse it's too much my kid just died I want to go home". Similarly, the earlier concept stimulation of the television character of "Charles Winchester Smith" who is depicted as unconcerned for the feelings of others, interested in his "career" and a descendent of an old, prominent Boston family, finds metaphoric extension in the person of

"Catherine deMedici" and the "agent". Finally, a "sword", being "plastic" or real, in the earlier REM context, is metaphorically transformed into "opera singing" where it is a common prop and where the surgeons of M.A.S.H. with their T.V. scapels ("swords") stage their "opera" - tions to humor, death, and drama.

The descriptive data in tables 5-10 illustrate information heretofore unavailable in previous REM incorporation studies. Hopefully some of these findings will be useful in both the theoretical formulation and design of future research in this area.

The results of Table 4 reinforce the contention that relatively simple concepts such as "running" are more often incorporated directly while more abstract conceptualizations such as "in need of help" are incorporated within a broader range of "metaphorical" transformations.

Although the total number of mentation reports by night and awakening did not allow for a more sophisticated analysis, the results portrayed in Table 5 point to the difficulty of subjects to incorporate information on the first night or first awakening of each night. It has long been known that the first REM period of each night is the shortest. Possibly, the intrusion of external stimuli disrupts to a greater extent this shorter REM period and in some way affects cognitive and physiological processes necessary for incorporation. The increase in the number of incorporations on the subsequent awakenings, may be a function of the earlier deprivation. Also, in most learning situations, performance improves as a function of practice. Theoretically, the subject may refine those cognitive, proprioceptive processes necessary for incorporation and recall. This hypothesis would help explain the improved performance on the subsequent nights.

Along a similar line, the results displayed in Figure 1 adds credence to the above hypothesis, as the amount of REM content dramatically increased on the second and third night and the second and third awakening of each night. Importantly, the fractional ratio of reports with REM mentation to total awakening also improved as a function of content length. Obviously if there is no (or extremely little) REM recall there can be no evidence of incorporation. Figures II and III demonstrate this relationship clearly. The rate of incorporation increases as a direct function of the mean number of verbs in the report, asymptoting at an average of 5 verbs per report.

Finally, in Tables 9 and 10, no direct relationship between the decibel level of the auditory stimulus, the length of time it remained on or the time interval tone off to the subsequent REM awakening to the incidence of incorporation was found to exist. These results suggest that incorporation may take place in a relatively broad interval of time within the REM period.

In reviewing the results of this dissertation, hindsight affords the opportunity to suggest modifications in design which would have allowed for a more complete examination of the dream-metaphor model, particularly with respect to the phenonmenon of metaphoric transformation of ongoing REM context. It would seem useful in the future to employ the incorporation of two conditioned stimuli into a single REM period. The first, possibly a simple direct concept, followed some period of time by a second indirect concept. In this way the experimenter could with more control examine when, and in what way, the onging REM context (first incorporation) was transformed (by the second incorporation).

Another possibility would be to increase the number of physiological recordings, specifically EEG evoked potential responses to the conditioned auditory stimuli. This could help identify a physiological "indicator" of incorporation, yielding the obvious benefit to the experimenter of knowing to what auditory amplitude level to increase the stimuli.

A final problem which deserves mention is the defining, in some more exact way, of the state (physiological and cognitive) of the subject during the presentation of the external stimuli. The question that remains unanswered is whether the subject can be described as fulfilling the criteria which are used to describe the various stages and states commonly referred to as sleep, or whether since the subject is, at that moment, in some unique form of consciousness. The focus of information necessary to answer this and other questions concerning the differences between sleep and wakefulness may result from data concerning the differential information processing strategies employed by man during the various and changing physiological states. More precisely, the effects of context and expectancy (at particular physiological threshold levels) on information processing may redefine, in a more precise way, the present categorical descriptions namely, sleep and wakefulness.

In summary, the operant avoidance procedure was an effective technique for both the incorporation of external stimuli and the eliciting of differential responses during REM sleep.

Some evidence was obtained which supports the dream-metaphor model. Concepts of a simple unitary nature (running) were more often incorporated directly while more abstract conceptualization such as "in need of Help" were generally metaphorically transformed. Several illutrations were depicted in an effort to reveal the effects of context in the processing of subsequent REM mentation. All in all, the path of the dream-metaphor model is worth following.

References

Anderson, B. F. Cognitive psychology: The study of knowing, learning and thinking. New York: Academic Press, 1975.

Anderson, J. R., & Bower, G. H. Human associative memory. Washington, D.C.: V. H. Winston & Sons, 1973.

Antrobus, J. S., Antrobus, J. S., & Fisher, C. Discrimination of dreaming and non-dreaming sleep. Archives of General Psychiatry, 1965, 12, 395-401.

Antrobus, J. S., Arkin, A. M., & Ellman, S. J. Dreaming, operant control, and meaning structure. National Institute of Mental Health Grant Proposal, September, 1976.

Antrobus, J. S., Schnee, R. K., Offer, V., & Silverman, S. A psycholinguistic scoring manual for mentation reports. Unpublished test, ETS test collection, Educational Testing Service, Princeton, New Jersey.

Arkin, A. M., Sanders, K. I., Ellman, S. J., Antrobus, J. S., Farber, J., & Nelson, W. T., Jr. The rarity of pain sensation in sleep mentation reports. Paper presented at the meeting of the Association for the Psychophysiological Study of Sleep, Edinburgh, May, 1975.

Atkinson, R. C., & Shiffrin, R. M. Human memory: A proposed system and its control processes. In K. W. Spence and J. T. Spence (Eds.), The psychology of learning and motivation: Advances in research and theory, Vol. 2. New York: Academic Press, 1968.

Baldridge, B. J. Physical concomitants of dreaming and the effect of stimulation on dreams. Ohio State Medical Journal, 1966, 62, 1271-1279.

Baldridge, B. J. Review of Hauri, P. & Van de Castle, R. L., Psychophysiological parallels in dreams. Sleep Research, 1974, 3, 312-314.

Baldridge, B. J., Whitman, R. M., Kramer, M., Ornstein, P. H., & Lansky, L. The effect of external physical stimuli on dream content. Paper presented at the meeting of the Association for the Psychophysiological Study of Sleep, Washington, 1965.

Beh, H. C., & Baratt, P.E.H. Discrimination and conditioning during sleep as indicated by the electroencephalogram. Science, 1965, 147, 1470-1471.

Berger, R. J. Experimental modification of dream content by meaningful verbal stimuli. British Journal of Psychiatry, 1963, 109, 722-740.

Billow, R. M. Metaphor: A review of the psychological literature. Psychological Bulletin, 1977, 84, 81-92.

Bransford, J. D., & Johnson, M. K. Consideration of some problems of comprehension. In W. G. Chase (Ed.), Visual information processing. N.Y.: Academic Press, 1973. Pp. 383-438.

Bransford, J. D., & Franks, J. J. The abstraction of linguistic ideas. Cognitive Psychology, 1971, 2, 331-350.

Breger, L. Function of dreams. Journal of Abnormal Psychology, 1967, 72, 1-28.

Breger, L. Dream function: An information processing model. In L. Berger (Ed.), Clinical-cognitive psychology - models and integrations. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1969.

Breger, L., Hunter, I., & Lane, R. W. The effects of stress on dreams. Psychological Issues, 1971, 7 (3, Monograph 27). (a).

Broadbent, D. E. Perception and communication. London: Pergamon Press, 1958.

Brown, R. Words and things. New York: Free Press, 1968.

Brown, S. The world of imagery. New York: Russell & Russell, 1966.

Bugelski, B. R., and Cadwallder, T. C. A reappraisal of the transfer and retroaction surface. Journal of Experimental Psychology, 1956, 52, 360-365.

Carmichael, L., Hogan, H. F., & Walter, A. A. An experimental study of the effect of language on the reproduction of visually perceived form. Journal of Experimental Psychology, 1932, 15, 73-86.

Castaldo, V., & Holzman, P. The effect of hearing one's voice on sleep mentation. Journal of Nervous and Mental Disease, 1967, 144, 2-13.

Castaldo, V., & Holzman, P. The effect of hearing one's own voice on dreaming content: A replication. Journal of Nervous and Mental Disease, 1969, 148, 74-82.

D'Amato, M. R. Experimental psychology: Methodology, psychophysics, and learning. New York: McGraw-Hill Book Company, 1970.

Dement, W. C. Experimental dream studies. In J. H. Masserman (Ed.), Science and psychoanalysis, Vol. III. New York: Grune & Stratton, 1964. (a).

Dement, W. C. Dreams and dreaming. International Journal of Neurology, 1965, 5, 168-186. (c).

Denes, P. B. On the statistics of spoken English. Journal of the Acoustic Society of America, 35, 892-904.

Eden, M. Handwriting and pattern recognition. I. R. E. Transactions on Information Theory, IT-8 (2), 160-166, 1962.

Foulkes, D. The psychology of sleep. New York: Charles Scribners & Sons, 1966.

Foulkes, D., & Rechtschaffen, A. Presleep determinants of dream content: Effects of two films. *Perceptual and Motor Skills*, 1964, *19*, 983=1005.

Foulkes, D., & Shepherd, J. Stimulus incorporation in children's dreams. *Sleep Research*, 1972, *1*, 119.

Freud, S. *Dreams and telepathy*. *Standard edition of the complete psychological works of Sigmund Freud*. (J. Strachey, Ed., trans.), Vol. 28. London: Hogarth Press, 1953. (a). (Originally published: 1922).

Freud, S. *The interpretation of dreams*. *Standard edition of the complete psychological works of Sigmund Freud*. (c). (J. Strachey, Ed., trans.), Vol. 4. (London: Hogarth Press, 1953).

Gardener, H. Metaphors and modalities: How children project polar adjectives onto diverse domains. *Child Development*, 1974, *45*, 84-91.

Goodenough, D. R., Sapan, J., Cohen, H., Portnoff, G., & Shapiro, A. Some experiments concerning the effects of sleep on memory. *Psychophysiology*, 1971, *8*, 749-762.

Goodenough, D. R., Witkin, H. A., Lewis, H. B., Koulack, D., & Cohen, H. Repression, interference and field dependence as factors in dream forgetting. *Journal of Abnormal Psychology*, 1974, *83*, 32-44.

Granda, A. M., & Hammack, J. T. Operant behavior during sleep. *Science*, 1961, *133*, 1485-1486.

Heneley, N. M. A psychological study of semantics of animal terms. Journal of Verbal Learning and Verbal Behavior, 1969, 8, 176-184.

Koulack, D. Effects of somatosensory stimulation on dream content. Archives of General Psychiatry, June, 1969, 20, 6, 718-725.

Leeper, R. A study of a neglected portion of the field of learning - the development of sensory organization. Journal of Genetic Psychology, 1935, 46, 41-75.

Lindsay, P. H., & Norman, D. A. Human information processing: An introduction to psychology. New York: Academic Press, 1972.

Mackey, L. Aristotle and Feidelson on metaphor: Toward a reconciliation of ancient and modern. Arion, 1966, 4, 272-285.

Miller, G. A. The magical number seven, plus or minus two: Some limits on our capacity for processing information. Psychological Review, 1956, 63, 81-97.

Miller, G. A., Heise, G. A., and Lichten, W. The intelligibility of speech as a function of the context of the text materials. Journal of Experimental Psychology, 1951, 41, 329-335.

Nagera, H. Basic Psychoanalytic Concepts on the Theory of Dreams. New York: Basic Books, Inc., 1969.

Neiser, U. Cognitive psychology. New York: Appleton-Century-Crofts, 1967.

Oswald, I., Taylor, A. M., & Treisman, M. Discriminative responses to stimulation during human sleep. Brain, 1960, 83, 440-453.

Palombo, S. R. The associative memory tree. In B. B. Rubinstein (Ed.), Psychoanalysis and contemporary science, Vol. 2, New York: Macmillan Publishing Company, 1973.

Potzl, O., Allers, R., & Teler, J. Preconscious stimulation in dreams, associations and images. Psychological Issues, 1960, 7, 1-40.

Ramsey, G. V. Studies of dreaming. Psychological Bulletin, 1953, 50, 432-455.

Rechtschaffen, A. Discussion of: Experimental dream studies, by W. C. Dement. In J. H. Masserman (Ed.), Science and psychoanalysis, Vol. 1, Development and research. New York: Grune and Stratton, 1964.

Rechtschaffen, A., Hauri, P., & Zeitlin, M. Auditory awakening thresholds in REM and NREM sleep stages. Perceptual and Motor Skills, 1966, 22, 927-942.

Rechtschaffen, A., & Kales, A. (Eds.). A manual of standardized terminology, techniques and scoring system for sleep stages of human subjects. (National Institute of Health Publication No.

Stevens, K. N. Toward a model for speech recognition. *Journal of Acoustical Society of America*, 1960, *32*, 47-55.

Tulving, E. *Episodic and semantic memory*. N.Y.: Academic Press, 1972.

Tulving, E., & Gold, C. Stimulus information and contextual information as determinants of tachistoscopic recognition of words. *Journal of Experimental Psychology*, 1963, *66*, 319-327.

Ullman, M. Dreaming as metaphor in motion. *Archives of General Psychiatry*, 1969, *21*, 696-703.

Underwood, B. J. *Experimental psychology*. (2nd ed.). New York: Appleton-Century-Crofts, 1966.

Williams, H. L., Hammack, J. T., Daly, R. L., Dement, W. C., & Lubin, A. Responses to auditory stimulation, sleep loss and the EEG stages of sleep. *Electroencephalography and Clinical Neurophysiology*, 1964, *16*, 269-279.

Williams, H. L., Morlock, H. C., Jr., & Morlock, J. V. Instrumental behavior during sleep. *Psychophysiology*, 1966, *2*, 208-216.

Winer, B. S. *Statistical principles in experimental design*. New York: McGraw-Hill, 1971.

Witkin, H. A. Influencing dream content. In M. Kramer, R. M. Whitman, B. J. Baldridge, & P. H. Ornstein (Eds.), Dream psychology and the new biology of dreaming. Springfield, Illinois: C. C. Thomas, 1969. (a).

Witkin, H. A., & Lewis, H. B. Presleep experiences and dreams. In H. A. Witkins & H. B. Lewis (Eds.), Experimental studies of dreaming. New York: Random House, 1967.