PRODUCTION OF STIMULUS INDEPENDENT THOUGHT AS A FUNCTION OF TASK PRIORITY, SIGNAL PREDICTABILITY, AND RATE OF SIGNAL PRESENTATION

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CHAPTER I

INTRODUCTION

Early psychologists made frequent attempts to understand human thought by studying its characteristics. James (1899), for example, characterized thought as being personal, constantly changing, "sensibly continuous," independent of itself, and selective. Of all its elusive properties, however, the property that has hindered the direct, objective study of thought processes is the personal and nonverifiable nature of human thought. The traditional scientific method as utilized within psychology requires that phenomena under study be accompanied by observable, objectively verifiable, and quantifiable events. Therefore, the content of thought and even the very occurrence of thought has remained beyond the scope of psychology.

Nevertheless, alterations in thought processes are commonly accepted as occurring and conscious states resulting from drugs, sleep, and self-induced states such as meditation, and daydreaming have become identified with particular alterations in normal thought processes. For example, we are all familiar with the experience of dreaming during sleep and the blank stare of the daydreamer. Specific alterations resulting from these general states have traditionally been more difficult to document, however, and, therefore, beyond the scope of scientific research.

Since thought processes have been beyond study this has led to the neglect of those states of consciousness which can only be experienced in a personal manner, i.e., that have no reliable observable correlate. Until recently dreaming was recognized as a commonly experienced state, but since it could not be located in time or directly observed by the experimenter it was rarely subjected to reliable scientific investigation. When rapid eye movements (REMs) were observed to accompany reports of dream activity it appeared that an objective method had materialized for the study of this subjective state of consciousness. Early successes in REM research led to tremendous enthusiasm on the part of scores of researchers and to the hope that physiological correlates would be found for other thought processes. Research began to seek physiological correlates for imagery processes (Oswald, 1957; Deckert, 1964; Simpson, Paivio, & Rogers, 1967; Paivio & Simpson, 1968), meditation (Anand, Chhina, & Singh, 1969; Kasamatsu & Hirai, 1969; Maupin, 1969; Wallace, 1970), hypnosis (Gastuat, 1969; Bertini, Lewis & Witkin, 1969; Shor, 1969), hallucinatory experiences (McGuigan, 1966),and other subjective states. Stoyva and Kamiya (1968) further contributed to this line of inquiry by proposing the strategy of converging operations (physiological indicator plus verbal report) as the rationale for the study of subjective states. Despite the fact that these early hopes have not been realized, the impetus provided by this line of research has continued. Given this new respectability and a change in the values of our society, psychologists no longer shy away from studying the characteristics of thought processes.

More recently research has been conducted upon the more subtle characteristics of human thought and self-induced states. The most common example of a subjective state which results in a significant alteration of thought processes is commonly referred to as daydreaming or mindwandering. When in this state an individual typically withdraws from the immediate sensory world and is preoccupied by events drawn from memory. Until recently little research had been done on this state due to its subjective and personal nature. This study will attempt to study variables which affect the occurrence of daydreaming and efficient performance.

Characteristics of Daydreaming

Singer and McCraven (1961) administered a questionaire about day-dream (DD) activity to 240 college educated adults between the ages of 19 and 50 years. Ninety-six percent of the sample reported some daily DD activity typically composed of images of people, events, or objects. The images were reported to be predominately visual. The content of the DDs revolved around anticipation and planning future actions and interpersonal contacts. Most DD activity appeared to occur at bedtime and little DD activity was reported to occur upon awakening, during meals and during sexual activity. Furthermore, most respondents reported that they found their DD activity enjoyable. Singer (1966) drew the following conclusions based upon the findings of this study:

> Analysis of the questionaire yields the general conclusion that daydreaming is a remarkably widespread common occurrence when people are alone and in restful motor states. It is a human function that chiefly involves resort to visual imagery and is strongly oriented towards future interpersonal behavior. (Singer, 1966, p. 57)

Practical concerns were the most frequently reported subject matter of DDs followed by DDs of sexual satisfaction, altruistic concerns, and unusual good fortune. Singer (1966) preferred to view the reported DDs as "attempts at exploring the future (p. 58)" rather than wishfulfilling ideation.

Higher incidences of DD activity have been found in younger Ss and in Ss raised in a city environment as opposed to the suburbs (Singer & McCraven, 1961). The development of the tendency to engage in DD activity was found to be fostered by an opportunity for the child to identify with a "benign parental figure" (usually the mother) who rewards the child for controlling his movements and emotions in situations demanding control of pressing desires and impulses (Singer, 1960; Singer & Schonbar, 1961; and Singer, 1966).

Socio-cultural variables also have been shown to be important for the production of DD activity. Singer and McCraven (1961) found that Negro and Jewish groups reported more DD activity than an Anglo-Saxon group. This finding was extended in another study by Singer and McCraven (1962) in which an Italian group reported the highest incidence of DDs followed in order from the highest reported incidence to the lowest by Negro, Jewish, Irish, and Anglo-Saxon groups. The three groups which reported the highest incidences of DD activity (Italian, Jewish, and Negro) saw themselves as least like their fathers in terms of behavioral preferences.

The DDs reported by the Ss in the Negro group tended to be concrete and realistic experiences concerned with sensual gratification and material security. The Irish group reported other-worldly, fantastic DDs which frequently contained instances of "modified partially controlled aggression." The Anglo-Saxon group produced the fewest DDs of an aggressive nature and the Negro, Jewish and Italian groups reported the highest incidences of erotic drive fantasies. The Ss in the

Irish group reported a high incidence of dramatic-heroic DDs frequently of a religious nature. Ss in the Italian group reported more DDs of a fatalistic nature.

Measures of intelligence and divergent productivity have not been found to correlate highly with reported DD frequency (Singer & Antrobus, 1963), but creativity in story writing has been shown to be related to DD frequency (Singer, 1961; Singer & Schonbar, 1961; Singer & McCraven, 1961).

One of the most interesting areas of research concerns the relationship between DD frequency and measures of anxiety. Singer and Schonbar (1961) used the Welsh A scale and Singer and Rowe (1963) used Cattell's Anxiety scale in studies of the relationship between DD activity and anxiety. Both of these studies found a positive correlation (.48 and .50 respectively) between anxiety and reported DD activity. Thus, the incidence of reported DD activity increased as measures of normal anxiety increased. Singer and Antrobus (1963) analyzed DD activity into several patterns. Normal anxiety was associated with "broad and wishful fantasy activity." Measures of instability, however, were found to be associated with fearful DDs preoccupied with the body. Singer (1966) reviewed these studies and concluded:

> The impression gained is less of one of neurotic, disturbed persons than one of persons willing to see themselves in temporal or spatial perspective and to engage in some form of imaginative living. In contrast, persons who limit their fantasy activity to fearful thoughts and somatic preoccupations seem more likely to be the ones who show evidence of clinical neuroticism. (Singer, 1966, p. 75)

Models of Daydreaming and Fantasy

Rosenbaum (1972) has advanced a theory of fantasy which assumes that fantasy results from the reification of cognitive structures which were appropriate to an earlier stage of development. These reified cognitive structures, cognitive residues, represent sets of expectations which have been replaced by newer, more accurate sets of expectations, but, nevertheless, the older structures remain intact in the mind. For example, when a young child sees an object hidden under a box he may first conclude that the object has disappeared. With experience the child acquires a concept of the permanence of objects and no longer concludes that the object has disappeared when it is hidden. Thus the child first acquires a cognitive structure which allows for the impermanence of objects which is eventually replaced by a more accurate cognitive structure. The older, inaccurate cognitive structure may remain intact, however, and may be reified when the newer structure does not hold up for some reason.

Reification is defined as the "tendency to seek fulfillment of expectations in as wide a range of experience as expectations allow (Rosenbaum, 1972, p. 472)." Reification may operate at either a passive level or an active level. Passive reification involves expectation alone. Events are predicted or anticipated by an individual without any attempt being made to maximize the possibility of realizing these expectations. Correct predictions tend to reinforce the cognitive structure representing the expectation and incorrect predictions result in correction and modification of the cognitive structure. Passive reification is rare, however, since any prediction usually affects the environment in some manner. In active reification the individual acts to control and direct the environment to increase the possibility of fulfilling his expectations. When his expectations are confirmed, the action taken is perceived to be adequate.

As long as expectations are confirmed a particular cognitive structure will continue to be reified. Failure of these expectations tends to inhibit or limit reification of the structure. In this situation the "risk" or "predictive necessity" associated with the structure determines the extent of the limitation of reification. Thus Rosenbaum (1972) seems to be saying that the structure might continue to be reified in low risk situations, but inhibited in high risk situations. Predictive necessity refers to the need to predict events regarding the fulfillment of basic biological needs.

Based upon his previous experiences or his "confidence" the individual controls and guides his predictive activity. Curiosity illustrates an expanding reification field, while conservatism describes a "stable and restricted reifying field (Rosenbaum, 1972, p. 473)." The coexistence of these two attitudes facilitates adaptation to the environment by aiding responses to novelty, and the maintenance of abilities and capacities already acquired.

Therefore, through experience the individual acquires a set of constantly updated, reasonable expectations about what to expect in the world. When these expectations are not met conflict is said to exist and future expectations for the same situation must be reshaped to prevent the occurrence of this conflict in the future. The process of resolving conflict and revising predictive structures is accomplished through three processes borrowed from Neisser (1962). Absorption occurs when old schemata or structures are incorporated within newer more inclusive schemata. The older schemata may continue to affect behavior, but they cannot be independently recalled. The second process is displacement. Displacement occurs when the old and the new schemata continue to exist independently, but the new schema provides a new way of dealing with the conflictive events. The third accomodative process, integration, is described as a "step to another level of abstraction in which outputs of the older models of processing are only a part of a more comprehensive whole (Neisser, 1962, p. 64-65)."

Older structures exist in the mind in the form of cognitive residues. These residues represent older sets of expectations which were contradicted yet continue to exist as an alternative set of expectations to prevent contradiction and modification of newer structures. Thus upon seeing a cartoon character walk on air we do not revise and modify our expectations concerning the operation of gravity, but an older, more primitive structure is temporarily reified which prevents a state of conflict from occurring. Obviously a serious modification of the current new structure concerning gravity is not called for and would clearly be maladaptive, so an older, less valid structure is reified which prevents immediate alteration of the newer structure.

Newer structures dominate older structures because of their continual reification, and residues continue to exist as residues because of the rarity of their reification. Rosenbaum proposes that when a newer structure is not realized or reified (expectations are not met) they temporarily "lose their effectiveness (Rosenbaum, 1972, p. 479)" and do not displace the older residues as actively. At this time the residues may be reified. This process guarantees the continued existance of the residues. The more a new structure fails to meet expectations the more an older residue will be reified and, therefore, maintain its presence as an alternative to the newer structure. The older residue will replace the newer one until it is realized that the residue represents a belief that has been abandoned or displaced by a newer structure. The newer structure then becomes dominant again.

Rosenbaum (1972) notes several implications of this model. He proposes that fantasy tends to propagate more fantasy and that this accounts for the continued existence of myths and legends. Further, he proposes that modern technology has created a situation which facilitates the establishment of numerous, intense cognitive residues. The existence of these residues results in an increased need for residual fantasy which cannot be rèalized. Thus experiences from movies may produce strong residual structures concerning flying men, invulnerability, and talking animals. These structures exert pressure to be reified, but the means of reification (movies etc.) are not always available. Thus according to Rosenbaum (1972) we live in a society which provides an excessive number of intense residual structures for which no adequate reification process exists. Rosenbaum (1972) proposes that the use of hallucinatory drugs may reflect this situation.

In response to the excess of residual structures Rosenbaum (1972) proposes that education be employed to limit the number of residues formed in children. He proposes restricting the child's exposure to fantasy expression and clearly differentiating between reality and fantasy for the child to accomplish this goal.

Though this model is facinating there appear to be some problems associated with it. First, Rosenbaum (1972) proposes a model in which cognitive structures are gradually modified and corrected when expectations about these structures are not met. It would appear that few, if any, older structures would continue to exist independent of modification if this modification process actually occurs. In other words, what determines when a structure is modified and when it is replaced entirely? Does it take a sudden insight or a traumatic event to retain an older structure independently of the modification process he proposes? Since most concepts are acquired gradually it appears that modification would be the prevailing form of accomodation and few residues would continue to exist in their older form.

In his explanation of drug abuse Rosenbaum (1972) fails to recognize the capacity of the mind for realizing or reifying fantasies or residues. Most individuals probably do not need external reification of their fantasies, but can derive satisfaction by internally reifying their fantasies. Rosenbaum (1972) seems to ignore the possibility that residues may be expressed through voluntary reification rather than through conflict situations. The ability to accept and experience one's own fantasies represents an important facet of mental health (Singer, 1966).

Klinger (1971) has proposed a model of fantasy which encompasses such activities as play, daydreaming, dreaming, and fantasy. According to Klinger (1971) fantasy episodes consist of integrated response sequences which proceed independent of feedback under the control of a "meaning complex." A meaning complex is defined as "an inarticulate but clearly structured response state whose formation must precede the segment (Klinger, 1971, p. 364)." Each fantasy segment consists of hierarchically organized components of relatively homogeneous content which unfolds in a smooth and automatic manner "with the completion of each segment serving as the discriminative stimulus for the onset of the next (Klinger, 1971, p. 361)."

Fantasy segments are associated with "subselves" which are defined as sets of attitudes and orientations which are adopted by individuals in specific situations or when acting in a particular role. When a subself is aroused by a thought or an external stimulus, relevant ideational responses are also aroused while irrelevant ones are suppressed. Thus, if an aroused thought is of particular significance to an individual, it may disrupt the current ongoing fantasy segment and elicit another subself. The new subself initiates a new integrated response segment until it is disrupted by still another stimulus. If a subself is not accompanied by instrumental activity during fantasy, it will be replaced by another subself. Furthermore, respondent segments (fantasy) associated with subselves are capable of initiating sequences of operant behavior through their thematic and affective content.

Respondent fantasy segments may intrude into operant activity as a function of the difficulty and duration of the operant task, sleep loss, and the lack of incentives for continued operant activity. These respondent segments may continue throughout the operant activity and may exert an influence upon current operant activity.

Klinger proposes that respondent segments may facilitate problem solving when the individual has the elements of the solution at hand, and he possesses the skills necessary to arrive at the solution.

Other important factors are the incentives for arriving at the solution, an opportunity for respondent activity and the individual's willingness and confidence to use respondent behavior.

Klinger (1971) proposes a concept of "current concerns" to account for the impact of incentives upon fantasy. "Current concerns" are a behavioral expression of the process of obtaining an anticipated incentive. This goal directed behavior persists until the goal is obtained or abandoned and it influences the content of behavior throughout the sequence. During this sequence of behavior respondent segments of relevance to the current concern will be potentiated. To the extent that incentives can induce goal directed behavior they can also potentiate fantasy content. Fantasy content, however, is influenced by incentive only to the extent that the probability of obtaining the incentive remains somewhat uncertain. Drives have no impact on fantasy except for their relationship with incentives.

Current concerns tend to elicit enhanced affect in relation to concern-related stimuli. Furthermore, when current concerns are consistent with ongoing operant activity the activity is likely to be experienced as less fatiguing and will be performed more efficiently. Just as current incentives can stimulate fantasy, unsettling events can stimulate fantasy content related to the events. Klinger (1971) attributes this to the relevance of the events to future incentives which are capable of eliciting new current concerns.

Klinger (1971) continues by proposing some conclusions about the relation of fantasy to overt behavior based upon his extensive review of the literature. He notes that for behavior supported by society correlations between content of fantasy and overt behavior are positive, for behaviors punished by society the same relationship is negative, and individuals who do not display a condemned activity tend to fantasize about the ill consequences of the activity. Self concepts tend to be positively related to fantasy content, and it seems that self concepts are constructed from information provided by fantasies.

The elaborate models proposed by Rosenbaum (1972) and Klinger (1971) have not yet been the subject of sufficient research to permit any firm conclusions to be drawn concerning the validity of these models, but a model advanced by Antrobus (1968) has generated considerable research.

Antrobus (1968) has proposed a model of information processing which recognizes external sensory experience and internal, non-perceptual events as common outputs of a limited capacity cognitive operator. The cognitive operator is able to process all inputs (both perceptual and non-perceptual events) as long as the capacity of the operator is not exceeded. Thus, in this state of affairs an individual's conscious awareness would consist of immediate sensory experience, thoughts related to the task, and spontaneous task-irrelevant cognitive activity (stimulus independent thought) arising from long-term memory. Daydreaming was operationally defined as any thought or group of thoughts which refer to events outside in time of the task at hand. Hereafter, daydreaming will be referred to as stimulus-independent thought (SI). When the capacity of the operator is exceeded a gating mechanism must operate to restrict one or more of the inputs to permit the remaining inputs to be processed adequately. Antrobus (1968) hypothesizes that the decision to gate out certain inputs in favor of other inputs is based on the relative "payoff" values of the inputs. "Payoff" value refers to the importance of the input to the individual. The cognitive operator works to maximize the total "payoff." When the demands of several inputs exceed the capacity of the cognitive operator a gating mechanism selects the inputs possessing the greatest "payoff" values to be processed. Thus an individual may be performing some task and simultaneously attending to long-term memories of a past event until his employer enters the room. The "payoff" value of work-related thoughts then quickly increases relative to other thoughts and the employee's mind returns to his work.

Review of the Literature

Several studies have confirmed the assumptions of the model proposed by Antrobus (1968). Antrobus, Singer, and Greenberg (1966) provided support for this model in a series of experiments on the production and suppression of SI thought. The first experiment hypothesized that less SI thought would be reported as the rate of signal presentation increased, and as reliance upon short-term memory for effective signal detection was increased. Ss were required to discriminate between high frequency and low frequency auditory signals in the non-memory condition. In the memory condition Ss had to compare each signal with the immediately preceding signal, and report either "same" or "different." Signals were presented at a high information rate (1/sec) or a low information rate (1/3 sec). Ss participated in each response condition (memory and non-memory) for trials of 2, 3, or 4 min duration. At the conclusion of each trial Ss rated the frequency of SI thought that occurred on the trial and also the frequency of various sub-categories of SI thought (Verbal

Thinking, Visual Imagery, and Auditory Imagery). The results indicated that SI thought and Visual Imagery were lower under the fast stimulus rate and the memory condition. Verbal Thinking was lower only on the fast stimulus rate, and Auditory Imagery was independent of both rate and memory conditions.

In the second experiment Ss were required to discriminate between high and low frequency tones and to report the occurrence of low tones. Fifteen signals were presented on each trial at a rate of 1/sec. At the conclusion of each trial the S operated a two position switch to indicate the presence or absence of SI thought on the just-completed trial. The penalty for failure to detect signals correctly was varied at 1 error/5¢, 2 errors/5¢, or 4 errors/5¢. The results of the experiment confirmed the hypothesis that an increase in the penalty would be accompanied by a decrease in reported SI thought. However, the "payoff" effect was confined to male Ss. The authors attributed this result to the satisfaction derived from mastering the task and satisfying Es instructions among the high-achieving college girls in the sample.

The third experiment sought to demonstrate that spontaneous cognitive events serve some useful function by varying the "payoff" for generating such events. Working on the assumption that spontaneous imaginal thought frequently serves a planning function in response to stimuli which disrupt the individual's projected environment, Antrobus et al. (1966) predicted that presenting S with information which drastically altered his projected environment would result in more reported SI thought. To test this hypothesis one group of Ss heard a mock broadcast just prior to the experiment which stated that Communist China had entered the Viet Nam war. A control group heard a neutral broadcast. It was predicted that the mock broadcast would disrupt the projected environment of the undergraduates in the experimental group and result in more reported SI thought in a signal detection task such as the one in the previous experiment. The results confirmed the hypothesis.

Antrobus (1968) provided further support for his model in a signal detection experiment in which Ss were required to detect up to three auditory signals presented at rates of 1/.5 sec, 1/sec, and 1/5 sec. Thus the information rate for the three presentation rates ranged from 2-6, 1-3, and .2-.6 bits per sec respectively. At the conclusion of each 15 sec trial, Ss were asked to indicate whether or not they experienced any SI thought during the trial. The amount of SI thought was found to decrease as the information rate increased. Such a finding is consistent with the limited capacity model proposed by Antrobus. As the demands of the task were increased a corresponding decrease in the processor's capacity allotted to lower "payoff" inputs (SI thought) occurred.

Drucker (1969) hypothesized that the degree of predictability in one's immediate environment determines the extent to which an individual can attend to task irrelevant material and maintain effective performance on the immediate task. Thus an individual can think about numerous irrelevant things while driving on a familiar street or redundant interstate highway, sampling the external environment only occasionally, but when driving on a less familiar or more hazardous highway he must maintain his attention on his driving. Drucker proposed that regular presentation of signals in a signal detection task would permit the "synchronization of an attentional scanning mechanism with sensory input," thereby, permitting S to simultaneously process material from long term memory and the immediate external environment. Irregular presentation of signals, on the other hand, would prevent the formation of "programs" for scanning the external environment, resulting in a decrease in an individual's ability to efficiently process information from both memory and the immediate sensory field. Thus an individual's signal detection performance would suffer or SI thought production would decrease. The results confirmed that most Ss decreased their processing of fantasy in the irregular tone condition and maintained tone detection on the same level with the regular tone condition. Continued processing of fantasy at high levels resulted in more tone detection errors in some Ss in the irregular tone condition.

In a second experiment Drucker (1969) attempted to determine if the results of the first experiment were due to greater general arousal elicited by the more novel, irregular, tone condition. The redeployment of attention observed in the first experiment may have resulted from greater general arousal making the S more prone to respond to the external environment. If this were the case then it would be expected that there would be increased processing of all external signals. To test this prediction a second experiment was conducted using the same procedure as before except that a concurrent visual, vigilance task was added. Ss were required to detect tones varying in pitch and concurrently detect luminance changes in one of several small lights. The arousal model predicted that better performance on the visual detection task would be associated with the irregular tone condition while the scanning-synchrony model would predict a decrease in processing the visual detection task. If the results of the first experiment were due to greater general arousal then there should be an equal tendency to respond to all external signals in the irregular tone condition. However, if the results were due to a "program" as the scanning-synchrony model would predict then the processing of the tones should draw approximately the same capacity as it did in the first experiment and the capacity required for processing should be taken from the processing of SI thoughts.

No difference in light detection was actually found between the two conditions, but Drucker felt that the model was not adequately tested. S tended to give higher priority to the visual detection task and suppressed both tone detection and fantasy production. Fantasy was never completely, suppressed, however, and Drucker concluded that the internal/external redeployment model based on arousal was not supported.

Further information on the role of arousal and daydreaming in the performance of a signal detection task was provided by a study conducted by Antrobus and Singer (1964). Ss were required to detect increments in brightness of a light during a 1½ hour watch session while either continuously counting or engaging in varied talking. During Varied Talking sessions Ss were instructed to "talk continuously and exclusively about anything they wished except rote material or anything associated with the experiment." During Counting sessions Ss were instructed to count continuously from 1 to 9. Varied Talking was considered to represent "an analogy of daydreaming or cognitive events with a high information level," whereas continuous counting was used to represent cognitive events of low information value. In this context information value refers to the predictability of sequential events.

The Watch session was preceded by two 3 minute, talking Alert periods alternated with two silent Alerts. Mean signal presentation rates were .4/min during the Watch session and 3/min during the Alert sessions. It was predicted that the higher information value of Varied Talking would act to maintain arousal during the detection period and result in either an increase or decrease in discriminatory performance. The results indicated that a significant decrement effect occurred when Alert minus Watch detections were summed across both talking conditions, but no significant difference in detections was observed between the talking conditions. A drowsiness scale administered to Ss revealed that Ss were more aroused during the Varied Talking condition than the Counting condition. Drowsiness on the Watch was associated with a decrement in detection performance in both talking conditions. Antrobus and Singer concluded that although Varied Talking increased arousal, the S-produced cognitive events of Varied Talking interfered with detection performance offsetting any possible advantage derived from the increased arousal.

To test this hypothesis a second experiment was conducted which attempted to control the level of arousal for the two talking conditions. In this experiment three minute Varied Talking trials were alternated with three minute Counting trials to prevent any major changes in arousal level. Since the interference of internally produced information upon detection performance might be assumed to be a function of the information rate of both internal and external sources, two stimulus rates (20 and 30 per minute) were used in this experiment. The entire experiment consisted of eight 3 minute Varied Talking trials and eight 3 minute Counting trials. In addition, band music was played between trials as an aid in maintaining arousal. The detection task was essentially the same as in the previous experiment.

This experimental design was successful in maintaing arousal at a high level and minimizing differences in arousal between the two talking conditions. With arousal eliminated as a factor the predicted interference of Varied Talking upon detection performance was supported. Detection performance during Varied Talking was significantly inferior to detection performance during Counting. No difference in performance was observed between the two information rates, however.

Thus Antrobus and Singer demonstrated that SI thought may interfere with task performance on a short-term basis, but on a longer duration task the increased arousal generated by SI thought acts to maintain task performance at a level comparable to that attained with monotonous, repetitive internal content. In conclusion, Antrobus and Singer point out that SI thought may interfere with discriminatory behavior when external stimulation maintains optimal arousal, but when external stimulation is reduced SI thought may enhance arousal and, therefore, improve discriminatory performance.

Goldstein (1968) attempted to determine if a sequential processing model or a parallel processing model applied to the production of SI thought. Eleven Ss were presented with a detection task in which auditory signals were presented at either 1 or 3 bits of information per presentation. Four intervals between a correct response and the next signal were used (0.0, 0.1, 1.0, and 4.0 sec). Each signal remained on until until a correct response was elicited. Ss received 100 15 sec trials.

The sequential model states that the central cognitive operator can attend to only one source of inputs (internal or external) at a time, and must process inputs by switching from one source to the other. Under this model production of SI thoughts would have to be limited to the intervals between the correct response and the next signal. Thus the length of this interval should affect the amount of SI thoughts reported. As the duration of the interval decreases, the probability of an SI thought should decrease. In a parallel processing model, however, the cognitive operator does not have to switch back and forth between the inputs and, therefore, the interval should exert no influence upon the production of SI thoughts.

The signal density (no. of bits/sec) results in an increased load on the cognitive operator, decreasing the amount of operator space available to SI thought in the parallel model but not in the sequential model. Thus, the sequential model predicts that increasing the interval between the correct response and the next signal should increase the proportion of SI thought reported, but the signal density should have no effect. If the parallel model is appropriate increasing the signal density should decrease the amount of SI thoughts reported, but varying the interval should not influence reported SI thought.

The results did not clearly support one model or the other. Production of SI thoughts increased as a function of both the signal density and the duration of the interval between the correct response and the subsequent stimulus. Only the interval effect attained statistical significance due to the small number of Ss, however, suggesting the sequential model. Evidence for the parallel model was noted, however, in that the probability of an SI thought was greater than zero for the 0 sec interval. Thus SI thoughts had to be generated during the processing of the stimuli.

Fortgang (1968) conducted a study in order to determine the contribution of modality-specific processing stages in the production of SI thought. Ss received either a visual detection task or an auditory detection task. Within each condition, half of the Ss were instructed to make an SI thought response for visual imagery thoughts and the other half were to make a similar response for the occurrence of auditory imagery. The auditory stimuli were two independent tones differing in intensity and presented in four possible signal confirurations (high intensity tone alone, low intensity tone alone, both tones simultaneously, and neither tone). The visual stimuli were figures (verticle line, horizontal line, both, and neither) superimposed upon a green circle. The signals were presented at rates of 1/5 sec, 1/sec, and 1/.5 sec creating information rates of .4, 2, and 4 bits/sec, respectively.

The results indicated that an increasing information rate inhibited imagery in the same sensory modality as the task rather than in the other modality. This supports a model in which long-term memory events of a particular modality share the processing stages for that modality. Thus when stimuli are to be processed, SI imagery production in the same modality as the task must be inhibited, but

SI imagery in the other modality may continue to be processed.

Antrobus, Antrobus, and Singer (1964) studied eye movements accompanying daydreaming, visual imagery, and thought suppression. Ss were interviewed to determine if any consistent cognitive content accompanied 4 sec intervals of either ocular motility or ocular quiescence using an interruption technique similar to that used in dream research (Dement & Kleitman, 1957; Aserinsky & Kleitman, 1953). Ss were also instructed to carry out specific instructions during three 1 minute intervals (episodes) consisting of generating and suppressing a wish, relaxed and active thinking, and moving and static visual imagery with eyes open and closed.

The data obtained from the interruption interviews revealed that periods of ocular motility were associated with more reports of looking around the room or direct perceptual activity than interruptions following ocular quiescence. "Secret wish" instructions resulted in slower rates of eye movements than instructions to suppress the wish and blinks were more frequent during the suppression instruction.

Only the instructions to visualize a moving scene with eyes closed resulted in more eye movements than the suppression period. Furthermore, blink rates during active thinking episodes were twice as high as during passive thinking episodes, and also higher than during the wish suppression episodes.

Instructions to visualize movement resulted in the greatest number of eye movements especially with the eyes closed. Also, blinking was more frequent under movement instructions than static instructions.

Thus episodes of wish-fulfilling daydreaming appeared to be associated with a decrease in ocular activity while instructions to suppress a wish or fantasy were associated with increased eye movements and blinking. It appears, therefore, that ocular activity reflects the rate of change of cognitive content.

Statement of the Problem

The studies reviewed reveal that reports of SI thought can be suppressed or facilitated by manipulating several variables which increase or decrease the amount of channel capacity delegated to the performance of a task. The most direct way this has been accomplished has been to increase or decrease the number of signals to be processed in a given time period or vary the information rate of the signals (Antrobus, Singer & Greenberg, 1966; Antrobus, 1968). As the signals come closer together in time the capacity left free for SI activity to be processed is decreased.

Another way to suppress SI thoughts is to vary the temporal certainty of signals (Drucker, 1969). The more predictable the occurrence of signals becomes, the more an S can safely attend to SI thoughts without risking a decrement in task performance. Moreover, when Ss are required to perform some mental operation on the signals, the demands of the task are increased and, therefore, the capacity available for SI thought is reduced (Antrobus et al., 1966).

All of the above variables operate on the task in order to vary the cognitive capacity allotted to the task at hand, others operate indirectly upon the task through motivational factors. Thus, Antrobus, Singer, and Greenberg (1966) were able to manipulate reported SI thoughts by varying the penalty for failure to detect signals and by disrupting the S's projected future.

Antrobus' model represents an information processing model which recognizes two potential sources of inputs to a limited capacity cognitive operator. The two potential sources of inputs are external sensory events and internal events. These two sources of events each exert some pressure for space in the cognitive operator proportionate to their "payoff" value or other demand characteristics.

To date little research has been done on the impact of short term (ST) memory load upon the capacity of the cognitive operator of Antrobus' model and the remaining capacity available for SI thought production. Antrobus, Singer and Greenberg (1966) found that having Ss compare a previous signal with a current signal in a signal detection task resulted in a suppression of rated frequency of SI thought, but this study represents the only study of SI thought production and memory processes.

Effective performance of dozens of tasks encountered in daily life is dependent upon the effective processing of both immediate, external sensory events and events drawn from memory. The relative priorities of immediate sensory events and events in memory may vary from one situation to another and help determine what is attended to or what receives space in the cognitive operator of Antrobus' model. One individual sitting in a classroom may be absorbed in the instructor's lecture due to its importance for his grade in the course, and be completely unaware of any past or future events except for an occasional instance of mindwandering. The person sitting next to him may be simultaneously experiencing difficulty attending to the lecture due to the impact of some event that occurred just prior to the class or the anticipation of an event later in the hour (e.g., rehearsing a class presentation). These two individuals differ in the relative priorities they have assigned to the two sources of inputs to the cognitive operator. Both inputs may be task oriented, but one is immediate and of a sensory nature while the other in concerned with events primarily in memory. It should be noted that the sensory events described above should not be classified as daydreaming since they are frequently task oriented. Occasional SI thoughts may occur, however, as the demands or priorities permit their occurrence. The individual who is trying to attend to both the instructor's lecture and to rehearse a class presentation may find he can do both effectively, but this will depend on several characteristics of the situation such as the rate of the instructor's speech, the predictability of his subject matter, and any other demands placed upon the listener.

The present study attempts to investigate the variables of importance for the simultaneous performance of a memory task and a signal detection task placing demands upon the sensory apparatus. The study was directed at determining the impact of such a task situation on the production of SI thought. The relative priorities of the two tasks were varied along with the demands of the signal detection task, and the predictability of the detection task.

Ss were presented with a series of 20 trials each of which consisted of a digit recall task and a signal detection task. The priority of the tasks was varied by varying the monetary payoff of each task, and the demands of the signal detection task were varied by varying the signal rate. Half of the Ss received the signal detection trials in a predictable manner and the remaining Ss received the trials in a less predictable manner. Ss in the regular condition (RC) received the signal detection trials at a constant signal rate within each group of 20 trials. Ss in the irregular condition (IC) received the detection trials within each group of trials at both signal rates.

It was predicted that the regular presentation of the signal detection trials would permit the development of "scanning programs" or rehearsal strategies which would permit Ss to attend to both the recall task and the signal detection task. Therefore, it was expected that detection performance and reported thoughts about the digits would be maintained at high levels in both the high payoff recall (HR) and low payoff recall (LR) conditions. SI thought production (ST and LT thoughts) was expected to remain at high levels in the regular conditions, but to decrease as the signal rate of the detection task limits attention to other, nontask oriented inputs.

Irregular presentation of the signal detection trials was expected to limit the development of "scanning programs" or rehearsal strategies, and Ss would be forced to attend to one task or the other, or attend to both tasks with great difficulty. Irregular presentation of the signals was expected to demand more channel capacity of the cognitive operator than regular presentation of the trials and to result in less capacity available for the production of SI thoughts. High recall (HR) Ss were expected to give greater attention or priority to the recall task yielding more reported thoughts about the digits. Ss in this condition were expected to attend to the detection task when the signal rate permitted rehearsal of the digits and the detection payoff was greatest. LT thought production was expected to be at a minimum in this condition. Ss in the low recall condition were expected to attend primarily to the detection task resulting in high detection performance and fewer reported thoughts about the digits, and to attend to the recall task when the signal rate permitted rehearsal of the digits. LT thought production for the low recall condition was expected to be greater than for the high recall condition. Thus, excess cognitive capacity and, therefore, SI thought production was expected to vary as a function of the payoffs and the signal rate in the irregular conditions.

CHAPTER II

METHOD

Subjects

Forty-eight undergraduate volunteers were obtained from psychology classes to serve as Ss in the experiment. The sample was composed of 24 males and 24 females. Ss were paid $1.00 for participating in the experiment and were told that they could earn up to an additional $1.00 in the experiment.

Materials and Apparatus

The experimental apparatus was set up with the programming equipment and E's control panel in one room and the S's response panel in an adjoining room. The rooms were connected by a two-way mirror so that E could observe the S without being a source of distraction to the S. The S's response panel contained a one plane readout display (Industrial Electronic Engineers, model no. 10-4749-1820L), 2 three position signal detection switches (one for Ss preferring to use their left hand and another for Ss preferring to use their right hand), 2 three position report switches, 2 signal detection payoff lights (green), a counter for accumulating the amount of money earned by the S, a rest light (red), a series of five red lights corresponding to the five portions of each trial of the experiment, and an apparatus for recalling the digits.

The control panel operated by E contained a one plane readout display, a series of five lights corresponding to the five portions of each trial (red), a bank of four counters which accumulated the number of trials presented, the number of detections which were present and absent, the number of signals correctly detected on each trial, and the amount of money earned by S. The control panel also contained 5 push-buttons used to initiate a trial, reset various functions of the apparatus, increment the payoff counters, and to signal S to repeat his recall of the digits. Three 3 position toggle switches on the control panel controlled the selection of the signal rate, illuminated the appropriate detection payoff lights on S's panel, and illuminated similar recall payoff lights on S's panel.

The entire experiment consisted of 80 trials presented in 4 groups of 20 trials. Each S received 20 trials at each unique combination of the two detection payoffs and two signal rates (see Table I). Each of the 80 trials of the experiment consisted of a series of five successive periods which were each signaled by the illumination of a red light on both the S's and E's panel. The five periods of each trial were: (1.) Ready; (2.) the presentation of a series of 5 digits (Digits); (3.) a signal detection task (Detect); (4.) reporting the presence or absence of stimulus independent (SI) thoughts during the signal detection task (Report); and (5.) the recall of the digits presented at the beginning of the trial (Recall). A flow chart of the sequence of the events on each trial is presented in Figure 1.

At the onset of the trial a series of 5 digits were presented on the display at a rate of 1 per sec. Four independent random sets of 20 groups of digits were constructed. Each of the sets of 20 groups of digits was randomly assigned to one of the four groups of trials

TABLE I

NUMBER OF TRIALS FOR EACH WITHIN-SUBJECTS TREATMENT COMBINATION

	Detection Payoff: Low		Detection Payoff: High	
	Signal Rate		Signal Rate	
	Low	High	Low	High
Number of Trials	20	20	20	20

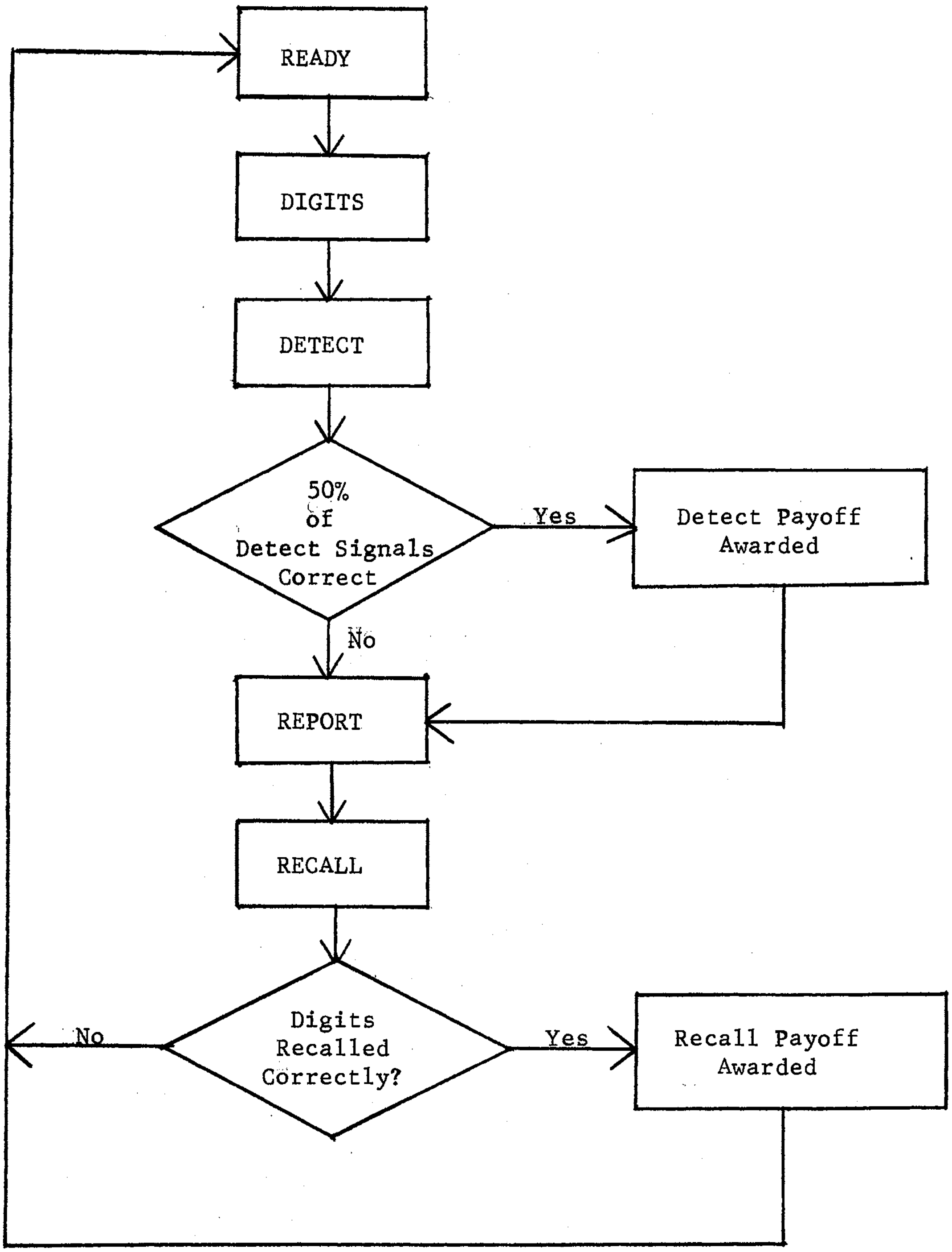

Figure 1. A Flowchart Presentation of the Sequence of Events on Each Trial of the Experiment

making up the experiment of each S. The order of the digit sets was randomly determined for each S with the limitation that within each between Ss condition each set of digits occurred three times at each of the four possible positions.

Immediately following the presentation of the last digit the Detect light was illuminated and a 20 sec signal detection task began. During the signal detection task a red light would appear on the display at one of two possible signal rates (1 per 2 sec or 1 per 5 sec). If a tone accompanied the red light, Ss were instructed to operate a 3 position toggle switch (detection switch) to the present position. If a tone did not accompany the red light, Ss were instructed to operate the toggle switch to the absent position. The tones were produced by an audio generator (LVE WA-44c) and were presented through a set of Sony headphones (DR 3a). The apparatus was programmed so that 50% of the signals on each trial would be present (tone present) and 50% would be absent (tone absent). If the detection switch was operated in the correct direction within ½ sec following the onset of the red light, the word "correct" would appear on the display. Otherwise the words "not correct" would appear on the display. When Ss correctly detected 50% or more of the signals on a trial he was awarded the current detection payoff. On high detection payoff trials Ss were awarded 1.0¢ and on low detection payoff trials Ss were awarded .1¢. The detection payoff was held constant within each group of 20 trials.

At the conclusion of the signal detection task the Report period began. During the Report period Ss were asked to report whether or not they experienced any short term (ST) or long term (LT) SI thoughts during the signal detection task. Short term SI thoughts were defined as thoughts about the digits (e.g., rehearsal, attempts at recall, etc.). Long term SI thoughts were defined as instances of mindwandering or daydream activity not related to the digits, the detection task, or any other stimulus or event occurring during the detection task. Two 3 position toggle switches were provided for reporting ST and LT independent thoughts. If a thought occurred during the detection task the appropriate switch was to be operated to the "present" position. If no such thought occurred the switch was to be operated to the "absent" position. Both switches were to be operated on each trial.

After both report switches had been operated, a 10 sec Recall period began. Ss were provided with a stylus which completed an electrical circuit when touched to one of nine contacts representing the digits. When Ss touched the stylus to one of the contacts, the appropriate digit was illuminated on both the S's and E's display. At the conclusion of the Recall period Ss were awarded payoff appropriate to their experimental condition if they recalled the digits correctly. Next, the Ready light was illuminated to prepare the S for the beginning of the next trial.

Procedure

Upon entering the experimental room each S was randomly assigned to one of four conditions resulting from a factorial arrangement of the two between Ss variables of the experiment (Regular-Irregular, and High and Low Payoff Recall). Ss were asked to read a booklet of instructions (see Appendix A) informing the S that he would be asked to perform two tasks simultaneously and that the payoffs for successfully performing one of the tasks would be varied. Each S was told to attempt to maximize his total payoff by performing both tasks if possible or by performing a single task if performing both tasks became impossible.

After each S had read the instructions he was asked to classify a series of ten thoughts as stimulus independent or stimulus dependent. The thoughts were typical of thoughts S might experience during the detection tasks and were presented to make certain S understood the definition of SI thoughts and was capable of identifying such thoughts (see Appendix B). When the S had completed classifying the thoughts, E examined S's responses and explained any errors of classification made by the S.

A series of 18 practice trials were then administered to the S. S performed the first two practice trials in the presence of E so that any initial difficulties encountered by S could be readily corrected. Appendix C presents the characteristics of the practice trials administered to each S. Upon completion of the practice trials the S's payoff counter was reset to 0 and the experiment was begun.

Ss were presented 80 trials in four blocks of 20 trials. Ss in the Regular signal condition (RC) received all of the signal detection trials at the same signal rate within each block of 20 trials. Thus Ss in this condition received a different combination of signal rate and detection payoff for each group of trials. In the Irregular signal condition (IC) Ss received both signal rates within each block of trials. The two signal rates were randomly distributed within each block of 20 trials so that each signal rate occurred on 10 trials. Four independent randomizations of the signal rates were constructed and randomly assigned to each group of trials for each S with the limitation that within each between Ss condition each of the four randomizations occurred three times at each of the four possible positions.

Ss in the high payoff recall condition (HR) were told that they would receive 1.0¢ each time they correctly recalled the digits on a trial. Ss in the low payoff recall condition (LR) were told that they would receive .1¢ each time they correctly recalled the digits on a trial.

CHAPTER III

RESULTS

Experimental Design

The design of the experiment was a four factor experiment with two between Ss factors and two within Ss factors (Kirk, 1968, p. 311-312). All factors were at two levels. The between Ss factors were signal presentation mode (regular or irregular) and recall payoff (high or low). The within Ss factors were detection payoff (high or low) and signal rate (high or low). Twelve Ss participated in each of the four between Ss contitions created by a factorial arrangement of the two between Ss factors. The dependent variables of the experiment were d' values, reported ST thoughts, reported LT thoughts, and recall performance. Means for each of the dependent variables were computed for each group of twenty trials which were presented at each of the treatment combinations created by the factorial arrangement of the two within Ss treatments. Since the raw data for reported ST thoughts, reported LT thoughts, and recall performance were expressed in percentages, arcsin transformations were performed on the data of each of these dependent variables prior to the analysis of the data. The arcsin transformations were performed to insure that the data of these variables were normally distributed and to stabilize the variances. The analyses for the untransformed data of each dependent variable appear in Appendix D.

Detection Performance

The data from the detection task was subjected to a signal detection analysis. The percentage of present signals which were correctly detected (hits) and the percentage of absent signals which were incorrectly detected (false alarms) were computed and d' scores were computed from these values according to the procedures outlined by Hochhaus (1972). The mean d' values for each treatment combination are presented in Table II. The analysis of the d' data is presented in Table III. The analysis revealed that the main effect for signal rate was significant ($F = 40.42$, 1, 44 df, $p. < 001$). The higher signal rate (1/2 sec) resulted in significantly higher values of d'. No other main effects or interactions were statistically significant.

Short Term Thoughts

The percentage of trials on which Ss reported the presence of ST thoughts (thoughts about the digits) was computed for each treatment combination and is presented in Table IV. The results of the main analysis revealed a significant detection payoff by signal rate interaction ($F = 4.69$, 1, 44, $p < .05$) (see Table V). All other main effects and interactions were not significant. The Newman-Keuls procedure was applied to the means of this interaction (see Table VI) and the results are presented in Table VII. The mean of the high detect payoff and high signal rate treatment combination proved to be significantly different from the mean of the high detect payoff and low signal rate treatment combination. None of the other comparisons were significant.

TABLE II

MEAN d' VALUES

		Detection Payoff: Low		Detection Payoff: High	
		Signal Rate		Signal Rate	
		Low	High	Low	High
Regular	High Recall Payoff	1.69	1.74	1.38	1.97
	Low Recall Payoff	1.51	2.21	1.58	2.22
Irregular	High Recall Payoff	1.14	1.51	1.05	1.52
	Low Recall Payoff	1.34	1.82	1.29	1.92

TABLE III

AOV OF MEAN d' DATA

Source	df	MS	F
Total	191		
Between Ss	47		
Presentation Mode (A)	1	4.70002	1.48
Recall Payoff (B)	1	4.12425	1.30
AB	1	0.02430	<1
Ss w. Grps.	44	3.18238	
Within Ss	144		
Detect Payoff (C)	1	0.04625	<1
AC	1	0.14520	<1
BC	1	0.19635	1.22
ABC	1	0.18750	1.17
C X Ss w. Grps.	44	0.16038	
Signal Rate (D)	1	12.64851	40.42##
AD	1	0.00075	<1
BD	1	0.44853	1.43
ABD	1	0.17885	<1
D X Ss w. Grps.	44	0.31295	
CD	1	0.34003	1.84
ACD	1	0.12100	<1
BCD	1	0.16568	<1
ABCD	1	0.49817	2.70
CD X Ss w. Grps.	44	0.18480	

Note: Significance levels are represented in all tables by the following: * = p<.05; ** = p<.025; *** = p<.01; # = p<.005; ## = p<.001.

TABLE IV

PERCENT OF TRIALS WITH REPORTED SHORT TERM THOUGHTS

		Detection Payoff Low		Detection Payoff High	
		Signal Rate		Signal Rate	
		Low	High	Low	High
Regular	High Recall Payoff	82	80	82	81
	Low Recall Payoff	93	90	89	85
Irregular	High Recall Payoff	90	87	93	88
	Low Recall Payoff	80	87	86	85

TABLE V

AOV OF PERCENT OF TRIALS WITH REPORTED SHORT TERM THOUGHTS

Source	df	MS	F
Total	191		
Between Ss	47		
Presentation Mode (A)	1	0.11549	<1
Recall Payoff (B)	1	0.02528	<1
AB	1	1.18761	<1
Ss w. Grps.	44	2.24917	
Within Ss	144		
Detect Payoff (C)	1	0.00444	<1
AC	1	0.05880	<1
BC	1	0.04895	<1
ABC	1	0.02883	<1
C X Ss w. Grps.	44	0.07726	
Signal Rate (D)	1	0.18875	2.85
AD	1	0.11684	1.76
BD	1	0.05415	<1
ABD	1	0.16504	2.50
D X Ss w. Grps.	44	0.06616	
CD	1	0.20468	4.69*
ACD	1	0.12607	2.89
BCD	1	0.05867	1.34
ABCD	1	0.02269	<1
CD X Ss w. Grps.	44	0.04369	

TABLE VI

MEANS OF THE DETECTION PAYOFF X SIGNAL RATE INTERACTION FOR SHORT TERM THOUGHTS

Detection Payoff			
Low		High	
Signal Rate		Signal Rate	
Low	High	Low	High
86	86	88	85

TABLE VII

TESTS ON THE DETECTION PAYOFF X SIGNAL RATE INTERACTION FOR SHORT TERM THOUGHTS USING THE NEWMAN-KEULS PROCEDURE

Conditions	Means	Arcsin Means	2.52	2.60	2.60	2.65
			85	86	86	88
High Detect Payoff High Signal Rate	85	2.52	----	.08	.08	.13*
Low Detect Payoff High Signal Rate	86	2.60		----	.00	.05
Low Detect Payoff High Signal Rate	86	2.60			----	.05
High Detect Payoff Low Signal Rate	88	2.65				----

p	2	3	4
Wp (.05)	.09	.10	.11
Wp (.01)	.12	.13	.14

$$Wp = q_{(p,n)} \sqrt{\frac{MS\ error}{n}}$$

Thus, the percentage of reported ST thoughts was higher for the low signal rate than for the high signal rate for the high detection payoff condition.

Long Term Thoughts

The percentage of trials on which Ss reported long term thoughts was computed for each treatment combination in the experiment. Table VIII contains the means of the treatment combinations. The results of the main analysis of the long term thought data which is presented in Table IX revealed a significant presentation mode by detection payoff by signal rate interaction ($F = 5.12$, 1, 44 df, $p < .05$).. A separate analysis was performed on each level of the presentation mode factor to aid in locating the source of this interaction. Table X presents the results of the separate analysis of the data for the regular presentation mode. No significant main effects or interactions were observed in this analysis.

The analysis of the data of the irregular presentation mode is contained in Table XI. The separate analysis of the irregular presentation mode revealed a significant detection payoff by signal rate interaction ($F = 5.75$, 1, 22 df, $p < .05$). Table XII contains the means involved in this interaction. The Newman-Keuls procedure was applied to the means involved in this interaction and the results are presented in Table XIII. The mean of the low detect payoff and low signal rate treatment combination was found to be significantly different from each of the other means of this interaction. None of the other comparisons were significant.

TABLE VIII

PERCENT OF TRIALS WITH REPORTED LONG TERM THOUGHTS

		Detection Payoff			
		Low		High	
		Signal Rate		Signal Rate	
		Low	High	Low	High
Regular	High Recall Payoff	49	47	49	39
	Low Recall Payoff	48	48	48	45
Irregular	High Recall Payoff	45	39	42	43
	Low Recall Payoff	58	47	46	46

TABLE IX

AOV OF PERCENT OF TRIALS WITH REPORTED LONG TERM THOUGHTS

Source	df	MS	F
Total	191		
Between Ss	47		
Presentation Mode (A)	1	0.02399	<1
Recall Payoff (B)	1	0.57710	<1
AB	1	0.17005	<1
Ss w. Grps.	44	1.57055	
Within Ss	144		
Detect Payoff (C)	1	0.43135	2.85
AC	1	0.00003	<1
BC	1	0.22577	1.49
ABC	1	0.25295	1.67
C X Ss w. Grps.	44	0.15161	
Signal Rate (D)	1	0.37128	1.99
AD	1	0.00206	<1
BD	1	0.01797	<1
ABD	1	0.17378	<1
D X Ss w. Grps.	44	0.18709	
CD	1	0.00633	<1
ACD	1	0.33551	5.12*
BCD	1	0.08420	1.29
ABCD	1	0.00109	<1
CD X Ss w. Grps.	44	0.06549	

TABLE X

AOV OF PERCENT OF TRIALS WITH REPORTED LONG TERM THOUGHTS FOR THE REGULAR PRESENTATION MODE

Source	df	MS	F
Total	95		
Between Ss	23		
Recall Payoff (B)	1	0.06031	<1
Ss w. Grps.	22	1.15074	
Within Ss	72		
Detect Payoff (C)	1	0.21219	1.88
BC	1	0.00039	<1
C X Ss w. Grps.	22	0.11297	
Signal Rate (D)	1	0.15902	<1
BD	1	0.15175	<1
D X Ss w. Grps.	22	0.25061	
CD	1	0.12483	1.34
BCD	1	0.03306	<1
CD X Ss w. Grps.	22	0.09329	

TABLE XI

AOV OF PERCENT OF TRIALS WITH REPORTED LONG TERM THOUGHTS FOR THE IRREGULAR PRESENTATION MODE

Source	df	MS	F
Total	95		
Between Ss	23		
Recall Payoff (B)	1	0.68684	<1
Ss w. Grps.	22	1.99035	
Within Ss	72		
Detect Payoff (C)	1	0.21918	1.15
BC	1	0.47833	2.51
C X Ss w. Grps.	22	0.19024	
Signal Rate (D)	1	0.21432	1.74
BD	1	0.04000	<1
D X Ss w. Grps.	22	0.12356	
CD	1	0.21701	5.75*
BCD	1	0.05223	1.39
CD X Ss w. Grps.	22	0.03772	

TABLE XII

MEANS OF THE DETECTION PAYOFF X SIGNAL RATE INTERACTION FOR LONG TERM THOUGHTS

	Detection Payoff			
	Low		High	
	Signal Rate		Signal Rate	
	Low	High	Low	High
Regular	48	48	49	42
Irregular	52	43	44	44

TABLE XIII

TESTS ON THE DETECTION PAYOFF X SIGNAL RATE INTERACTION OF THE IRREGULAR PRESENTATION MODE FOR LONG TERM THOUGHTS USING THE NEWMAN-KEULS PROCEDURE

	Means		43	44	44	52
Conditions		Arcsin Means	1.42	1.43	1.43	1.62
Low Detect Payoff High Signal Rate	43	1.42	----	.01	.01	.20***
High Detect Payoff Low Signal Rate	44	1.43		----	.00	.19***
High Detect Payoff High Signal Rate	44	1.43			----	.19***
Low Detect Payoff Low Signal Rate	52	1.62				----

	2	3	4
Wp (.05)	.12	.14	.16
Wp (.01)	.16	.18	.20

$$Wp = q_{(p,n)} \sqrt{\frac{\text{MS error}}{n}}$$

Digit Recall

An analysis of the percentage of digits recalled correctly for each treatment combination (see Table XIV) revealed a significant main effect for signal rate (see Table XV) ($F = 17.84$, 1, 44 df, $p < .001$). Recall of the digits was significantly better for the low signal rate than for the high signal rate.

TABLE XIV

PERCENT OF TRIALS ON WHICH THE DIGITS WERE RECALLED CORRECTLY

		Detection Payoff Low		Detection Payoff High	
		Signal Rate Low	Signal Rate High	Signal Rate Low	Signal Rate High
Regular	High Recall Payoff	93	85	92	87
	Low Recall Payoff	92	78	88	77
Irregular	High Recall Payoff	85	80	85	80
	Low Recall Payoff	80	75	79	73

TABLE XV

AOV OF PERCENT RECALLED

Source	df	MS	F
Total	191		
Between Ss	47		
Presentation Mode (A)	1	1.79997	1.72
Recall Payoff (B)	1	1.41905	1.35
AB	1	.09495	<1
Ss w. Grps.	44	1.04862	
Within Ss	144		
Detect Payoff (C)	1	0.00127	<1
AC	1	0.01381	<1
BC	1	0.05528	<1
ABC	1	0.04320	
C X Ss w. Grps.	44	0.10422	
Signal Rate (D)	1	2.00152	17.84##
AD	1	0.18087	1.61
BD	1	0.15983	1.43
ABD	1	0.09230	<1
D X Ss w. Grps.	44	0.11218	
CD	1	0.01453	<1
ACD	1	0.03436	<1
BCD	1	0.00502	<1
ABCD	1	0.07152	<1
CD X Ss w. Grps.	44	0.08763	

CHAPTER IV

DISCUSSION

The tasks of this experiment did not prove to be as demanding for the Ss as they were expected to be. Ss proved to be reasonably proficient at both the detection and the recall tasks. Because of this it is possible that Ss did not have to select the task to attend to on the basis of the relative payoffs, but were able to perform both tasks with roughly comparable levels of performance regardless of the experimental conditions. In spite of the high levels of task performance exhibited by Ss in the experiment, the results of the experiment proved to be interesting.

Production of ST thoughts (thoughts about the digits) was influenced by the detection payoff and the signal rate. Under the treatment combination of high detection payoff and low signal rate, a higher percentage of ST thoughts were reported than for any of the other treatment combinations. The recall payoffs and the presentation modes did not influence the production of ST thoughts. It had been predicted that the production of ST thoughts would be influenced by the signal rate in the regular presentation mode, and by the recall payoff, the detection payoff and the signal rate in the irregular presentation mode. Thus the ST thought data of the experiment was not consistent with the hypotheses.

It appears contradictory that more thoughts about the digits would be generated by the high detection payoff condition without regard to the recall payoffs. From a motivational point of view it seems possible that the high detection payoff coupled with the sensory demands of the detection task would act to increase the general arousal of the Ss and, consequently, their attention to both of the tasks. The increased demands of the high signal rate reduced the percentage of reported ST thoughts for the high detection payoff condition to the level of the low detection payoffs.

Another possible interpretation is that the significant signal rate effect for the high detection payoff condition reflects a tendency for Ss to adopt a rehearsal strategy. Thus, Ss responded to the high detection payoff conditions by rehearsing the digits in the intervals between the signals, and the probability of thinking about the digits was, therefore, a function of the length of the intervals between the signals. In the low detection payoff conditions the decreased payoffs led Ss to generally give more emphasis to the recall task. Ss in the low detection payoff conditions, therefore, tended to rehearse the digits independent of the physical characteristics of the signals.

In contrast to the ST thought data, the LT thought data more closely corresponds to the hypotheses. It was expected that the production of LT thoughts would be influenced by the signal rate in the regular presentation mode. The results of the analysis of the data for the regular presentation mode, however, indicates that neither the signal rate nor any of the other variables of the experiment had any impact upon the production of LT thoughts. Thus, in the regular presentation conditions, Ss appear to have engaged in considerable LT activity which was independent of all of the variables of the experiment. The precise reason for this is not clear, however, it is possible that the predictable and somewhat automatic nature of the tasks in the regular conditions enabled Ss to process LT activity in parallel with other inputs to the cognitive operator. Goldstein (1968) found evidence for parallel processing of LT activity when Ss continued to report some LT activity even when the interval between a correct response and the next stimulus was 0 sec.

Production of LT thoughts was altered by the irregular presentation conditions. It was expected that less overall LT activity would occur in the irregular conditions, and that the payoffs and the signal rates would influence the amount of reported LT activity. The results of the experiment proved to be more complex. The most frequent LT activity in the irregular conditions was observed for the low detect payoff and low signal rate treatment combination. No significant changes in LT activity were observed for the remaining treatment combinations.

The impact of the irregular presentation conditions can probably best be explained on an ad hoc basis by postulating that Ss attempted to maximize their performance by adopting a strategy which assumed a high signal rate on each trial. Thus, when expecting a high signal rate, a temporary excess of cognitive capacity would be freed which Ss could continue to devote to the task or release for spontaneous LT events. When the payoffs for the tasks were relatively low Ss might be expected to be more likely to devote the excess capacity to spontaneous LT activity. When the payoffs were substantial, the Ss might be expected to devote this excess of capacity to one or both of the tasks.

The d' scores for the detection task reflect the detectability of the signals. The d' scores indicate how effectively Ss were able to discriminate the signals from the other demands of the environment. The higher the value of d' the more effectively Ss were able to perform the detection task. The analysis of the d' data of the experiment revealed that Ss had higher d' scores for the high signal rate than for the low signal rate. None of the other main effects or interactions of this analysis were significant. This finding is contrary to the expectation that the higher signal rate would be more difficult and would, therefore, result in lower d' values.

It appears that the impact of the signal rates may have been influenced by the presence of the recall task. In the absence of the recall task it might be expected that d' scores would be higher for the low signal rate than for the high signal rate. This means that if Ss do not have to contend with other pressing tasks in memory we might expect that d' scores would be higher for the low signal rate than for the high signal rate. In the presence of the recall task, however, regardless of the payoffs, Ss have the option of filling the interval between the signals with either attention to the recall task or in preparation for the next signal. The presence of the recall task makes it likely that Ss filled the interval between the signals with rehearsal of the digits. By so doing Ss may have decreased their efficiency on the detection task by increasing the environmental demands which reduced the detectability of the signals.

With the high signal rate, Ss did not have as long an interval between signals to fill and were probably not inclined to devote as much attention to the digits or engaged in some sort of parallel processing of the digits. The increased intersignal interval of the low signal rate allowed Ss to actively rehearse the digits and attend to other inputs to the cognitive operator thereby decreasing the detectability of the signals. Thus, under these circumstances d' values would fall for the low signal rate due to the increased interference of the recall task upon the detection task. Recall of the digits, however, would be expected to be better for the low signal rate due to the increased opportunity for rehearsal as was observed. Future research could clarify this problem by comparing detection performance with and without the recall task.

In summary, it appears that the results of this experiment have several implications for everyday life. In a regular and predictable environment, individuals appear to be able to maintain their task performance and concurrently process LT events largely independent of the task payoffs and the physical characteristics of the tasks. For example, an assembly line worker who performs a job which consists of a set of regular and predictable set of events will probably be able to perform the job and process concurrent LT events. As long as the task parameters remain regular and predictable, LT activity can be processed independent of the task payoffs and the physical demands of the task such as the speed of the assembly line.

If the same assembly line worker is faced with a less predictable set of demands his processing of LT events will vary as a function of the task payoffs and the physical characteristics of the tasks. As long as the physical demand characteristics of the tasks and the payoff for performing the tasks remain relatively high, the worker will maintain his performance with minimal LT activity. If, however, the payoffs for the task and the physical characteristics of the tasks both decrease, an excess of cognitive capacity will be created which will likely be devoted to increased LT activity. Although the results of this experiment did not reveal any decrease in task efficiency resulting from this increased LT activity, it appears logical that this situation would not be conducive to effective task performance.

Finally, there appears to be a need for further research on this and related problems. The impact of the recall task upon LT activity and task performance could best be determined by an experiment which required Ss to perform the detection task with and without the concurrent recall task. Such an experiment would probably determine whether or not the reduced d' values for the low signal rate were due to the impact of the recall task as has been proposed. Similarly, it would be interesting to conduct an experiment in which Ss received a payoff for only one of the tasks or in which the payoffs were less predictable.

CHAPTER V

SUMMARY

The purpose of this study was to investigate the impact of task demands and motivational variables upon the production of task oriented and non-task oriented thoughts. The experiment consisted of four groups of twenty trials. Each trial consisted of the presentation of a series of five digits; a twenty sec signal detection task; the report of the presence or absence of task oriented and non-task oriented thoughts; and the recall of the digits.

The signal rate for the signal detection task, the payoff for correctly detecting the signals, and the payoff for correctly recalling the digits were all systematically varied. Ss in the regular presentation mode condition received each trial within each group of trials at the same signal rate while in the irregular presentation mode condition the signal rate was randomly varied from trial to trial within each group of trials. Thus Ss in the irregular condition could not predict what the signal rate would be from one trial to the next.

It was predicted that the regular presentation mode would permit Ss to set up "scanning" programs or rehearsal strategies which would permit them to perform both tasks effectively. As a result it was expected that the payoffs would not influence task performance. Since Ss would find the task within their capacity to perform it was predicted that both short term (ST) thoughts (thoughts about the digits) and long term thoughts (LT) (spontaneous daydream-like thoughts) would vary primarily as a function of the signal rate. In the irregular presentation mode, it was expected that Ss would experience difficulty in setting up "scanning" programs or rehearsal strategies due to the unpredictable nature of the detection task. Therefore, it was predicted that Ss would have to evaluate the relative payoffs of the two tasks in order to maximize their payoffs. As a result it was predicted that ST and LT thoughts would vary as a function of the payoffs as well as the signal rate of the detection task.

Production of ST thoughts was found to vary as a function of the detection payoff and the signal rate independent of the other variables of the experiment. This finding was judged to be inconsistent with the prediction that ST thoughts would vary as a function of the signal rate for the regular presentation mode and as a function of the payoffs and the signal rate for the irregular presentation mode. Thus, it was found that more ST thoughts were reported for the treatment combination of low detection payoff and low signal rate. This finding was attributed to greater general arousal of the Ss in the high detection payoff conditions or a tendency for Ss to adopt a rehearsal strategy in the high detection payoff conditions which was limited by the physical characteristics of the detection task.

The production of LT thoughts were found to be independent of all of the variables of the experiment for the regular presentation mode. The failure of LT thoughts to be influenced by the signal rate was attributed to possible parallel processing of LT thoughts.

In the irregular presentation mode, LT thoughts were found to be more frequent for the treatment combination of low detection payoff and low signal rate. For the LT thoughts the recall payoff was not a significant factor. These findings were judged to be consistent with the hypothesis that Ss would be forced by the unpredictable nature of the detection task in the irregular presentation mode to adopt strategies for the performance of the tasks which would involve evaluation of the payoffs as well as the signal rate. It was concluded that Ss in the irregular presentation mode were forced to evaluate the payoffs of the tasks in this presentation mode and adopted a strategy of expecting the high signal rate on each trial in order to maximize their payoffs. When the high signal rate did not occur and the payoffs did not justify continuous attention to the tasks, increased LT activity occurred. The implication of this finding for efficient task performance in everyday life was discussed.

Recall of the digits and d' scores for the detection task both varied as a function of the signal rate. More digits were correctly recalled for the low signal rate and higher d' scores were obtained for the high signal rate.

SELECTED BIBLIOGRAPHY

Anand, B., Chhina, G., & Singh, B. Some aspects of electroencephalographic studies in Yogis. In C. Tart (Ed.) Altered States of Consciousness. New York: John Wiley and Sons, Inc., 1969.

Antrobus, J. The effects of varied and repetitive talking on visual vigilance performance under reduced external stimulation. Unpublished doctoral dissertation, Teachers College, Columbia University, 1963. Cited by J. Singer, Daydreaming. New York: Random House, 1966.

Antrobus, J. Information theory and stimulus independent thought. British Journal of Psychology, 1968, 59, 423-430.

Antrobus, J., Antrobus, J., & Singer, J. Eye movements accompanying daydreaming, visual imagery, and thought suppression. Journal of Abnormal and Social Psychology, 1964, 69, 244-252.

Antrobus, J., & Singer, J. Visual signal detection as a function of sequential variability of simultaneous speech. Journal of Experimental Psychology, 1964, 68, 603-610.

Antrobus, J., Singer, J., & Greenberg, S. Studies in the stream of consciousness: experimental enhancement and suppression of spontaneous cognitive processes. Perceptual and Motor Skills, 1966, 23, 399-417.

Aserinsky, E. & Kleitman, N. Regularly occurring periods of eye motility, and concomitant phenomena during sleep. Science, 1953, 118, 273-274.

Bertini, M., Lewis, H. & Witkin, H. Some preliminary observations with an experimental procedure for the study of hypnagogic and related phenomena. In C. Tart (Ed.) Altered States of Consciousness. New York: John Wiley and Sons, Inc., 1969.

Deckert, G. Pursuit eye movements in the absence of a moving visual stimulus. Science, 1964, 143, 1192-1193.

Dement, W. & Kleitman, N. The relation of eye movements during sleep to dream activity, an objective method for the study of dreaming. Journal of Experimental Psychology, 1957, 53, 339-346.

Drucker, E. The role of temporal uncertainty in the deployment of attention to external signals or stimulus independent thought and fantasy. Unpublished doctoral dessertation, The City University of New York, 1969.

Fortgang, N. The role of sensory-modalities in the production of stimulus independent imagery. Unpublished Honors Thesis, City College, City University of New York, 1968. Cited by J. Antrobus, J. Singer, S. Goldstein, and M. Fortgang. Mindwandering and cognitive structure. Transactions of the New York Academy of Sciences, 1970, 32, 242-252.

Gastuat, H. Hypnosis and pre-sleep patterns. In L. Chertok (Ed.) Psychophysiological Mechanisms of Hypnosis. New York: Springer-Verlag, 1969.

Goldstein, S. Parallel versus sequential processing of stimulus independent thoughts. Unpublished Honors Thesis, City College, City University of New York, 1968. Cited by J. Antrobus, J. Singer, S. Goldstein, and M. Fortgang. Mindwandering and cognitive structure. Transactions of the New York Academy of Sciences, 1970, 32, 242-252.

Hochhaus, L. A table for the calculation of d' and B. Psychological Bulletin, 1972, 77, 375-376.

James, W. The Principles of Psychology. New York: Henry Holt and Co., 1899.

Kasamatsu, A. & Hirai, T. An electroencephalographic study of the Zen meditation (Zazen). In C. Tart (Ed.) Altered States of Consciousness. New York: John Wiley and Sons, Inc., 1969.

Kirk, R. Experimental Design: Procedures for the Behavioral Sciences. Belmont, Calif.: Brooks/Cole, 1968.

Klinger, E. Structure and Functions of Fantasy. New York: John Wiley and Sons, Inc., 1971.

Maupin, E. Individual differences in response to a Zen meditation exercise. In C. Tart (Ed.) Altered States of Consciousness. New York: John Wiley and Sons, Inc., 1969.

Neisser, U. Cultural and cognitive discontinuity. In the Anthropological Society of Washington, Anthropology and Human Behavior. Washington, D. C.: Gaus, 1962. Cited by D. Rosenbaum. The theory of cognitive residues: A new view of fantasy. Psychological Review, 1972, 79, 471-486.

Oswald, I. The EEG, visual imagery and attention. The Quarterly Journal of Experimental Psychology, 1957, 9, 113-118.

Paivio, A. & Simpson, H. Magnitude and latency of the pupillary response during an imagery task as a function of stimulus abstractness and imagery ability. Psychonomic Science, 1968, 12, 45-46.

Rosenbaum, D. The theory of cognitive residues: A new view of fantasy. Psychological Review, 1972, 79, 471-486.

Shor, R. Hypnosis and the concept of the generalized reality-orientation. In C. Tart (Ed.) Altered States of Consciousness. New York: John Wiley and Sons, Inc., 1969.

Simpson, H., Paivio, A., & Rogers, T. Occipital alpha activity of high and low visual imagers during problem solving. Psychonomic Science, 1967, 7, 49-50.

Singer, J. The experience type: some behavioral correlates and theoretical implications. In M. R. Rickers-Ovsiankina (Ed.) Rorschach Psychology. New York: John Wiley and Sons, Inc., 1960.

Singer, J. L. Imagination and waiting ability in young children. Journal of Personality, 1961, 29, 396-413.

Singer, J. Daydreaming. New York: Random House, 1966.

Singer, J. & Antrobus, J. A factor-analytic study of daydreaming and conceptually-related cognitive and personality variables. Perceptual and Motor Skills. Monograph Supplement 3-V 17, 1963. Cited by J. Singer. Daydreaming. New York: Random House, 1966.

Singer, J. & McCraven, V. Some characteristics of adult daydreaming. Journal of Psychology, 1961, 51, 151-164.

Singer, J. & McCraven, V. Patterns of daydreaming in American subcultural groups. International Journal of Social Psychiatry, 1962, 8, 272-282.

Singer, J. & Rowe, R. An experimental study of some relationships between daydreaming and anxiety. Journal of Consulting Psychology, 1962, 26, 446-454.

Singer, J. & Schonbar, R. Correlates of daydreaming: a dimension of self-awareness. Journal of Consulting Psychology, 1961, 25, 1-6.

Stoyva, J. & Kamiya, J. Electrophysiological studies of dreaming as the prototype of a new strategy in the study of consciousness. Psychological Review, 1968, 75, 192-205.

Wallace, R. Physiological effects of transcendental meditation. Science, 1970, 167, 1751-1753.

APPENDIX A

INSTRUCTIONS

INSTRUCTIONS

In this experiment you will be asked to perform two tasks simultaneously and how efficiently you are able to do this will determine how much money you will receive as a bonus in this experiment.

The first task consists of recalling a series of digits after a short time interval and the second task consists of detecting the presence or absence of auditory signals at various points. On each trial the exact sequence of events will be as follows:

1. READY

2. DIGITS

3. DETECT

4. REPORT

5. RECALL

You will first see the READY light come on. This merely serves as a signal that you should be ready for the beginning of the trial. The trial will actually begin when the DIGITS light comes on. At this point a series of digits will be presented on the display in front of you. You will be asked to recall these digits later in the trial.

Immediately following the presentation of the last digit the DETECT light will come on and the signal detection task will begin. During this portion of the trial a series of red lights will appear at either a high rate or a low rate on the display in front of you. If the occurrence of the red light is accompanied by a tone over the headphones you should operate the DETECTION SWITCH to the PRESENT position and then return the switch to its center position. If a tone does not accompany the red light you should operate the DETECTION SWITCH to the ABSENT position and then return the switch to its center position.

In order to correctly detect a signal you must operate the appropriate switch in the correct direction and you must do so while the red light is still on. The red light will remain on for a very short period of time, therefore, you must be ready to operate the DETECTION SWITCH quickly. If you correctly detect a signal the word CORRECT will appear on the display, but if you do not detect the signal correctly the words NOT CORRECT will appear.

At the end of the detection task the REPORT light will come on. During the REPORT period you are to report whether or not had any stimulus independent thoughts during the detection task. Stimulus independent thoughts are defined as thoughts about events or stimuli which did not occur during the detection task. Thus, if your mind wandered to such thoughts as a class you have tomorrow, what you did last weekend, a person you know, or anything else which is unrelated to the detection task you should classify it as stimulus independent. If you experienced any such thoughts during the detection task you should operate the LONG TERM stimulus independent thought switch to the PRESENT position and return it to its center position. If you experienced no such thoughts during the detection task you should operate the switch to the ABSENT position and return it to its center position.

Since you will be asked to recall the digits later in the trial you may find it necessary to rehearse the digits during the detection task in order to keep them in mind. Since such thoughts are totally unrelated to the performance of the detection task they are stimulus independent. On each trial, therefore, you should report the presence or absence of thoughts about the digits by operating the switch labeled SHORT TERM stimulus independent thoughts. If you rehearsed the digits or thought about the digits in any way during the detection task you should operate the SHORT TERM stimulus independent thought switch to the PRESENT position and return it to its center position. If you experienced no thoughts about the digits during the detection trial you should operate the switch to the absent position.

After both report switches have been operated the RECALL light will come on and you should recall the digits presented at the beginning of the trial in the correct order. The digits are to be recalled by touching the RECALL STYLUS to the contact on the black box in front of you corresponding to the appropriate digit. Touch the RECALL STYLUS to the contacts one at a time in the correct order as quickly and accurately as you can.

Touching the digit contacts on the black box illuminates the appropriate digit on your display and on a similar display in the experimenter's room. Make certain that the digits are illuminated long enough for your response to be recorded by the experimenter. If you make an error in reporting the digits such as touching two digits at once or accidently reporting the wrong digit you should touch the stylus to the CORRECT contact and then report your corrected series of digits. If the experimenter fails to receive the digits adequately the REPEAT Light will flash and you should report the digits again. You should always recall the digits as quickly and accurately as you can.

Immediately following the end of the recall period the READY light will come on again and in a few seconds the next trial will begin. The order of events on each trial will be identical. To refresh your memory they are as follows:

1. READY (prepare for the beginning of the trial)

2. DIGITS (presentation of the digits)

3. DETECT (detect the presence of absence of tones when the red light appears on the display)

4. REPORT (report the presence or absence of stimulus independent thought during the detection task)

5. RECALL (recall the digits)

(At this point Ss were asked if they understood the order of events that would occur on each trial and E quickly reviewed what would occur on each trial before continuing with the instructions.)

The trials will be presented in groups, and the end of a group of trials will be signaled when the REST light comes on. At this time you will have a brief rest before the beginning of the next group of trials. The next group of trials will begin when the READY light comes on.

Now, you have been guaranteed $1.00 for participating in this experiment and you can earn an additional $1.00 in the experiment. You can earn the additional $1.00 by performing efficiently on the recall and detection tasks. The green payoff lights on your panel will tell you how much you can earn on each trial by correctly recalling the digits in the correct order and by detecting at least ½ of the signals correctly on each trial. The payoff for correct recall and detection trials will either be 1¢ or .1¢. Thus, if the 1¢ lights are on for both recall and detection you may earn a total of 2¢ by correctly performing both tasks on that trial. If one of the task payoffs is set at 1¢ and the other is set at .1¢ the maximum payoff you will be able to earn on that trial is 1.1¢. If both payoffs are set at .1¢ you will be able to earn .2¢ for correctly performing both tasks. You may attempt to perform both tasks on each trial or you may attempt any single task, you should simply try to maximize your payoff. The maximum possible payoff, of course, will be derived from correctly performing both the detection and recall tasks, however, this may not be possible at times and you may have to concentrate on one task or the other at these times. At the end of each trial the amount of money you have earned will be totaled on the counter on your panel.

Are there any questions?

Before we go any further I want to make certain that you understand what is meant by short-term stimulus independent thought and long term stimulus independent thought. On the table in front of you you will find a list of possible thoughts you might have during the detection task. You should decide whether each thought is stimulus dependent (corresponding to a stimulus experienced during the detection task) or stimulus independent (referring to an event or stimulus occurring outside of the detection period). You should place a check in the appropriate column to indicate your choice. If you judge any of the thoughts to be stimulus independent you should further classify those thoughts according to whether they are SHORT TERM stimulus independent thoughts or LONG TERM stimulus independent thoughts. LONG TERM stimulus independent thoughts refer to thoughts about events or stimuli outside the immediate experimental trial while SHORT TERM stimulus independent thoughts refer to thoughts about the digits. Now classify the thoughts on the list.

APPENDIX B

LIST OF POSSIBLE THOUGHTS

Possible thoughts during the detection task.	Stimulus Dependent	Stimulus Independent	Short Term Stimulus Independent	Long Term Stimulus Independent
			If the thought is stimulus-independent classify it as short or long	
1. I missed the last detection signal.				
2. I hope I passed that math test.				
3. Let's see, the digits were........				
4. I'm beginning to feel tired				
5. This detection task is easy				
6. This chair is uncomfortable				
7. 4-7-9-3-5, 4-7-9-3-5..........(rehearsal)				
8. I wonder if I should go home next weekend....				
9. I wonder when the next detection signal will come........				
10. Why did I ever volunteer for this experiment?				

APPENDIX C

PRACTICE TRIALS

Trial #	Signal Rate	Detection Payoff	Recall Payoff
1	1/2 sec	payoffs not operative	
2	1/2 sec	payoffs not operative	
3	1/2 sec	payoffs not operative	
4	1/2 sec	payoffs not operative	
5	1/2 sec	payoffs not operative	
6	1/5 sec	payoffs not operative	
7	1/5 sec	payoffs not operative	
8	1/5 sec	payoffs not operative	
9	1/5 sec	payoffs not operative	
10	1/5 sec	payoffs not operative	
11	1/5 sec	1.0¢	S's assigned payoff
12	1/5 sec	1.0¢	S's assigned payoff
13	1/2 sec	1.0¢	S's assigned payoff
14	1/2 sec	1.0¢	S's assigned payoff
15	1/2 sec	.1¢	S's assigned payoff
16	1/2 sec	.1¢	S's assigned payoff
17	1/5 sec	.1¢	S's assigned payoff
18	1/5 sec	.1¢	S's assigned payoff

APPENDIX D

ANALYSES OF THE UNTRANSFORMED DATA

TABLE XVI

AOV OF PERCENT OF TRIALS WITH REPORTED SHORT TERM THOUGHTS FOR THE UNTRANSFORMED DATA

Source	df	MS	F
Total	191		
Between Ss	47		
Presentation Mode (A)	1	0.01505	<1
Recall Payoff (B)	1	0.00880	<1
AB	1	0.20021	<1
Ss w. Grps.	44	0.23029	
Within Ss	144		
Detect Payoff (C)	1	0.00000	<1
AC	1	0.01505	1.87
BC	1	0.00422	<1
ABC	1	0.00750	<1
C X Ss w. Grps.	44	0.00803	
Signal Rate (D)	1	0.01333	3.50
AD	1	0.00255	<1
BD	1	0.00630	1.65
ABD	1	0.02521	6.62**
D X Ss w. Grps.	44	0.00381	
CD	1	0.01021	3.21
ACD	1	0.00630	1.98
BCD	1	0.00422	1.33
ABCD	1	0.00187	<1
CD X Ss w. Grps.	44	0.00318	

TABLE XVII

AOV OF PERCENTAGE OF TRIALS WITH REPORTED SHORT TERM THOUGHTS FOR THE REGULAR PRESENTATION MODE FOR THE UNTRANSFORMED DATA

Source	df	MS	F
Total	95		
Between Ss	23		
Recall Payoff (B)	1	0.14648	<1
Ss w. Grps.	22	0.32665	
Within Ss	72		
Detect Payoff (C)	1	0.00753	2.59
BC	1	0.01148	3.95
C X Ss w. Grps.	22	0.00291	
Signal Rate (D)	1	0.01378	4.42*
BD	1	0.00315	1.01
D X Ss w. Grps.	22	0.00312	
CD	1	0.00023	<1
BCD	1	0.00023	<1
CD X Ss w. Grps.	22	0.00160	

TABLE XVIII

AOV OF PERCENTAGE OF TRIALS WITH REPORTED SHORT TERM THOUGHTS FOR THE IRREGULAR PRESENTATION MODE FOR THE UNTRANSFORMED DATA

Source	df	MS	F
Total	95		
Between Ss	23		
Recall Payoff (B)	1	0.06253	<1
Ss w. Grps.	22	0.13391	
Within Ss	72		
Detect Payoff (C)	1	0.00753	<1
BC	1	0.00023	<1
C X Ss w. Grps.	22	0.01314	
Signal Rate (D)	1	0.00211	<1
BD	1	0.02836	6.30*
D X Ss w. Grps.	22	0.00450	
CD	1	0.01628	3.42
BCD	1	0.00586	1.23
CD X Ss w. Grps.	22	0.00476	

TABLE XIX

TESTS ON THE RECALL PAYOFF X SIGNAL RATE INTERACTION OF THE IRREGULAR PRESENTATION MODE FOR SHORT TERM THOUGHTS USING THE NEWMAN-KEULS PROCEDURE FOR THE UNTRANSFORMED DATA

Conditions	Means	83	86	87	92
Low Recall Payoff Low Signal Rate	83	--	03	04	09***
Low Recall Payoff High Signal Rate	86		--	01	06***
High Recall Payoff High Signal Rate	87			--	05*
High Recall Payoff Low Signal Rate	92				--

p	2	3	4
Wp (105)	04	05	06
Wp (.01)	06	06	07

$$Wp = q_{(p,n)} \sqrt{\frac{\text{MS error}}{n}}$$

TABLE XX

AOV OF PERCENTAGE OF TRIALS WITH REPORTED LONG TERM THOUGHTS FOR THE UNTRANSFORMED DATA

Source	df	MS	F
Total	191		
Between Ss	47		
Presentation Mode (A)	1	0.00376	<1
Recall Payoff (B)	1	0.08970	<1
AB	1	0.04230	<1
Ss w. Grps.	44	0.25046	
Within Ss	144		
Detect Payoff (C)	1	0.03939	1.89
AC	1	0.00033	<1
BC	1	0.00574	<1
ABC	1	0.02408	1.15
C X Ss w. Grps.	44	0.02088	
Signal Rate (D)	1	0.07720	2.76
AD	1	0.00012	<1
BD	1	0.00105	<1
ABD	1	0.01783	<1
D X Ss w. Grps.	44	0.02794	
CD	1	0.00158	<1
ACD	1	0.06939	5.92**
BCD	1	0.00376	<1
ABCD	1	0.00001	<1
CD X Ss w. Grps.	44	0.01172	

TABLE XXI

AOV OF PERCENTAGE OF TRIALS WITH REPORTED LONG TERM THOUGHTS FOR THE REGULAR PRESENTATION MODE FOR THE UNTRANSFORMED DATA

Source	df	MS	F
Total	95		
Between Ss	23		
Recall Payoff (B)	1	0.00440	<1
Ss w. Grps.	22	0.17656	
Within Ss	72		
Detect Payoff (C)	1	0.01628	<1
BC	1	0.00315	<1
C X Ss w. Grps.	22	0.01755	
Signal Rate (D)	1	0.03565	<1
BD	1	0.01378	<1
D X Ss w. Grps.	22	0.03755	
CD	1	0.02503	1.54
BCD	1	0.00211	<1
CD X Ss w. Grps.	22	0.01630	

TABLE XXII

AOV OF PERCENTAGE OF TRIALS WITH REPORTED LONG TERM THOUGHTS FOR THE IRREGULAR PRESENTATION MODE FOR THE UNTRANSFORMED DATA

Source	df	MS	F
Total	95		
Between Ss	23		
Recall Payoff (B)	1	0.12760	<1
Ss w. Grps.	22	0.32436	
Within Ss	72		
Detect Payoff (C)	1	0.02344	<1
BC	1	0.02667	1.10
C X Ss w. Grps.	22	0.02420	
Signal Rate (D)	1	0.04167	2.27
BD	1	0.00510	<1
D X Ss w. Grps.	22	0.01833	
CD	1	0.04594	6.43*
BCD	1	0.00167	<1
CD X Ss w. Grps.	22	0.00715	

TABLE XXIII

MEANS OF THE DETECTION X SIGNAL RATE INTERACTION FOR LONG TERM THOUGHTS FOR THE UNTRANSFORMED DATA

	Detection Payoff			
	Low		High	
	Signal Rate		Signal Rate	
	Low	High	Low	High
Regular	48	48	49	42
Irregular	52	43	44	44

TABLE XXIV

TESTS ON THE DETECTION PAYOFF X SIGNAL RATE INTERACTION OF THE IRREGULAR PRESENTATION MODE FOR LONG TERM THOUGHTS USING THE NEWMAN-KEULS PROCEDURE FOR THE UNTRANSFORMED DATA

Conditions	Means	43	44	44	52
Low Detect Payoff High Signal Rate	43	--	01	01	09***
High Detect Payoff Low Signal Rate	44		--	00	08***
High Detect Payoff High Signal Rate	44			--	08***
Low Detect Payoff Low Signal Rate	52				--

p	2	3	4
Wp (.05)	05	06	07
Wp (.01)	07	08	09

$$Wp = q_{(p,n)} \sqrt{\frac{MS\ error}{n}}$$

TABLE XXV

AOV OF PERCENTAGE OF DIGITS CORRECTLY RECALLED FOR THE UNTRANSFORMED DATA

Source	df	MS	F
Total	191		
Between Ss	47		
Presentation Mode (A)	1	0.22005	1.66
Recall Payoff (B)	1	0.14083	1.06
AB	1	0.00021	<1
Ss w. Grps.	44	0.13290	
Within Ss	144		
Detect Payoff (C)	1	0.00630	<1
AC	1	0.00005	<1
BC	1	0.00521	<1
ABC	1	0.00083	<1
C X Ss w. Grps	44	0.00705	
Signal Rate (D)	1	0.25521	22.69##
AD	1	0.02083	1.85
BD	1	0.01505	1.34
ABD	1	0.00880	<1
D X Ss w. Grps.	44	0.01125	
CD	1	0.00187	<1
ACD	1	0.00333	<1
BCD	1	0.00047	<1
ABCD	1	0.00005	<1
CD X Ss w. Grps.	44	0.00794	

VITA

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