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FANTASY, AFFECT AND THE PERCEPTION OF TIME

by

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Table of Contents

List of Tables

List of Illustrations

Introduction

The proposed study was given impetus by two specific problems in the area of time perception. The first is a particularly interesting phenomenon noted by William James as far back as 1890 in the Principles of Psychology:

> In general a time filled with varied and interesting experiences seems short in passing, but long as we look back. On the other hand, a tract of time empty of experiences seems long in passing but in retrospect short (James, 1890, p. 624).

The first problem which shall be focused upon in the proposed study is the attempt to gain a better understanding of the paradox raised in the above statement. This paradox involves the question of why there should be the reversal of temporal judgments of an interval from the passing experience to the retrospective experience.

The second problem to be investigated is one raised again in the statement made by James. That question is the one concerning filled and unfilled time. The literature on the problem of filled and unfilled time stretches back for a considerable period in the history of time perception research. James himself originally meant by "empty" or unfilled time an interval that contained no physical events. However, he rectified this position by stating that we mark off empty intervals by a natural physiological and mental rhythm which denotes events of change. This was, "The

condition on which our perception of time's flow depends" (1890, p. 620). James' position in this area seems to have created some confusion for investigators that succeeded him. The findings on this question are by no means consistent. Some of the results appear to support James' contention that filled time while passing is perceived as being longer than it really is. On the other hand according to Gilliland et al (1946) others have obtained the directly opposite results. The authors suggest that one explanation of these discrepancies is the fact that it is difficult to determine whether an interval is filled or empty. For example, on one hand an interval may be filled with a large amount of visual, auditory or other type of external stimulus change, but these may have little attention value for the individual. On the other hand, the time interval may be relatively quiet in regard to external stimuli and still be richly filled with mental content by the subject himself (Gilliland et al 1946).

Early experimental work on filled vs unfilled intervals has been discussed in a monograph by Triplett (1931). In a summary of the findings she concludes that filled and unfilled intervals by themselves did not account for the differences in interval reproduction. She further speculated that the variations that occurred may have been the result of individual differences in the subjects in terms of the criteria used to estimate duration and from differences in the attitude toward the experimental task itself.

Some more recent studies, such as that of Helm (1937) involved the investigation of the effects of attention. He found that attention focus was an important variable in determining the estimation of temporal intervals. Harton (1938, 1938a, 1939) discovered that activities of varying difficulty influenced time perception. In the most recent review of time perception studies, Wallace and Rabin (1960) concluded that the issue of filled vs unfilled time still remains unsettled. Their view of the situation was somewhat similar to the Gilliland et al position. Although the bulk of the evidence showed little significant results in time estimation under the two conditions this may be due to the fact that the distinction between filled and unfilled time is more in the mind of the E rather than in the experience of the S (Wallace and Rabin, 1960).

A second factor may account for the failure of studies investigating the effects of filled and unfilled intervals on the perception of time to show consistent findings. That is, the necessity to differentiate between the subjective retrospective estimation of interval duration and the experience of time flow proper. This important distinction becomes apparent in examining the original statement by James. In that statement he used the words "short in passing" and "long in passing" in referring to one kind of temporal experience. The other words employed in the same statement were "in retrospect" and "as we look back". These two sets of terms imply two different kinds of temporal experiences. The first is the experience of time's flow or passage which

may be seen as moving along at a specific rate. The other is the act of retrospectively estimating the duration of time which was marked by a beginning and an end. These two experiences then, may be influenced by different variables inside and outside of the subject. In regard to these variables a particular model of temporal experience is proposed as a possible explanatory mechanism. This model employs a motion or spatial analogue in attempting to conceptualize the subjective aspect of time perception.

Model

A person who observes his movement in a train or car over a particular route will note that the vehicle he is in is moving at some rate of speed. This rate will usually be judged by the speed at which the surrounding countryside is moving past his window (trees, telephone poles, houses etc.). If after some ground has been covered, another person would ask the observer how far he had travelled, the observer would probably guess the distance travelled by resorting to the memory he had of the rate at which the landscape had been passing his window. If it had been moving by his window rapidly he would probably guess at a distance covered that would be greater than the distance he would have estimated if the landscape had been passing his window at a much slower rate. In other words the estimate of distance travelled would be in part determined by the observer's perception of how rapidly he had been traveling along the particular route. The faster he felt he was moving the longer he would judge the distance travelled to have been.

Applying this same reasoning to the temporal situation, the person who perceives time to be flowing by at a rapid rate will in retrospect, when asked, estimate how long the particular interval was by scanning his memory for the various events that occurred during that interval. If he judges the rate of the occurrence of those events to have been high he will estimate the duration to have been longer than a person who judged the rate of event occurrence to have been low.

With the proposition of this conception of temporal experience in mind the next question deals with the variables which determine the perception of the rapid or slow rate of time passage. Two main theoretical positions offer possible explanations for the experience of differential rates of time flow. The first one James himself alluded to in his discussion of rapid or slow passage of time (1890, p. 620, 624) and might be called an attentional hypothesis. The same type of explanation has been mentioned by Gilliland et al (1946) in their review of the area of time perception. They speak of it in connection with the entire problem of filled and unfilled time. These authors pointed out that if certain stimuli have no "attention value" for the subject, the interval will be unfilled for the subject while seeming to be filled when viewed by the experimenter. Also Fraisse (1963) argued for an attentional explanation of the differential rates of time flow, stating that the perception of duration was a function of our attitude, the most important element of which seemed to be the attention paid to perceived time.

The greater attention the longer the interval seems. (Fraisse, 1963, P. 147). Presumably then the discussion by James of time "filled with varied and interesting experiences" refers to events which are attention commanding and thus lead to less attention being paid to the flow of time, which in turn leads to the experience of a rapid flow.

A second explanatory hypothesis was offered by Rosenzweig and Koht (1933). In their study of the effects of need tension on time perception these investigators proposed that a kind of wishful thinking situation developed in subjects who were in a state of high need tension. This may be interpreted as referring to any situation which generates some kind of unpleasant affect or emotional state within the subjects whereby they would like to have the tension they are experiencing terminated as quickly as possible. This desire to have the situation over with caused the individuals' subjective time mechanisms to speed up, they desired to have time flow more quickly in order to have the unpleasant experience ended. The acceleration of their internal time mechanisms caused the subjects to perceive objective time as flowing by more slowly or dragging. In other words the flow of objective time remains constant which the subjects' "internal clocks" have speeded up in response to their desires to have the unpleasant experience end, thus by comparison objective time is seen as dragging.

The notion of internal clocks was introduced at the same time that Rosenzweig and Koht (1933) proposed their views on

time perception and need tension. An articulate exponent of this view was the physiologist Hoagland (1933). In this paper he outlined his concept of an internal biological clock. Later (1943) he further elaborated the mechanisms that underlay the internal time clock. Hoagland based much of his theory on the concept that internal chemical processes occur at a specific rate under normal conditions. If these conditions were altered in some ways, as in the case of an abnormal rise of body temperature, these processes would be speeded up accordingly. This acceleration would cause a concomittant speed up of subjective time flow. By comparison then, objective time whose rate of flow remains constant would be perceived as passing rather slowly or in other words dragging. To document this theory Hoagland cited studies with subjects having high fevers who tended to overestimate the objective duration. Hoagland's view of the internal clock was based solely on a biological conception. It nevertheless set the tone for a consideration of a subjective time sense, which can be speeded up or slowed down, thus affecting a person's perception of objective physical time flow.

Situational Variables

In recent years reports on the role of various internal factors in the determination of temporal experience have increased markedly. Many of these studies were stimulated by the findings of Rosenzweig and Koht (1933) and were attempts to either support, challenge, or further elaborate their findings concerning time estimation and need tension. However, as in the case of filled and unfilled time the findings

of these studies can hardly be considered consistent. The work of Filer and Meals (1949) showed some support for the basic position of Rosenzweig and Koht (1933). Their results pointed to the fact that motivation at various levels affected interval estimations of subjects, concluding that "an attractive goal affects the psychological distance to the goal." In other words when Ss are motivated to have time pass in order to reach a goal, time passes more slowly (as indicated by over-estimation of intervals).

Another study (Burton, 1943) reported no consistent or significant results with respect to overestimation of time under conditions of monotony. Again the motivation of the Ss was presumed to be to have time pass quickly. However, a study by Hindle (1951) studied the relation between monotony and overestimation. It tended to confirm the Filer and Meals (1949) findings showing a positive relationship between monotony and overestimation of intervals.

Another study which supported the need tension views of Rosenzweig and Koht (1933) was that of Falk and Bindra (1954). This investigation employed the production method to measure the subjects time estimations (Bindra and Wasberg, 1956). Here the experimental group received a shock at the end of some trials in producing a 15 second time interval; the control group did not. These authors concluded that overestimations of shock intervals were a result of anxiety (stress) produced by the expectation of the shock. In a more recent study Sattler (1965) found that under stress conditions (waiting to see the grade of an examination) Ss under greater stress

subjectively viewed a five minute interval as being shorter than the Ss who already knew their examination grades. This research differed from most of the other studies in the area in that the subjects were not asked to estimate an objective length of time but rather to indicate (by choosing one of several time scales minutes, hours, days etc.) which best represented the time unit they desired at the moment. The author attributed the choices of the Ss under the stress condition to the fact that they would like to have had time pass quickly in order to see the examination grades.

On the other hand, along with the above mentioned study by Burton (1943) there have been some current researches that have not supported the need tension conceptualization. Two such studies were those performed by Meade (1959, 1960). In both of these studies the investigator dealt with the relationship of need tension or motivational level and the rate of progress towards a goal to the interval estimates of subjects. His findings showed that need tension alone was not responsible for the variance of time interval estimates made by his subjects. He claimed that it was the perceived rate of progress through a particular task that influenced the time estimates and that perceived rate was independent of need tension.

There is not consistent support for the need tension hypothesis for differential experience of time perception. A good part of the problem rests with the failure to use some standard or reference in measuring the subjective experience of time's flow. Essentially Wallace and Rabin (1960) argue

similarly, saying that the variability in experimental design and terminology have made it quite difficult if not impossible to compare various findings and to draw definite conclusion. Most crucial in this regard is the fact that all the studies cited thus far having to do with need tension or motivational factors failed to employ a measure of time flow or passage, but rather employed either verbal estimates or production of interval techniques (Bindra and Wasberg, 1956). These approaches have a particularly serious drawback which was noted by Gilliland et al (1946), much before many of these studies were performed. In waiting or boredom (situations in which the motivation to have time pass quickly is presumed) time is experienced as passing slowly, but the estimator may make a correction. This is, he may know that the time could not be as long as he subjectively felt it was, and make a correction or overcorrection for this occurrence (Gilliland et al, 1946). If this kind of situation occurs, the results from one study to another may vary widely, depending upon whether the subjects have corrected, overcorrected or given true subjective estimates of the interval length. This problem relates back to the earlier discussion of the Jamesian paradox and the question of the experience of the rapid or slow passage of time vs the retrospective estimation of an interval's duration.

In cases where the immediate experience of time is in question, it is more appropriate in terms of the original statement by James to employ a technique which aims at

obtaining the impression of the subjective experience of time's flow or passage, and not the interval duration. This would both avoid the difficulties pointed out by Gilliland et al (1946) as well as conform more closely to the spirit of James' original observation. Interval estimation would be the appropriate measure in the situation of true retrospective experience of the time interval. Of course the problem of what is, and what is not retrospective can easily arise in any future study. However, if the procedure of operationally defining the meaning of retrospective is done, comparison of studies which operationally define retrospect in exactly the same fashion will be possible. Replication could be accomplished more readily and comparison of results made more meaningful.

Personality Variables

Along with the interest in variables of a situational or transient nature (i.e. immediate motivational, affective or tension factors) there has also been an increased incidence of research in the area of personality variables and their effect on temporal experience. Rapaport (1950) stated that "time experiencing appears to be itself a phenomenon dependent upon affective life." He further proposed a relationship between temporal experience and temperament. Such a connection may be demonstrated in the differences among people in their readiness to act upon some idea or impulse, or in other words, the tendency of some people to delay, postpone, to take more time.

The notion of the relationship between the ability to delay and temporal judgment was picked up and further investigated by Singer and his associates (1956). Ss who showed poorer impulse control tended to overestimate the length of specific time intervals. The ability to delay was also shown to be related to the Ss tendency to engage in fantasy activity. A relation between impulse control and estimation of time was also demonstrated by Siegman (1962). This study on anxiety, impulse control and time estimation, again showed that Ss with inability to delay impulses tended to overestimate the particular time durations employed in the experiment.

Another area of personality research and time experience was initiated by the team of Knapp and Garbutt (1958). This research attempted to demonstrate a relationship between characteristic ways of describing time and the degree of need achievement measured by the TAT (McClelland et al, 1953). To accomplish this the authors constructed 25 time metaphors (statements designed to express the person's general experience of time flow). The Ss were required to rank the phrases in order of their appropriateness in describing time. The results showed that these metaphors generally fell into three distinct clusters (arrived at by factor analysis). One was the Dynamic-Hasty group, the other a Naturalistic-Passive cluster and the third was the Humanistic cluster. It was clearly shown that Ss with high need achievement tended to choose the Dynamic-Hasty cluster as the most appropriate imagery for describing time flow.

In a later study by Grossman et al (1960) on the importance of time and its subjective speed, it was found that people who underestimated the specific interval to time preferred swift images in describing the passage of time. In their study they employed the Knapp and Garbutt time Metaphor Scale (1958) to obtain the measure or prefered imagery. Continuing along the same line Kurz (1963) attempted to find a relationship between time imagery and the Rorschach human movement response. Kurz's findings led to the conclusion that Ss who report more M in the Rorschach records prefer to conceptualize time in slow or static terms, whereas those who report seeing little human movement prefer to conceptualize time in swift, dynamic terms. These research studies indicate that personality factors are in fact related to an individual's experience of time. More important, however, is the possible comparison that may be drawn between this tendency to conceptualize time in one fashion or another and Hoagland's (1933, 1943) position on an internal biological clock. Hoagland's internal clock was based only on a physiological conception, the above evidence appears to support a view of an internal clock that may be conceived of in a more clearly psychological manner. If individuals develop a characteristic way of conceiving time's flow, then it seems reasonable that in any given situation time will be seen to be passing slowly or rapidly depending upon a comparison with the usual speed of the person's own internal psychological clock. If one's view of time flow is usually in slow or static terms, then by comparison time's objective flow will

be experienced to be generally rapid in rate. If on the other hand a person usually conceives of time in swift, dynamic terms then the reverse should be the case. The speed-up or slow-down of one's characteristic way of conceiving time (a psychological internal clock) may occur as a result of an increase or decrease in need tension or in other words the existence of greater or lesser motivation for time to pass quickly. In any given situation, therefore, an individual's experience of time flow may be determined by his characteristic way of conceiving time plus the amount of need tension present at the particular moment. Under normal conditions (moderate amount of tension) a person's characteristic way of conceiving time's flow will remain dominant, and he will perceive time's passage according to the comparison between this characteristic manner and the objective flow. Thus if he normally conceives of time in static images then objective time will be seen to flow relatively rapidly. However if conditions are such that his need to have time flow rapidly is increased, time will be perceived as flowing more slowly. In other words immediate situational factors may override the characteristic style at least under extreme need tension producing conditions.

Fantasy's Effect on Temporal Experience

Returning to the original question of filled and unfilled time intervals, the problem as conceived by James (1890) and later by Gilliland et al (1946) concerned the difficulty in determining what was a filled or an unfilled interval. Both

Gilliland et al (1946) and Wallace and Rabin (1960) raised the issue of whether or not the filled quality or unfilled quality of any given interval was in the conception of the experimenter rather than being in the experience of the subject. In this regard it was specifically noted by Gilliland and his associates that intervals seen by the E as empty might in reality be filled by the internal productions of the Ss. This raises the question of what the actual role of internal fantasy activity or daydreaming is in determining particulary, the retrospective judgments of temporal duration. The theoretical considerations that seem most pertinent to this problem of fantasy's role in determining temporal judgment are the statements of Gilliland et al (1946) and Woodrow (1951). Along with James (1890) they argue for a memory process in discussing retrospective judgment of time intervals. According to Gilliland et al (1946) the retrospect estimation of time depends upon the memory of events occurring within any interval. If the interval is filled with many events it will seem long in recall. If it is relatively uneventful it will be recalled as short. Similarly Woodrow (1951) expressed a position much in the manner of James (1890), stating that in general, a time period filled by pleasant, interesting, well motivated activities seems shorter in passing than one spent simply in waiting but in retrospect however, the relations may be reversed.

A direct relationship between fantasy activity and temporal experience has yet to be demonstrated, although one

study indicated that a close relationship between this internal activity (stimulation) and the judgment of temporal duration may exist, (Kurz et al, 1965). Correlating Rorschach responses with specific estimations of time intervals, the findings indicated that Ss who had a greater amount of M in their records tended to estimate the objective interval to be less than Ss who had lower amounts of M and more C in their records (actually both groups overestimated the objective interval.) This was especially so with the longer 12 minute interval. It has been noted by others that the incidence of M may be an indicator or rich internal fantasy life or a disposition towards thoughtfulness (Singer, 1960 and Barron, 1955).

The interpretation that was made by Kurz and his associates (1965) involved the conclusion that high M subjects have greater impulse control and therefore less need for time to pass. This presumably accounts for their lower overall estimates of the interval as compared to the low M subjects. However another approach may be taken in explaining fantasy's effect on temporal judgment. If the estimation of the time interval is performed in retrospect, that is at some time well after the termination of the specific interval in question, then a reversal of the Kurz et al (1965) findings may be the result. According to Singer et al (1956) high Rorschach M indicated rich inner life (high fantasy activity). Then it may be assumed that during any given situation the high M person will fill an interval more than the low M person. In other words the fantasy activity itself may be seen

as filling stimulation, and as such would give rise to longer interval estimations in retrospect much in the manner which James indicated. It is proposed that fantasy activity can be treated as events which are the equivalent of external stimulation. This would relate directly to the problem as stated by James (1890) and reiterated by Gilliland et al (1946) and Wallace and Rabin (1960). The demonstration that differential amounts of internal activity (fantasy) influence the retrospective judgments of a particular time interval may resolve some of the inconsistencies surrounding the results of research on filled and unfilled time.

It is hypothesized that fantasy events influence retrospective temporal judgments in the following manner. In a situation where individuals are engaged in a task which results in minimal attention demands (i.e. signal detection), the individual's experience of the degree to which the time period is filled will be related to or a function of the amount of internal activity which is occurring, along with the stimulation provided by the task itself. Therefore, those people who engage in greater amounts of fantasy activity should experience the interval as being more "filled" as compared to those who engage in less internal stimulation. In making retrospective judgments of the time interval the high fantasy Ss should have a greater amount of events to recall as having occurred during that specific period and thus estimate it as being longer than Ss who were low in fantasy.

In addition the differential amounts of fantasy among subjects could also account for the paradox implicit in the James statement concerning the reversal to time judgments made in passing and in retrospect. Earlier the need to make a firm distinction between the experience of time flow or rate of passage and the retrospective estimation of any duration was emphasized. In this regard then fantasy activity may effect an individual's perception of the speed of flow or passage as well as his retrospective judgment of the duration. If a person is engaged in a great amount of fantasy activity then he will not have his attention focused on the passage of time per se. The importance of the attention factor in temporal experience has been noted by Helm (1937), Gilliland et al (1946) and Fraisse (1963). They stated that greater attention paid to the passage of time led to increased perception of its rate of flow (intervals seemed longer). Thus, if the person's attention is focused on the internal stimulation he is providing for himself then he will not be aware of time's flow and is likely to perceive its passage to be relatively rapid. On the other hand if an individual is not preoccupied with internal stimulation he is more likely to be aware of time's flow and thus perceive its passage to be relatively slow. However, when the same two individuals are asked to retrospectively estimate the same duration the high fantasy person will have more events to recall (his attention now being called to those past events) and thus he will estimate the interval to have been relatively long. The low fantasy person will have fewer events to recall as having occurred

during the interval and thus will make a shorter estimation of its duration. This proposed explanation would account for the Jamesian paradox. If the need tension hypothesis is envoked as the explanation for the differential experience of time flow fantasy activity still may play a role. It has already been mentioned that several authors explain experienced differential rates of time flow on the basis of impulse control (Kurz, 1965, Singer et al, 1956 and Rapaport, 1950). Essentially their point is that if a person has less need to have time pass quickly then the perceived rate of flow should be relatively rapid. If one's need is to have time flow rapidly then by comparison objective time is seen as flowing slowly. It has been found by several investigators, among them Singer et al (1956) that high M people have greater ability to delay gratification and thus have greater impulse control. If we go along with the conclusion that high M people usually have greater fantasy life then it may be that fantasy activity itself is an aid to reducing any immediate amount of need tension or unpleasant affect which would have created a desire for time to flow rapidly. Thus, in any given situation which might result in the individual's desire to have time pass quickly fantasy activity could reduce this desire and cause the person's perception of the speed of passage to be relatively rapid. If the individual cannot or does not engage in a large amount of fantasy activity the need to have time pass may not be reduced and thus lead to a perception of slow rate of passage. Retrospectively the same explanation, as

outlined previously will hold and result in the reversal as depicted in the statement of James. That is, the more filled the interval is (greater fantasy) the longer the duration will be judged to be.

The following set of hypotheses were formulated from the above introduction.

I The rated passage of time will vary with the immediate experience of affect. Subjects who experience the task situation as relatively less unpleasant will perceive the time during the signal detection task to have passed relatively rapidly. Conversely, the subjects who experience the task as relatively unpleasant will perceive the task period to have passed relatively slowly (dragged).

II High fantasy subjects (more task irrelevant imagery) will be more likely to report less unpleasant affect in the signal detection task situation than will low fantasy subjects (low task irrelevant imagery).

III The retrospective estimation of time duration (measured in minutes) will vary with the amount of cognitive activity reported. The low fantasy subjects (less task irrelevant imagery) will give relatively shorter retrospect estimations of the signal detection task duration. High fantasy subjects (more task irrelevant imagery) will give longer retrospect estimations of the signal detection task period.

IV Subjects who rate the signal detection task as having passed slowly will in retrospect estimate the interval to have been shorter than the subjects who rated the signal detection task to have passed rapidly.

METHOD

Subjects

The Ss were volunteers selected from among students in various courses in psychology, the majority being from undergraduate introductory classes. They were chosen on the basis of their responses on the Imaginal Processes Inventory (Singer and Antrobus, 1966). The questionnaires were handed out during classes and returned at later class meetings. Thirty Ss falling in the upper quartile and thirty in the lower quartile in terms of predisposition towards fantasy activity were selected to take part in the laboratory procedure of the experiment. The Ss ranged in ages from 18 to 22 years with a total of 32 males and 28 females.

Materials

Fantasy Measurement: Imaginal Process Inventory (Singer and Antrobus, 1966). The instrument covers a wide range of daydreams and fantasy themes. It is designed to determine the frequency of such activity on an average daily basis. The items used in scoring for high and low predisposition to fantasy included all of Part I and items 31, 32, 33, 35, 36, 37, 39, 40, 41, 42, 44, 45, 48, 49, and 51 of Part II.

Signal Detection Apparatus: This equipment included tape recorder, earphone headset, recordings of the tones to be discriminated plus the interruption points and instructions. Also included were two response keys plus the recording devices designed to pick up and record the Ss signal detection responses, and their reports of task irrelevant imagery (Antrobus, Coleman and Singer, 1967).

Time Flow Measurement: This included a semantic differential scale including four sets of metaphors, graphic scale in between. The metaphors were designed to reflect an expression

of time flow using a variety of motion analogies. Further equipment included a disc with a series of dots spaced equidistantly, masking disc with a two inch by one inch frame cut in it; one hundred and fifteen volt electric motor, plus variac control device; 8 mm motion picture projector plus film of man walking. The Man Walking Film was taken at five different speeds: 8, 12, 24, 32, and 64 frames per second.

Affect, Personality Measures: The scales used were the multiple rating scales for the measurement of affective states (Plutchik, 1966), an instrument sensitive to immediate change in affective experience. Added to the standard scale was a time dimension designed to determine the amount of time the particular emotion was experienced. A further addition to this scale was the inclusion of two items in semantic differential form tapping the global experience of the Ss on the dimensions of pleasant-unpleasant. The personality variable was measured by the Time Metaphor Scale (Knapp and Garbutt, 1958). This measure employs a series of metaphors which must be ranked by the Ss as being more or less representative of characteristic ways of conceiving time.

Objective Time Measures: A timer and standard stop watch.

Procedure

The Ss were chosen by the use of the Imaginal Processes Inventory. The following introduction and instructions were employed:

> This is a research project dealing with fantasy and daydreaming. I am interested in the

frequency and scope of daydreaming or fantasy activity. I would very much like your cooperation. Please fill out this questionnaire at home and return it during the next class meeting. Be as honest as possible in making your responses.

This is the first half of the research; some of you will be selected to be involved in the second half. That part of the research is a laboratory procedure and will take no more than an hour of your time. Anonymity will be maintained, since after the selection has been completed code numbers will be assigned.

The Ss were asked to report to the laboratory. Upon entering the lab they were told that they were to take part in an experiment concerning the relationship of signal detection to daydreaming activity. They were placed in a sound attenuated, light free cubicle to minimize external cues other than the auditory signals. The instructions they received are as follows:

Listen carefully to the instructions you are about to receive. You will be presented with a series of tones of different pitch. These tones will be presented in a random order so you will not be able to determine which are coming next. Look at the box in front of you. The black telegraph key on the left corresponds to the low tone, the key on

the right corresponds to the high tone. If you hear a high tone I want you to push the key on the right. If you hear a low tone I want you to press the key on the left. If you hear a combination of these tones I want you to press the keys simultaneously. In order for your presses to count you must press the key or keys before the next tone comes on each time. Do not hold the keys down, simply press it down and let it up again as quickly as you can for each time. Instead of tapping the key we suggest that you rest your fingers lightly on the key and then give the particular key an extra press or push. This will eliminate any extra noises every time you tap a key and will make it easier for you to hear the tones. The hissing sound you hear in the background is supposed to be there. It's purpose is to mask any unwanted sounds and to cushion the sound of tones themselves. I will now give you some practice at detecting tones. Remember the left hand key is for the low tones and the right hand key is for the high tones. Here are some practice trials.

Listen carefully to some further instructions. Every so often the tones will stop and you will hear the masking hiss pulsating,

that is going off and on instead of in a steady stream. This is the signal to indicate whether you have had any task irrelevant thoughts during the immediately preceding trial. The definition of a task irrelevant thought is any thought or image occurring during the immediately preceding trial which has as a referent some perceptual event that did not occur during that trial. Thoughts, such as a recent conversation, errands to be run in the future, or what the experimenter is doing in the next room are all examples of a task irrelevant thought. Any thoughts about the accuracy of your performance should be considered task relevant only if they refer to your performance within that trial, but they should be considered task irrelevant if they refer to your performance on a previous trial or over the task in general. Now I am going to give you a test to see that you understand the definition of task relevant and task irrelevant thoughts. I will read you a series of questions and you will tell me verbally whether the thought is task relevant or irrelevant.

1. I thought about a girl/boy I had been seeing.

2. I thought about the uses for this experiment.

3. I thought about whether I had differentiated the previous tones in this trial correctly.

4. I thought about the experiment beforehand.

5. I thought about how badly I had done on the trial preceding this one.

6. I thought about talking to a friend about the experiment.

7. I thought about the instructions.

8. I thought about how I missed the previous tone.

9. I thought about how I just pressed the wrong key.

10. I thought that I felt hungry.

If the thought is relevant which way will you throw the yes/no switch?

If the thought is irrelevant which way will you throw the yes/no switch?

The experiment has now begun.

Signal presentations, interuptions, scoring and recording of detection reports of extraneous thoughts were all automated. Trials were 15 seconds in length. The Ss received trials consisting of 15 tones presented at a rate of one per second. The total time of the signal detection task was 17.5

minutes. Before entering the experimental cubicle the Ss were asked to surrender their watches.

Time Flow Measurement: Immediately after the Ss finished the signal detection task, they were asked to indicate how fast time seemed to pass during the experimental situation. This was accomplished by the use of a seven point continuum in a semantic differential form. The Ss were instructed to choose a point between the four sets of words that best represented their experience of the flow of time during the signal detection situation. Instructions were as follows:

> During any given situation time seems to pass at some relative rate for us, that is, either relatively quickly, relatively slowly or somewhere in between. I would like you to indicate how time seemed to pass for you during the experimental task situation. Select a point somewhere on the graph line between each of the four sets of words presented, which best approximates your experience of time's passage while you were engaged in the signal detection task. Make your choice by placing a check mark at the point you choose. Please use the extreme ends of the scales when it is appropriate.

Example of Scale

Time:

crawled along _____ flew by

seemed like a

fast moving stream _____ a quiet pool

moved at a the speed of

snail's pace _____ a rabbit

hardly seemed

whizzed by _____ to move

Affect Measures: Following the conclusion of the time flow measurement the Ss were administered the Multiple Rating Scales for Affective States (Plutchik, 1966). This was administered in order to get a measure of their affective response to the experimental condition. The application of this scale followed the procedure outlined by Plutchik (1966) with two additions however. That is, there was an inclusion of a time dimension within the standard scale, in order to determine how long the particular emotion was felt during the experimental task. This gave a density measure of the emotions, D = F(I, T).

Example: How much of the time during the experimental situation did you feel these emotions?

1	2	3	4	5
rarely or never	some	about half of the time	most of the time	almost all the time
0 - 20%	20 - 40%	40 - 60%	60 - 80%	80 - 100%

In other words the Ss were requested to indicate how long they were feeling a particular emotion as well as how intensely they felt it.

The other addition to the Plutchik scale was the presentation of an item in semantic differential form. This was aimed at gaining a measure of their overall feeling about the experimental task situation instead of getting at the specific emotions involved.

Example: Rate, according to the scale presented below, your overall feeling concerning the experimental task. Please be as honest as you can.

unpleasant ___3___2___1___0___1___2___3___ pleasant

After the affective measures were taken the Ss were given the Knapp and Garbutt Time Metaphor Scale (1958). This was administered in order to gain a picture of the Ss characteristic manner of experiencing time. This was necessary in order to cover the possibility that more static personality factors also play a role in determining a person's experience of time flow. The instructions for the scale are as follows:

> Time is an aspect of our experience of which we are all in some degree and in different ways aware. Below are listed 25 phrases which might be employed by a poet or a writer to symbolize his sense of time. I should like you to read through this list of phrases and then indicate before each how appropriate you think this phrase is in evoking for you a satisfying image of time.
>
> First select the five phrases that seem to you most appropriate and before each place the number"1".

Then pick out the next five most appropriate phrases and before them place the number "2". Continue this process until you have placed the number "5" before the five least appropriate phrases in your opinion. Please remember this refers to your general sense of time not to the experience during the signal detection task.

Immediately following the completion of the Time Metaphor Scale the Ss were asked to make judgments on two further time passage measures. This was an attempt to develop an alternate nonverbal measure of time flow. This involved the use of two visual analogues of time's rate of passage. The first was the use of a moving picture of a man walking. The Ss were asked to choose the speed of his walking which represented their experience of time's passage during the signal detection task. The second visual approach involved the use of moving dots through a frame. The movement of the dots was controlled by a variable speed device. The speeds ranged along a continuum from very slow to very fast. The Ss were asked to adjust the speed of the dot's passage through the frame, to approximate their experience of time's flow during the experimental task situation. This was divided into five increments of speed 1 - 5.*

* The aim of this procedure was to investigate the possibility of gaining some degree of convergence of these three approaches to measuring the subjective experience of time passage. A reasonable convergence would suggest that the flow of time may be conceived of as a construct that transcends the straight forward verbal rating. However, the test of the hypotheses presented will be based upon the Ss verbal rating of time flow.

The final part of the procedure involved the interview of the Ss regarding their fantasy activity. This was accomplished after they had completed their choices of speed of time passage on the nonverbal scales. This interview involved the following questions:

(1) What was the nature of your task-irrelevant thoughts during the signal detection task? Were they pleasant or unpleasant? Choose one or the other.

(2) Did your thoughts remain on one topic or did they vary in their theme?

(3) What was pleasant or unpleasant about the whole situation?

At a point exactly 30 minutes after the termination of the signal detection task, the Ss were asked to estimate as precisely as possible how long (in seconds, minutes, etc.) the experimental situation actually was (the signal detection task only). This 30 minute gap served as an operational definition of retrospect for the purposes of this particular study.

Instructions for obtaining the retrospect estimates of the duration are as follows:

> I would like you to estimate as precisely as possible, the length of time that you were engaged in the performance of the experimental task, that is, while you were in the soundproof room. The interval between the words "The experiment has begun" and the words "The experiment is over", not including the instructional period. Again, make sure you are as accurate and precise as possible.

Diagram of Procedure

Time Taken		Operation
10 min	1	Taped instructions
		10 min
17.5 min	2	Beginning of Signal Detection Task
		17.5 min
	3	Rating of time passage
	4	Ratings of Emotions experienced
	5	Rating of task on the unpleasant to pleasant scale
	6	Filling out Time Metaphor Scale
30 min	7	Judgments of time passage on Man Walking measure
	8	Judgments of time passage on Moving Dots measure
	9	Interview concerning type of Fantasy experienced. Conversations concerning ease or difficulty in using scales - what they expected the experience to be, etc.
	10	Retrospective estimation of Signal Detection task period.

Total time of Experiment - Approximately 60 minutes.

RESULTS

The results of the study are presented in three sections. The first deals with the four hypotheses. The second section concerns the post hoc analyses that were performed. The final section is devoted to the reliability and validity of the time passage measures.

HYPOTHESES

Affect and Time Passage

In order to test the hypothesis that rapid passage of time would be related to a pleasant experience during the signal detection task and slow passage of time would be associated with an unpleasant experience, correlations between each of the density scores of the emotions in the Plutchik Scale (1966) and the ratings on the overall verbal time passage measure (hereafter referred to as the VTP measure) were calculated. The density score for each affect was derived by multiplying the number chosen by the S on the intensity scale by the number he chose on the percentage of time felt scale. This procedure was employed in order to increase the sensitivity of the measure to periodic fluctuations of affect. Pearson product-moment r's were then computed between these density scores and the rating of time passage. The VTP rating was obtained by averaging the ratings of each of the three verbal analogues which made up the overall time passage scale. None of the correlations attained significance at the .05 level (see Table 1). They range in absolute values from a low of .10 to a high of .24. However, the correlation (.40)

between the Ss ratings on the VTP measure and their ratings of their overall feeling about the task on the seven point semantic differential scale of unpleasant to pleasant was significant at the .01 level. On the basis of this finding hypothesis I was confirmed.

Affect and Fantasy

The second hypotheses stated that high amounts of fantasy activity (task irrelevant imagery) would be related to more pleasant experience during the signal detection task while low amounts of fantasy would be accompanied by an unpleasant experience during signal detection. This hypothesis was tested by computing the correlations between the density scores of the emotions in the Plutchik scale and the reports of task irrelevant imagery made by the Ss. The amount of fantasy for each S was obtained by counting the number of times they indicated a yes response during the entire 17.5 minute signal detection period. This score was then correlated with their density scores for each emotion of the Plutchik scale. This procedure yielded no significant correlations (see Table 1). The correlation (.13) between the amount of fantasy and the rating of overall feeling about the task on the unpleasant to pleasant scale also did not attain significance ($p>.05$). These results did not confirm hypothesis II.

TABLE 1

Correlations* of Each Emotions Density Score with the Rating of Time Passage on the VTP Measure and the Number of Task Irrelevant Images Reported (Fantasy) N=60

Emotions	VTP	Amount of Fantasy
Joyful	.21	.19
Fearful	-.15	.12
Agreeable	.24	.21
Angry	.20	-.14
Expectant	.24	.22
Disgusted	-.19	.08
Sad	-.10	.10
Surprised	.22	.17
Overall feeling about the task (Unpleasant to Pleasant Scale)	.40**	.13

* r of .25 needed for significance at .05 level

** $p<.01$

Fantasy and Retrospective Time Estimates

In order to test the hypothesis that high fantasy Ss would give longer retrospective time estimates than low fantasy Ss a t test was performed between the mean time estimate of the high fantasy group and the mean estimate of the low fantasy group. The original design of the study called for the selection of Ss by means of the Imaginal Processes Inventory. The upper and lower quartiles of the whole distribution of Ss responding to the questionnaire were chosen in order to maximize the difference in predisposition to engage in fantasy activity. However, when the means of the fantasy scores of the two pre-selected

groups was tested for significance a t of 1.03 was obtained. This was not significant ($p>.05$). As a result of the failure of the two pre-selected groups to show a significant difference in the amount of actual fantasy reported during the signal detection task, it was decided to perform a median split of the obtained distribution of reported fantasy (task irrelevant imagery). High and low fantasy groups were established on this basis. The mean time estimate for the high fantasy group was 13.70 minutes (S.D. = 6.95). The mean estimate for the low fantasy group was 15.70 minutes (S.D. = 4.82). A t test of the difference between means yielded a non-significant t value of .60. The retrospective time estimates were obtained 30 minutes after the termination of the 17.5 minute signal detection task. As a result of the non-significant t value obtained the third hypothesis was not confirmed.

Time Passage and Retrospective Time Estimation

Hypothesis IV stated that Ss rating the passage of time as rapid would also tend to give longer estimates of the interval's duration while Ss rating time's passage as slow would tend to give shorter estimates of the interval's length. The correlation coefficient between the Ss ratings of time passage on the VTP measure and their retrospective time estimates was .36, significant at the .01 level. This relationship is contrary to the fourth hypothesis.

POST HOC ANALYSES

Fantasy, Affect and Retrospective Time Estimates

In order to investigate further some possible relationships between time estimations and affect not suggested by the hypotheses, several other correlations were calculated. The correlation between the Ss' ratings of their overall feeling about the task on the unpleasant to pleasant scale and the retrospective time estimates was -.60, significant at the .01 level. The biserial correlation between feeling about the task and the judgment of fantasy to be pleasant or unpleasant was .35, $p<.01$. These judgments were made in a dichotomized fashion, the choice being either pleasant or unpleasant fantasy. The correlation coefficient obtained between the amount of fantasy (task irrelevant imagery) reported and the rated passage of time on the VTP measure was .31, ($p<.05$).

Using the additional data provided by the dichotomized judgments of the Ss fantasy to be either pleasant or unpleasant a more extensive analysis of the relationship of retrospective time estimates to the amount of fantasy reported and the kind of fantasy reported was performed. To accomplish this a 2 x 2 analysis of variance was employed. The four groups were derived by dividing the high and low fantasy groups into two sub-groups of pleasant and unpleasant types of fantasy. As such, the four groups are classified as pleasant high fantasy, unpleasant high fantasy, pleasant low fantasy and unpleasant low fantasy. An F ratio of 28.45 was obtained for the main

effect of the kind of fantasy, ($p<.001$). This indicates that a significant difference between the means of the pleasant fantasy and the unpleasant fantasy groups exists. The means for these two groups are 11.88 minutes and 18.72 minutes respectively. F ratios for the other main effect (amount of fantasy) and the interaction between the two main effects were not significant ($p>.01$) (see Table 2).

TABLE 2

2 X 2 Analysis of Variance of Four Groups of Retrospective Time Estimates (Pleasant High Fantasy, Unpleasant High Fantasy, Pleasant Low Fantasy, Unpleasant Low Fantasy)

Source of Variation	SS	d.f.	Mean Square	F	
A Amount of Fantasy	97.00	1	97.00	4.33	
B Kind of Fantasy	640.70	1	640.70	28.45	*
A X B	10.47	1	10.47	.46	
Within groups	1279.37	56	22.84		
Total	2027.54	59			

* $p<.001$ Total N = 60

An additional analysis of retrospective time estimations was performed by establishing high and low fantasy groups on the basis of the Ss responses to the Imaginal Processes Inventory. Those Ss classified as the high fantasy group gave responses to selected items that averaged 4.3 or above on a five point scale. Those classified as low gave responses that averaged 1.7 or less on the same selected items. The mean time estimation for the high fantasy group was 14.16 minutes (S.D. = 5.85). The low fantasy group had a mean time estimate of 16.72 minutes (S.D. - 4.96). The t

test of the difference between means that was performed yielded a value of .72, this was not significant ($p>.05$).

A biserial correlation was computed between the Ss scores on the Imaginal Processes Inventory and their ratings of time passage. This procedure produced an r of .19 which was non-significant at the .05 level.

Sex Differences

In order to determine whether or not there were any differences between male and female subjects in regard to retrospective time estimations, mean estimates for each of these groups were calculated. The males had a mean estimate of 13.73 minutes (S.D. = 6.25) and the females showed a mean time estimation of 16.61 minutes (S.D. = 5.58). A t test of the difference between means yielded a value of .92 which was not significant ($p>.05$).

Accuracy of Performance

The accuracy of performance of the Ss was determined by computing the overall percentage of accurate discriminations for the entire sample ($N = 60$). The percentage of correct detections for all subjects was 87.5%. The percentage of error for the high fantasy Ss (task irrelevant images) was 16.4% and the percentage of error for the low fantasy subjects was 8.6%. After using a square root transformation to correct for a skewness of the data a t of 1.78 was obtained, this was not significant ($p>.05$). A further comparison of the percentage of error for high and low fantasy groups was performed by testing for the significance of the difference between the

error percentage of the high and low groups based upon the responses to the Imaginal Processes Inventory. In this case the high fantasy group had an error percentage of 14.7% and the low group a percentage of error that was 10.3%. A square root transformation was again performed and following this a *t* of 1.07 was computed. This value was also not significant ($p>.05$).

Time Metaphors

As a part of the post hoc analysis the Knapp and Garbutt Time Metaphor Scale (1958) was used in order to cover the possibility that more stable personality variables might effect the *Ss* judgments concerning time passage and/or retrospective time estimates. Product-moment correlations between the *Ss* ratings of time passage and the median rankings on two clusters of the Time Metaphor Scale were calculated. The value of *r* for the correlation between time passage ratings and the median rankings on the Dynamic-Hasty cluster was .21 ($p>.05$). This cluster contained the metaphors: a dashing waterfall, a speeding train, a fast-moving shuttle, a galloping horseman, a fleeing thief, a spaceship in flight, a whirlagig. The correlation coefficient (-.16) between the time passage ratings and the median rankings on the Naturalistic-Passive cluster was not significant ($p>.05$). The cluster consisted of the following metaphors: a vast expanse of sky, a quiet motionless ocean, a road leading over a hill, drifting clouds, wind driven sands, the Rock of Gibraltar, budding leaves. The correlations of the median

rankings for the two clusters of metaphors with the retrospective time estimates of the Ss were .18 and -.14. These correlations were also not significantly different from zero ($p>.05$).

The correlation between the swift images and slow images median rankings and the amount of fantasy reported by the Ss during the signal detection task were .15 for and -.17. Both correlations failed to reach significance ($p>.05$) (see Table 3).

TABLE 3

Correlations* of the Median Rankings of Two Clusters on the Time Metaphor Scale with Ratings of Time Passage, Retrospective Time Estimates and Amount of Fantasy Reported

Type of Correlation	r
VTP ratings with Dynamic-Hasty cluster	.21
VTP ratings with Naturalistic-Passive cluster	-.16
Time Estimates with Dynamic-Hasty cluster	.18
Time Estimates with Naturalistic-Passive cluster	-.14
Fantasy reported with Dynamic-Hasty cluster	.15
Fantasy reported with Naturalistic-Passive cluster	-.17

* r of .25 needed for significance at .05 level

Reliability and Validity of the Time Passage Measure

Correlations were calculated between each of the four verbal analogues of the VTP measure. the r's between

analogues 1, 3 and 4 were moderately high. While the r's obtained between analogue 2 and the three other analogues were of a much lower value (see Table 4). Analogue 1 consisted of the two poles crawled along ____ flew by, number 2 was the analogue a fast moving stream ____ a quiet pool, number 3 consisted of the poles a snail's pace ____ the speed of a rabbit and finally the fourth analogue involved the poles whizzed by ____ hardly seemed to move. As a result of the values of r obtained analogue 2 was dropped from the computation of the time passage rating.

TABLE 4

Correlations of Each of the Four Verbal Analogues of the VTP Measure with Each Other

Analogue Relationships	r
#1 crawled along ____ flew by with #2 seemed like a fast moving stream ____ a quiet pool	.22
#1 crawled along ____ flew by with #3 moved at a snail's pace ____ the speed of a rabbit	.75
#1 crawled along ____ flew by with #4 whizzed by ____ hardly seemed to move	.82
#2 seemed like a fast moving stream ____ a quiet pool with #3 moved at a snail's pace ____ the speed of a rabbit	.27
#2 seemed like a fast moving stream ____ a quiet pool with #4 whizzed by ____ hardly seemed to move	.14
#3 moved at a snail's pace ____ the speed of a rabbit with #4 whizzed by ____ hardly seemed to move	.77

An attempt at establishing construct validity of the time passage measure was made by employing two other nonverbal

measures of time passage. The two nonverbal measures were the Man Walking analogue and the Moving Dots analogue. Both of these measures involved the selection of a speed of movement ranging from 1 through 5 that best approximated the Ss experience of time flow during the signal detection period. The correlation coefficients between the VTP measure and the two nonverbal measures were of a moderately high value (.71 and .67) (see Table 5). The value of r obtained for the correlation between the Man Walking analogue and the Moving Dots analogue was high in value (.93).

TABLE 5

Correlations of VTP Measure with the Two Nonverbal measures (Man Walking and Moving Dots) plus the Correlation of the Two Nonverbal Measures

Type of Relationship	r
VTP With Man Walking	.71
VTP With Moving Dots	.67
Man Walking With Moving Dots	.93

DISCUSSION

Affect and the Passage of Time

The results of the study indicate that the Ss who rated the task as being for the most part a pleasant experience perceived time to flow at a relatively rapid rate. This finding was in agreement with hypothesis I. The hypothesis was tested by the use of both the global semantic differential scale of unpleasant to pleasant and the atomistic measure of affect. Hypothesis I was confirmed by the global ratings while the ratings obtained on the more specific affects was not successful. Correlations of time passage ratings and the emotions of the Plutchik Scale (1966) were all of a magnitude which did not indicate a relationship other than that expected through chance (see Table 1). One explanation for the inconsistency of the results produced by the two scales may be in what DeSoto (1961) has called a predilection for single orderings. In his paper DeSoto cited many exmples for what he claimed was a general predilection of human beings to order events, concepts, theories, etc. in a single continuum or progression and a general antipathy towards multiple orderings of various factors in their environment. He went on to say that part of the predilection may be rooted in the ease with which people can handle single orderings compared with multiple ones. He further argued that in certain situations people might be so discontent with multiple orderings that they seek to transform them into single orderings.

Turning then to the inconsistent findings produced by the two scales employed to tap the subjects feelings about the experimental task, the observation is readily made that these two scales represent a single and a multiple ordering. Employing DeSoto's reasoning then it may have been that the Ss found the particularized rating scale consisting of eight emotions too difficult to use in that they do not readily think in terms of such specific feelings. As such, the ratings they made could have contained more error variance than was produced when they rated their feeling about the task on the simpler continuum of pleasant to unpleasant.

The positive finding resulting from the use of the single continuum pleasant to unpleasant scale tends to support some of the previous notions about the relationship of feeling to the perception of time. James (1890) had claimed that time filled with varied and interesting experiences was perceived to flow by rapidly. Whereas intervals devoid of interesting and varied events would lead to a perception of time's flow as being slow. Other theorists (Rosenzweig and Koht 1933) introduced motivation as a possible factor in the experience of rapid or slow passage of time. If you "needed" or "desired" objective time to flow by rapidly as would be the case when you were in a situation you experienced to be unpleasant, then by comparison subjective time would be perceived to be passing rather slowly. If on the other hand your experience was of a pleasant nature the need for time to pass by rapidly would not be present. In which case, the opposite need might exist, that is for time to flow by slowly

so as to allow for the enjoyment of the experience as long as possible, under such conditions perception of time's flow would be rapid by comparison with the felt need. The positive correlation of the Ss' ratings of time passage and their ratings of their overall feeling about the task is congruent with Rosenzweig and Koht's position. Presumably the Ss who experienced the task as being pleasant overall did not feel the need for time to flow by rapidly and as such rated its passage as fairly rapid. On the other hand those Ss who rated the task as unpleasant felt a stronger desire for time to flow by rapidly, the result being that they experienced its passage to be rather slow. Later in the discussion the relationship of the Ss fantasy activity, both in the areas of quantity and quality will be related to their experience of time flow.

Fantasy and Affect

No significant relationship between the amount of fantasy reported by the Ss and their rating of the task on the continuum of unpleasant to pleasant was demonstrated. This finding was consistent for both of the scales employed. The data collected therefore did not confirm the hypothesis that more pleasant experience would be associated with high amounts of reported fantasy, while unpleasant experience would be related to lower amounts of fantasy.

Analysis of further data relating to the general question of fantasy's relationship to the report of pleasant and unpleasant feeling revealed some interesting findings. As a

part of the general procedure of the study the Ss were interviewed concerning various parameters of the fantasy they experienced during the signal detection period. The first question they were asked was whether the fantasies they had were for the most part pleasant or unpleasant. This question was presented in a forced choice form so that the subjects could choose only one of the two categories. A small but significant relationship between the Ss ratings of their overall feeling about the task and the kind of fantasy they experienced (either pleasant or unpleasant) was found. The lack of relationship between the amount of fantasy (task irrelevant imagery) and feeling about the task when considered with the significant correlation between the kind of fantasy and the overall feeling about the task suggest that hypothesis II missed the mark. The important factor in determining the Ss judgments as to the pleasantness or unpleasantness of the experiment was the kind of fantasy they experienced rather than the quantity they produced.

Of some further interest is the apparent relationship between the Ss reports of unpleasant fantasy and their feelings about how well they had done in the signal detection task. It was observed that 15 of the Ss who judged their fantasy to be of an unpleasant variety complained that they were dissatisfied with their performance of the signal detection task. Some stated that they had trouble with the buttons, others said that they felt they were making too many mistakes, etc. Most important was the fact that many of their evaluations of

poor performance were not corroborated by the data recorded, (the number of correct and incorrect discriminations was automatically tabulated by the experimental apparatus). The self-criticism was nine out of fifteen times not congruent with the objective facts. It appears then, that much of the unpleasant fantasy that was reported was connected to self-criticisms of a negative variety relating to the performance of the signal detection task itself. This finding suggests that further research in the area of the effect of individuals' perception of the quality of performance of a given task on their time judgments might prove a fruitful undertaking.

At this time it appears reasonable to bring in a discussion of the accuracy of performance of the signal detection task by the subjects as a whole and the relationship of quantity of fantasy produced to performance per se. The percentage of correct discriminations for the entire group was 87.5%; this figure is somewhat below that reported by Antrobus et al (1967). They found the percentage of correct detections to be 95.9% in their study; however this difference might be accounted for by the slight difference in the detection task itself. In the present study the Ss were required to discriminate three different kinds of tones (high, low and a combination). In the Antrobus et al study the task was somewhat easier, the Ss being required to make discriminations between the two tones only, without the combination.

The percentage of error for the high and low fantasy (actual fantasy reported) groups did not show a difference

was statistically significant. Here the differences on inspection appeared to be fairly wide (16.4% high and 8.6% low) but the test of significance showed this to be an appearance only. A further comparison of error percentage made on the basis of the responses of Ss on the Imaginal Processes Inventory showed the difference between the high and low groups to be somewhat smaller. Ss classified as being predisposed towards higher amounts of fantasy demonstrated an error percentage of 14.7% and those classified as low in predisposition to fantasy showed a 10.3 percentage of error. Again the difference was found to be nonsignificant. The data relating to the high and low fantasy groups (actual reported fantasy) is in line with the findings of the Antrobus et al study. In that study differences between high and low fantasy Ss tended to approach significance but did not attain it. It may be that although some Ss are distracted by their own internal productions and as such produce more errors in discriminations there are enough individuals who can either carry on a kind of two track operation or can switch back and forth rapidly enough to allow them to fantasize without too much loss of detection accuracy.

The rationale underlying the hypothesis that greater amounts of reported fantasy would lead to a more pleasant experience of the task was the following. It was proposed that people, when faced with a situation that was experienced by them as being relatively unpleasant would resort to some means of reducing the degree of unpleasantness they were

beginning to feel. The logic was that those subjects who were predisposed towards fantasy activity would resort to this internal stimulation and as such reduce the degree of unpleasant feeling that was being generated by the situation they were in. On the other hand subjects who did not readily engage in fantasy would be at a disadvantage in coping with the unpleasant feelings and would thus report the overall experience to have been more unpleasant than the high fantasy subjects. However this conceptualization of the effect of high amounts of reported fantasy on the judgment of the overall task to be pleasant or unpleasant was not born out by the data. Apparently the assumption that under unpleasant conditions the fantasy that would be produced would also be generally of a pleasant variety was an incorrect one. The earlier discussion of some of the content of the fantasy demonstrates that on the contrary the fantasy themes themselves might have contributed further to the general experience of unpleasantness.

Fantasy and Retrospective Time Estimates

The third hypothesis was concerned with the effect of high and low fantasy activity (amounts of task irrelevant imagery reported) on retrospective estimations of the interval's duration. A *t* test of the difference between the mean time estimates of the high fantasy group and the mean of the low fantasy group failed to attain significance. The hypothesis in question stated that the high fantasy subjects should give longer retrospective interval estimations than

the low fantasy subjects. It will be noted that the difference that was demonstrated although not significant was in the opposite direction to the one stated in hypothesis III.

What may be some of the explanations for the failure of hypothesis III to be confirmed? To review, the third hypothesis was based upon the theories related to the question of filled and unfilled time. James (1890, p. 624) argued that in retrospect a time filled with varied and interesting events would be perceived as long in duration, although in passing it would be seen as flowing by rather rapidly. The other authors who theorized about the effect of filled and unfilled time include Gilliland et al (1946). These writers stated that the retrospective estimation of time depends upon the memory of events occurring within the interval. If the interval were filled with many events it would be perceived as long in recall. If it was relatively low in events it would be recalled as short. On the basis of these theoretical contentions it was hypothesized that Ss who had high amounts of task irrelevant imagery would estimate the task interval as being longer than those Ss who produced lower amounts of task irrelevant imagery. The rationale was that all the Ss would be engaged in the same task (signal detection) and as such the difference of filled or unfilled time would be produced by the differing amounts of internal stimulation (fantasy activity).

Another analysis of the time passage ratings and the retrospective interval estimations was performed using the

original responses of the Ss on the Imaginal Processes Inventory as a basis for establishing the high and low fantasy groups. As in the case of the actual fantasy activity groups the means of the retrospective time estimates did not differ significantly. The relationship between the Ss responses to the questionnaire and their ratings of time passage was in a positive direction. In other words the higher the predisposition towards fantasy the faster the time was perceived to pass. However, this relationship also failed to attain significance ($r = .19$, $p > .05$).

A reason for the failure of hypothesis III to be confirmed is the problem of the definition of a retrospective estimation. For the purposes of the present study retrospect was defined as being an estimation which was made exactly 30 minutes after termination of the interval to be judged. Each S was asked to estimate how long the period of the signal detection task had been. Observations of some of the verbalizations made by the subjects when making this estimation suggest that the 30-minute period may not have been long enough to establish the estimation as a retrospective one. For example, verbalizations such as "I felt like it was" or "To me it felt like I was in there" etc. occurred in approximately half the cases. These verbalizations seem to point to the fact that many of the Ss were still making their judgments on the basis of feeling or an emotional tone rather than by cognitive factors such as the recall of events which had occurred during the experimental task period. If the Ss

were making their judgments more on the basis of their feeling then this might explain the fact that the trend demonstrated by the results was opposite to that predicted, that is that the high fantasy group gave lower estimates of the interval duration rather than longer estimates. This would seem to indicate that the retrospective estimations were simply another measure of time flow or passage and not distinct from the rating of time passage that was made by the subjects.

In the introduction to the present study a model was proposed as one possible means of conceptualizing the process involved in time perception. Another such model has been suggested by Treisman (1963). In this model she has postulated several components including a specific arousal center, a pacemaker, a counter, a comparator, a store, and a verbal response selective mechanism. The function of two components within her model seems most closely related to the model proposed earlier in this paper. The pacemaker she postulates produces a regular sequence of pulses which travel along a pathway at a constant rate. Facilitation of the pacemaker by the specific arousal center may be affected by features such as the subjects' expectations, attitudes, or by the variety or monotony of the stimulus input or task. The variation of the rate of pulses produced by facilitation or lack of facilitation of the pacemaker by the specific arousal center could be likened to the rate at which a subject perceives stimulus changes in his surrounding environment.

Variations in temporal judgments according to Treisman are a function of the changes in the activity of the specific arousal center and its effect on the pacemaker. Increased facilitation of the pacemaker results in shortening of the interval (or overestimation), while decreased facilitation produces lengthening (or underestimation). If it is assumed that fantasy activity is one factor that can effect the specific arousal center by decreasing anxiety (general arousal) (Rowe, 1963), thus lowering the facilitation of the pacemaker then the results obtained might be explained on the following basis. The tendency (although not significant) for high fantasy Ss to give shorter estimates of the overall duration was the result of the lower pulse rate produced by the defacilitated pacemaker. Conversely the tendency towards higher estimates by the low fantasy Ss was the result of the facilitated pacemaker.

Another model of time perception has been suggested by Cohen (1964). This model is also somewhat similar to the one proposed in the present study. Cohen tends to link time perception very closely to that of distance and speed of motion. For example, in one experiment he performed subjects were blindfolded and told they were to be taken on a trip during which a bell would ring. When the trip was over, they were asked to estimate its duration (time), distance and speed before and after the sound of the bell. The main outcome of these experiments was the demonstration of an interdependence of apparent duration, distance and speed

such that if two parts of the trip took the same amount of time, the part with the greater distance and speed seemed to last longer to the subjects. This phenomenon he called the kappa-movement effect.

The Reversal Paradox

At this point the discussion of hypothesis III converges with the findings related to hypothesis IV, and thus the data pertinent to that hypothesis should be reviewed. Hypothesis IV dealt with the notion introduced in the statement by James (1890) concerning the paradoxical reversal of time perception experiences. James stated that in passing a period filled with interesting and varied events would seem short, while in retrospect the same interval would be perceived as long. Hypothesis IV then predicted that those Ss who rated the passage of time as being rapid would in retrospect estimate the interval as being longer than those Ss who rated the time's passage as being slow. The correlation between the Ss ratings of time passage and their retrospective time estimates was .36. This small but positive relationship was opposite to that hypothesized. In other words instead of the Ss reversing their retrospective time estimates (judging the interval to be long after having rated it to have passed quickly) they remained consistent. Those who rated the time as having passed rapidly also tended to estimate the interval's length as being short. Thus, as was pointed out earlier the two measures do not appear to have been distinct from each other but rather were tapping much of the same phenomenon. The failure of the predicted reversal to

be demonstrated is very much connected with the opposite trend shown in the results related to hypothesis III. The fact that the judgments of interval length may not have been determined by factors supposed to be inherent in retrospective estimations (recall of past events) could account for both the findings related to hypothesis III and IV. At any rate the data related to these two hypothesis still leaves the problem of retrospective vs immediate perception of time unresolved. The question of, was it, or what is not a retrospective judgment of a time interval still seems a crucial issue that must be answered through further research.

However, aside from the above explanation for the lack of confirmation of the third and fourth hypotheses there is another interpretation which may be offered to explain the data. The present research sought to clarify some of the problems that have surrounded the attempts to empirically support or refute James' original observation concerning filled and unfilled time and his assertion of the reversal paradox. As reported in the review by Gilliland et al (1946) there has been much conflicting evidence surrounding the effect of filled and unfilled time on the perception of interval duration. Some studies have supported James' view while others have not. The data of the present study do not support the position of James having to do with the reversal phenomenon. In essence the trend demonstrated by the results related to hypothesis III (see Table 3) are in agreement with the results reported by Kurz in his 1965 study. Kurz showed that Ss with higher amounts of M in their Rorschach records gave significantly

shorter interval estimates than those Ss with low amounts of M and more C in their protocols. If we accept that higher amounts of M indicate a greater tendency towards engaging in fantasy activity (Singer, 1960 and Barron, 1955), then the results of the present study might lend some support to his findings since higher fantasy people tended to give slightly lower interval estimates than low fantasy Ss (although the difference was not significant).

Drawing on the experience resulting from the performance of this study, it seems plausible that a design constructed so as to enable the determination of the precise point at which subjects judgments of time begin to reverse themselves could be of great help in settling the problem of retrospect. By choosing a series of intervals after the termination of a specific time period and having subjects first rate the speed of time passage and then at these various points also have them give interval estimates it might be possible to find a more exact point where the estimates begin to negatively correlate with the time passage ratings. In this regard much longer retrospective durations (say weeks or months) might be employed by having the subjects called in at a later date or contacted by phone and then asked for their interval estimation. This point might then offer a more precise definition of retrospective. This type of design might yield more conclusive data regarding the difference between the immediate perception of time's passage or flow and the so-called retrospective estimation of the interval duration.

Although the data did not support hypothesis III a further post hoc analysis yielded some interesting results. A 2 x 2 analysis of variance of four groups of retrospective time estimates corresponding to high pleasant fantasy, low pleasant fantasy, high unpleasant fantasy and low unpleasant fantasy yielded a significant F ratio. The significant F was indicative of a difference between the unpleasant and pleasant fantasy groups averaged over the levels of amount of fantasy. These findings indicated that as was the case in the second hypothesis, the most important factor in producing differential retrospective time estimates was the kind of fantasy reported by the subjects and not the quantity they produced. The shortest estimates of the signal detection interval were given by those subjects who judged their fantasy to be of a pleasant nature, the longest by those who had judged theirs to be of an unpleasant variety. This finding tends to support some of the earlier work done in the area of need tension and as such remains consistent with the data reported relating to hypothesis I. As mentioned earlier the need tension hypothesis of Rosenzweig and Koht (1933) suggests that when people are in a state which causes them to wish for time to flow rapidly by comparison the objective time appears slow, and when they are in a state which causes them to desire time to pass slowly, in comparison it is perceived to pass rapidly.

Another of the post hoc analyses tended to support the need tension hypothesis. The correlation between the subjects'

time estimations and their ratings of overall feeling about the task on the unpleasant to pleasant scale was -.60. This negative relationship indicates that the more pleasant the subjects experienced the task to be the more likely they were to give shorter interval estimations. This finding also is consistent with that which would be expected by the principles expressed in the need tension hypothesis.

Turning back to the question of fantasy activity itself, can it be said that the amount of fantasy reported had no relationship to the time perception experience? Although some of the data show no significant relationship between amount of fantasy reported and the interval estimations another analysis performed shows that the discounting of the quantity of fantasy produced as a factor in time perception would not be a proper conclusion. A product-moment correlation between the amount of fantasy reported and the subjects' ratings of time passage showed a value of .31, this was significant at the .05 level. This relationship indicates that those subjects who reported higher amounts of fantasy activity tended to rate the passage of time during the signal detection task as being relatively rapid.

Related to the above findings is an unpublished study performed by Moore and reported by Singer (1966). In this experiment hungry Ss were assigned three different types of activity. Onegroup was instructed to engage in fantasy pantomime irrelevant to hunger, another group was told to engage in fantasy eating and the third set of Ss was given

non-fantasy tasks relevant and irrelevant to the hunger drive. Both sets of fantasy subjects experienced time as passing more rapidly than did the non-fantasy subjects. Singer concluded that the opportunity to engage in some fantasy which was diverting seemed to relieve the stress so that time did not appear to drag during waiting. A further study that demonstrates fantasy's ability to relieve stress or tension was one by Rowe (1963). This research indicated that subjects who were allowed to engage in fantasy showed less elevation in heart rate while waiting for an electric shock than subjects who were performing a digit repetition task. Although no time estimations were taken the expected results would be that those Ss showing lower heart rate elevations as a result of engaging in fantasy activity would have perceived time to have passed more rapidly than the digit repetition Ss.

Although a definite causal statement cannot be made concerning the direct effect of greater or lesser amounts of fantasy on the perception of time flow, some speculation as to the possible cause and effect relationship might be in order. In the introduction to the present research it was reported that some authors working in the area of time perception have offered what might be called an attentional hypothesis for the explanation of differential judgments of time among people. James (1890) was one of those and his position was that when a person is engaged in some activity which commands attention he is likely to perceive the

time involved to have passed rapidly. Gilliland et al (1946) also spoke of stimuli as having or not having "attention value". They stated that if stimuli have low attention value then the interval will be unfilled for the person and as such his perception of time will be of a rather slow passage. Fraisse (1963) also spoke of an attention type of hypothesis for the explanation of differential experiences of time flow. He pointed out that the more attention that was paid to the passage of time per se, the slower time seemed to pass. According to Fraisse's reasoning therefore, if a person is engaged in some activity which keeps him from paying attention to time's passage, his experience will be of a fairly rapid flow.

In the present study, those with higher amounts of reported fantasy presumably had less chance to pay attention to time's passage and as such their perception of its flow was rapid in comparison to the Ss who reported lesser amounts of fantasy. Those low fantasy Ss had more opportunity to be aware of the flow of time itself and as a result perceived it to be passing slowly. The above could explain the small but significant relationship demonstrated between the amount of fantasy the subjects reported and their ratings of time's passage.

Sex Differences in Retrospective Time Estimates

Another post hoc analysis of the data was performed in regard to the question of whether or not the sex of the subject influenced the estimation of interval duration.

Although the mean time estimate for males was lower than that for the females the difference was not found to be statistically significant. In both cases the mean time estimates (16.61 minutes for females and 13.73 minutes for males) were under-estimations of the actual interval length (17.5 minutes). The data therefore suggest the conclusion that sex was not a major factor in determining differential retrospective judgments of the time interval.

Time Metaphors

In the present study, data that was collected by the use of the Time Metaphor Scale (Knapp and Garbutt, 1958) was not found to be significantly related to the Ss judgments of interval duration or to their ratings of time passage (see Table 3). Correlations between ratings on the Time Metaphor Scale and the amount of fantasy reported also failed to attain significance. This finding runs somewhat contrary to the results obtained by Kurz (1963). In his study Kurz showed that subjects with more M in their Rorschach records tended to prefer the Naturalistic-Passive type metaphors in conceptualizing time. His reasoning as to the basis of the relationship involved the notion of delay of gratification, presumably the Ss with more M possessed a greater impulse control and as a result their need to have time pass quickly was not great and thus resulted in their preference for slow, static images in conceptualizing time. If we accept the contention of some authors (Singer, 1960, Barron, 1955) that high M

is an indicator of a predisposition towards a rich fantasy life or towards thoughtfulness then it is reasonable to expect that fantasy activity reported during the experiment might also relate to preferences for the Naturalistic-Passive cluster in time metaphors. However, the data collected does not demonstrate this and the conclusion must be drawn that fantasy activity measured in the manner employed in the present study shows no relationship with imagery preference in conceptualizing time.

The use of the Time Metaphor Scale in the present research represented an attempt to investigate the manner in which personality variables may also contribute to the differential experience of time perception. It was suggested that some sort of combination of both situational variables and personality variables might be the factors producing differing time perception judgments. However, in the light of the findings related to the Time Metaphor Scale it must be stated that in this study at least the personality variables tapped by the scale showed no relationship to actual judgments of time perception. However, anecdotal evidence (i.e. pleasant vs unpleasant fantasy content) tends to point to the fact that self concept and its effect on fantasy content might be related to time perception judgments. (see pages 47 and 48).

Reliability and Validity of the Time Passage Measure

The time passage scale used to measure the subjects' experience of time's flow was constructed by the use of four

verbal analogues that were attempts to portray the flow of time in ways most commonly used in every day language. The complete scale consisted of four sets of words, indicating the extreme ends of a continuum from very slow to very fast. The four sub-scales were, time: #1 crawled along ____ flew by, #2 seemed like a fast moving stream ____ a quiet pool, #3 moved at a snail's pace ____ the speed of a rabbit, and #4 whizzed by ____ hardly seemed to move. There were seven points between each of the poles and the subjects were asked to check a point on each of the sub-scales that best represented their experience of time's flow during the signal detection task. In Table 4, the correlations of each sub-scale with every other sub-scale are presented. Analogues #1 (crawled - flew) #3 (snail - rabbit) and #4 (whizzed - hardly moved) showed fairly high correlations with each other. On the other hand analogue #2 (stream - pool) had the lowest correlations with all of the other three analogues. As a result of this finding, analogue #2 was dropped from the computation of the time passage rating. This statistical finding was congruent with comments made by the subjects during the various analogues of the time passage measure. After the subjects had completed rating their experience of time's flow the experimenter asked them how easy they found the scale to use. Thirty-six of the subjects replied that they had little difficulty in using the scale, however complaints that did come forth were usually directed at analogue #2. Other comments by subjects indicated that many

of them used analogue #2 to express a feeling about the time period which appeared to be related to its turbulence or tranquility and not necessarily to its speed of flow. These observations together with the statistical findings suggest that analogue #2 was not measuring the same ype of phenomenon as analogues #1, #3, and #4 and as such its removal from the analysis was justified.

Validation of the VTP measure took the form of the concurrent employment of two other time passage measures. These two measures were nonverbal, one consisted of a motion picture of a man walking which was shot at five different speeds. The second nonverbal measure was an apparatus consisting of black dots which moved through a frame, again at five different speeds. In each case the subjects were asked to choose the speed that best represented their experience of time's passage while they were engaged in the signal detection task. Correlations were calculated between the VTP measure and each of the nonverbal measures. Both nonverbal measures correlated fairly highly with the VTP measure (.71 VTP with the Man Walking and .67 with the Moving Dots). The correlation of the two nonverbal measures was very high, $r = .93$. These relatively high correlations indicate that these types of scales form a valid construct of time passage.

Further Proposed Research on Filled and Unfilled Time

The present research although indicating support for the need tension hypothesis concerning differential experience of time perception failed to demonstrate any clear cut

results relating to the problem of filled and unfilled time. In general the findings did not support the Jamesian proposition. It is suggested that the following study might throw some increased light on this problem. The idea for the study originated from a personal experience. After retiring one evening, the writer was awakened after being asleep for some unknown period of time. At that point he had the occasion to judge that about four hours had elapsed since falling asleep. When the time was noted the actual period had been only one and a half hours. Surprised at this, the writer tried to determine why he had judged the time passed to have been four hours instead of the one and a half that had actually elapsed. He realized then, that at the time of awakening he had been in the midst of a dream. In this situation the dream might be considered to be activity and stimulation that had filled the period that had just elapsed, and as such was the factor that produced the overestimation of the interval's length. Further consideration brought forth the notion that without dream activity and the recall of that activity a person would have little or no cues to allow him to estimate how long he had been asleep. With that idea in mind the present author decided that under the condition of no dreams or recall of dreams the experience of elapsed time on awakening would be very short, while under the condition of a dream state and recall of the dream content, the experience of elapsed time would be significantly longer.

With the above proposition considered, it seems plausible

that a study using sleep subjects might be designed. Four groups of subjects would be employed. One group would consist of subjects awakened after a specific period of time who were shown through EEG readings to be in a non-REM state. Presumably these Ss would have no dream activity to recall upon awakening. Another group would also be non-REM Ss but with a different length of time asleep. The third and fourth groups would be Ss showing REM activity and would correspond to the dream condition; they would be asked to report their dreams as well. These two groups would also have the two different periods of time asleep. Following awakening, all the Ss would be asked to estimate how long they had been asleep. This design would lend itself to a 2 x 2 analysis of variance whereby both the dream and non-dream conditions, the two different interval lengths and the interaction between these factors could be evaluated for the effects on time estimations.

The study suggested above could provide a relatively more pure condition of filled vs unfilled time. In most of the waking state studies (including the present research) the filled or unfilled quality of the interval is always a relative condition. The proposed study would bring the degree of relativeness concerning filled and unfilled situations to a level which might result in more definite findings.

Conclusions

1) Reasonable support for the need tension hypothesis has been demonstrated. In two analyses where subjects

indicated the pleasantness or unpleasantness of an experience (one the task itself, the other the Ss fantasy activity) the more pleasant ratings the more rapid was the perception of time's passage and the shorter the estimation of the time interval.

2) The quantity of fantasy activity did not effect in a differential manner, the retrospective interval estimates of the subjects but did show a relationship with the rating of time's passage. It was suggested that in this case fantasy activity may be an attention diverting factor which aids in producing the experience of more rapid flow of time.

3) The quantity of fantasy activity per se did not relate to the experience of the task as being more or less pleasant. However, the kind of fantasy reported (either pleasant or unpleasant) was shown to have a moderate relationship with the subjects ratings of the task itself as being relatively pleasant or unpleasant.

4) The time passage measure and the retrospective interval estimates were not demonstrated to be distinctly separate measures. Rather it was shown that they had a moderately positive correlation and as such were probably tapping much of the same kind of experience in the subjects.

5) No significant relationship between preference for slow or swift images in conceptualizing time and ratings of time passage was demonstrated. Neither was there shown to be a significant correlation between retrospective time estimates and subject preference for swift or slow images. Fur-

thermore no significant correlation was obtained between preference for swift or slow images and the amount of fantasy reported in the signal detection task. As a result of the data collected no statements as to the combined effect of personality variables (preference of time imagery) and situational variables can be made. The variance produced in the Ss time perception judgments (both time passage ratings and interval estimations) was significantly related only to the situational type variables (pleasant or unpleasant feelings and immediately produced fantasy activity).

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