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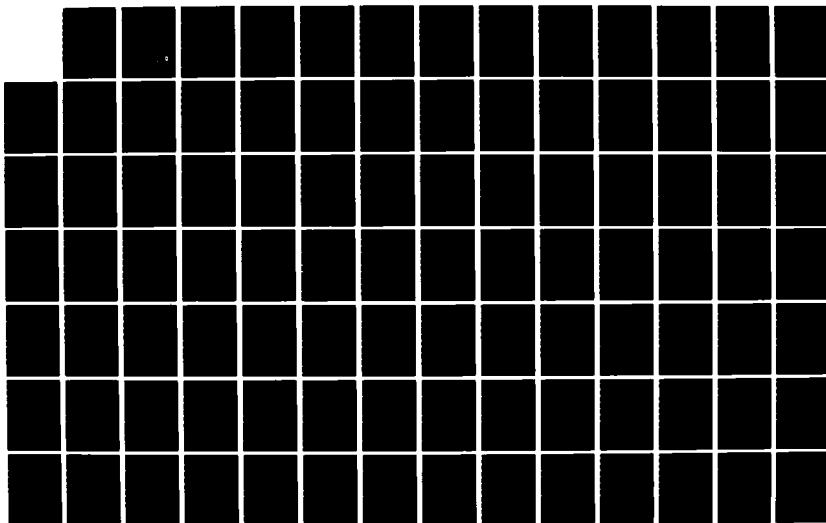
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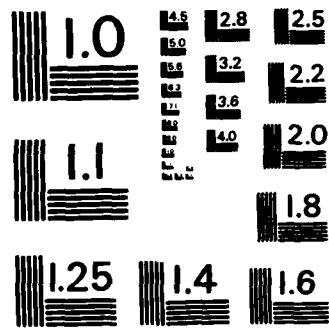
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ATTENTION ALLOCATION, DISTRACTION, AND THE
TYPE A/TYPE B BEHAVIOR PATTERN

by

Alfred James Guardino

A Thesis Presented in Partial Fulfillment
of the Requirements for the Degree
Master of Arts

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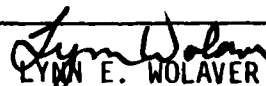
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ABSTRACT

This ~~experiment~~^{study} sought to determine whether individuals identified as having a Type A or Type B behavior pattern allocate attention differently in the presence of a distractor. Thirty-seven university students, grouped by type through use of the Jenkins Activity Survey, and further divided into distractor and control groups, performed two discrete tasks for eight blocks under single- then dual-task conditions. The distractor was presented during the dual-task condition on Blocks 6 and 7. While the results did not support the hypothesized relation, this study did support previous findings of a differential effect of noise on multiple-task performance: Both quiet groups' performance improved on both tasks, whereas both noise groups' performance improved on the primary task but leveled off on the secondary task during and after the distractor. Further research is required.

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CHAPTER I

Introduction

Since the Wright Brothers' first powered flight, we have built faster and more sophisticated aircraft. Spurred by technological advances, cockpit automation and its associated monitoring components have proliferated. For instance, the L-1011 has 886 separate annunciators, and the Navy's newest fighter utilizes four cathode-ray tubes to monitor separate aircraft functions. These increases in automation have caused a shift in the pilot's role from controller to system monitor, and many pieces of information must be processed concurrently to successfully complete the mission.

The same situation is true in the industrial workplace. The controllers of a nuclear power plant are continuously faced with having to monitor hundreds of instruments to ensure safe, effective operation, and they are not always successful. In discussing the results of the many studies of the human-factors errors associated with the problems at the Three Mile Island plant, Wickens (1984) stated that "the overwhelming complexity of information presented to the human operators and the

confusing format in which it was displayed was probably sufficient to guarantee that . . . the intrinsic limits of human abilities . . . to process information . . . would be exceeded" (p. 2). To attempt to avoid such problems as occurred at Three Mile Island from recurring in the future, and to assist tomorrow's pilots, today's user/machine system designers must understand and consider the operator's limited capacity to process information.

Kahneman (1973) believed that our limited capacity is caused by a limitation in the amount of attention available in the individual at any given time, and that individuals develop a strategy to allocate whatever attention is available in a particular situation. One avenue to study information processing, then, would be to examine the factors that influence this attention-allocation strategy.

One such factor is the characteristic behavior pattern an individual has developed to achieve goals or objectives. A relatively new construct that describes such a behavior pattern, developed by Friedman and Rosenman (1959), is the Type A/B coronary-prone behavior pattern. Friedman and Rosenman (1974) described the Type A pattern as

an action-emotion complex that can be observed in any person who is aggressively involved in a chronic, incessant struggle to achieve more and

more in less and less time, and if required, against the opposing efforts of other people or things. (p. 67)

In contrast, the Type B pattern is defined as a more relaxed, less time-driven approach to accomplishing goals and objectives, i.e., the relative absence of Type A behavior.

Recent studies have shown that individuals exhibiting Type A behavior allocate attention differently than those exhibiting Type B behavior. Burnam, Pennebaker, and Glass (1975), Price and Clarke (1978), and Matthews and Brunson (1979) all reported that Type As performed better on a primary task than Type Bs when a distracting stimulus was introduced. Further, Strube, Turner, Patrick, and Perrillo (1983) reported that while soft, simple music improved the primary-task performance of initially frustrated Type B subjects, it had no affect on Type As.

The present experiment was designed to determine whether there is a relation between goal-achievement behavior (Type A versus Type B) and attention-allocation strategy in the presence of a distracting stimulus. To assess this relation, the experiment was divided into two parts. First, the subjects, undergraduate college students, were identified as either Type A (hard-driving, multiple-goal oriented) or Type B (relaxed, less time-driven) through

use of the student version of the Jenkins Activity Survey. Second, within each of these groups, half the subjects heard an irrelevant, distracting, auditory stimulus during two of eight blocks of trials, and the other half performed in relative quiet throughout the experiment.

All subjects performed a complex cognitive task consisting of a designated primary and secondary task. This complex task was designed to ensure that the individual's full information-processing capacity would be demanded. The introduction of the distractor stimulus was designed to further load the subject's information-processing system to determine if there are any differences in allocation strategies between the Type A and B subjects.

Two major hypotheses were derived from the previous Type A attention-allocation studies to assess the behavior pattern/attention allocation relation. These were as follows:

1. Because of their high innate motivation and increased arousal when accomplishing challenging tasks, Type As working under the distractor would perform better on the primary task but worse on the secondary task than Type As working without the distractor. The Type As working with the distractor would also perform better on

the primary task but the same on the secondary task as Type Bs working with the distractor.

2. Because they keep a broader span of attention and are less goal-driven, Type Bs working under the distractor would perform poorer on both tasks than Type As and Bs working without the distractor.

CHAPTER II

Selective Attention and Information Processing

Influence of Attention on Information Processing

Selective attention can be defined as "the focus of attention exclusively on stimuli from a particular source or that share some other characteristic" (Kahneman, 1973, p. 112). Peterson and Peterson (1959) found that on a short-term memory recall test, if the subject was prevented from allocating attention to rehearse the stimulus string, the probability of correct recall dropped to near zero by 15 s. Posner and Rossman (1965) reported that performing a distractor task, a number-classification task, interfered with digit rehearsal and degraded digit recall performance, and Crowder (1967) reported that key-punch responses to lights had the same affect on a letter-recall task. Selective attention, then, is critical to the operations which comprise the information processing system, and, therefore, is critical to information processing.

Evidence for Limited Attention Capacity

It has been shown that we have only a limited amount of attention, or processing capacity, available at any

given time. Kahneman and Peavler (1969) and Kahneman and Wright (1971) demonstrated that as the difficulty of a secondary recall task increased, physiological measures of effort also increased while performance on a primary tracking task decreased. Keele (1967) reported that response times to a primary choice-RT task slowed as subjects performed more difficult levels of a secondary task (counting backward by one, three, or seven). Kahneman (1970) showed that response times to single, unpredictable light flashes slowed and error rates increased when the subjects were required to perform a choice-RT and a letter-matching task simultaneously. These studies provide strong support for the limited attention/processing capacity hypothesis.

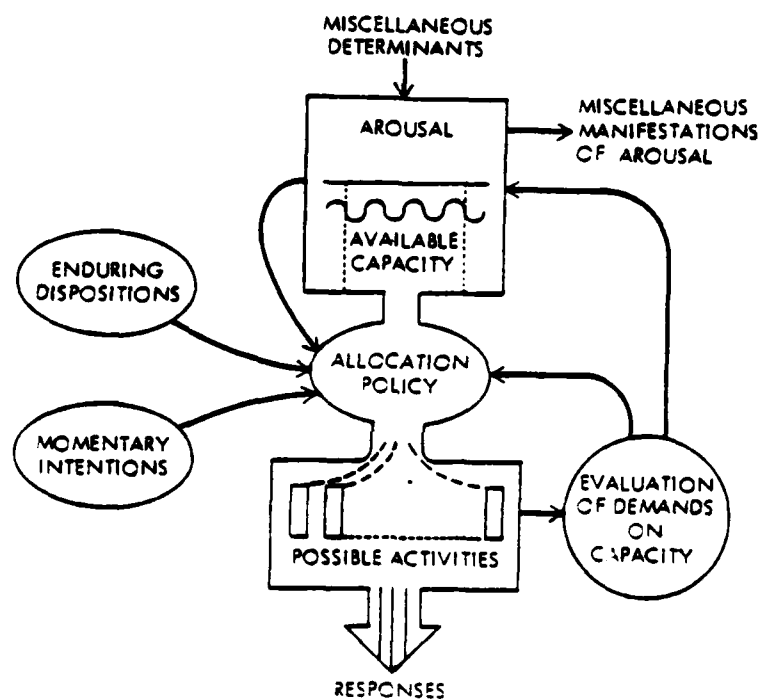
A Limited Capacity Model

Based on his extensive research into selective attention, Kahneman (1973) developed a conceptual model relating processing capacity and attention allocation (Reference Figure 1). All activities we perform require some portion of this limited attention capacity, with those tasks of "greater importance, salience, or complexity" requiring greater capacity (Kahneman, 1973, p. 9).

Arousal and attention allocation. Kahneman's (1973)

FIGURE 1
Model of attention capacity*

*From Kahneman, 1973



model identified several key factors influencing attention allocation: level of arousal, enduring dispositions, and momentary intentions. Level of arousal refers to the level of neural activity or alertness of the individual and is controlled by two sets of factors according to Kahneman's model: (a) the demands imposed by ongoing or anticipated activities, and (b) "miscellaneous determinants" such as anxiety, fear, intense stimulation, etc.

The changes in performance produced by changes in arousal level can be understood through the Yerkes-Dodson law and Kahneman's (1973) model. The Yerkes-Dodson law states that the quality of performance on a task will improve with increased arousal up to a point, after which further increases in arousal will cause performance to deteriorate (Yerkes & Dodson as cited in Kahneman, 1973). The optimum level of arousal at which performance peaks, however, is not constant, but varies across both individuals and tasks. Kahneman's (1973) model would explain this arousal-performance interaction through changes in available processing capacity. As arousal increases from some low state, attention capacity is increased and performance improves. At some point, however, further increases in arousal, above the optimum level for the individual and the situation, would diminish the available attention and performance would deteriorate.

Enduring dispositions. Also critical to attention allocation are what Kahneman (1973) called "enduring dispositions." These enduring dispositions predispose us to pay more attention to one stimulus than another. Novel stimuli, in particular, are favored in the allocation of capacity.

This tendency to direct attention toward a novel stimulus has been termed the "orientation response" (OR), and will be discussed here to demonstrate one effect such dispositions have on attention allocation. Kahneman (1973) drew several conclusions from the numerous studies he reviewed on the OR. Two of these conclusions were:

1. Any individual presented with a new or unexpected stimulus will automatically undergo some physiological changes that prepare the body to deal with this new stimulus.

2. If a stimulus is repeated, and is not significant to the individual, the orientation response will habituate. This does not mean that the stimulus is no longer being perceived; rather, the individual has learned to expect the stimulus and no longer directs attention to its processing, unless it again changes and violates expectations. Enduring dispositions, then, function to ensure that potentially critical information receives attention, and

these dispositions have a strong influence on attention allocation.

Momentary intentions. Finally, Kahneman (1973) believed our momentary intentions affect attention allocation. These intentions reflect the specific goals and objectives guiding our responses in a given situation. They may coincide with the enduring dispositions, such as for an assembly-line worker required to identify and remove defective, hopefully "novel," items from the production process, or they may fall along a continuum up to being completely at odds with our preset dispositions.

Smith (1982) conducted a series of studies that examined the interaction between noise distraction and shifting task priority, or shifting momentary intentions, on a task requiring recall of order and location. He hypothesized that task performance would be determined by a complex combination of factors such as dominance set by instructions, level of task difficulty and arousal level.

The results supported this hypothesis. When the designated primary task was actually performed before the secondary, there was a significant Noise x Task (primary/secondary) interaction (Smith, 1982, Experiment 1). However, when the designated secondary task was performed first, shifting the subject's momentary intentions.

the noise effect was eradicated (Smith, 1982, Experiment 1).

The effect, then, of momentary intentions on attention allocation is obvious. We approach each situation with certain goals and objectives that, when not overridden by the enduring dispositions, guide how the available processing capacity is employed. At any given time, the level of arousal determines how much of an individual's processing capacity will be available. Because some portion of this capacity is required for any task to be performed, the situational factors affecting arousal and momentary intentions, the two elements of Kahneman's (1973) model that control attention allocation and can themselves be controlled, must be understood.

Type A Pattern Behavior and Selective Attention

Exploring the Type A and B behavior patterns may provide some insight into the effect of goal-achievement behavior on attention allocation. Recent research has shown that Type As and Type Bs may allocate attention differently when performing complex cognitive tasks. If a systematic pattern of attention allocation can be associated with a particular behavior pattern, then further Type A/B research may provide another avenue for examining selective attention and information processing.

The Type A behavior pattern was described above as

an "action-emotion complex exhibited by individuals engaged in a chronic struggle to achieve" (Friedman & Rosenman, 1974), and the Type B pattern as a more relaxed, less time-driven approach to accomplishing goals and objectives. Of the many characteristics associated with the Type A individual, two appear particularly relevant to this study: an intense, sustained drive toward goal achievement, and extra-ordinary physical and mental alertness. Both of these characteristics should influence an individual's level of arousal and momentary intentions.

Numerous studies have highlighted the Type A, hard-driving, achievement characteristics:

1. Burnam, Pennebaker, and Glass (1975, Experiment 2)--Type As completed more arithmetic problems than Bs when working with no deadline.

2. Krantz (as cited in Glass, 1977)--Type As recalled more items per slide when the slides were exposed for intervals of 5 to 8 seconds.

3. Frankenhaeuser, Lundberg, and Forsman (1980)--When left to themselves, Type As chose faster work rates than Type Bs and maintained the same level of accuracy.

To accomplish such high levels of performance, Matthews (1981) believed that Type As must "work efficiently, persist in spite of fatigue, and ignore potentially interfering distractions" (p. 301).

Further, during an extensive review of the Type A literature, Matthews (1981) found strong evidence supporting the alertness (or arousal) description of the Type A pattern. In 10 of 14 studies, male Type As exhibited higher elevations in systolic blood pressure, epinephrine, and norepinephrine in response to certain environmental events than did Type Bs. These environmental events could be characterized as frustrating (Glass et al., 1980, Experiment 1), difficult (Dembroski et al., 1978, 1979), and moderately competitive (Dembroski et al., 1979; Glass et al., 1980, Experiment 2).

Contrada et al. (1982) studied the cardiovascular and plasma catecholamine response in Type A and B individuals performing under various levels of control over aversive stimuli. While subjects performed a choice RT task, they received loud bursts of low and high frequency noise and/or electric shocks on designated trials. Each type group was further divided into a contingency group, which could avoid the aversive stimuli by maintaining a criterion level of performance on the task, and a non-contingency group, which had no control over the aversive stimuli.

Analysis of the norepinephrine (NE) data yielded a significant Type x Contingency x Trial x Frequency Level interaction. From their graphical analyses, it appeared

this finding was due to differences in performance between the Type A and B contingency groups who received the high-frequency noise. Contrada et al. (1982) concluded that their Type A subjects became more physically aroused than their Type B subjects when the avoidance of an aversive stimuli was contingent upon task performance.

It is possible, then, through Kahneman's (1973) model to explain why Type As and Bs would have different attention-allocation strategies for performing a complex task. As Type As are more achievement oriented and aroused by a difficult or competitive task than Type Bs, the Type As must enter a situation with a different level of processing capacity and different momentary intentions, goals and objectives, than their Type B counterparts. Consequently, Kahneman's model would predict that Type As would channel more of their capacity to the task components most relevant to task success than the Type Bs who might maintain a broader span of attention. Limited research to date has supported this hypothesis.

Burnam et al. (1975) and Price and Clarke (1978, Experiment 1) conducted some of the first research into this area through use of the time-estimation task. In the Burnam et al. experiment, male and female students were first identified as Type A or B through scores on the student version of the Jenkins Activity Survey (JAS).

Those with scores above the median of 6.9 were classified as Type A and those with scores below as Type B. The subjects were then instructed to read a passage aloud while estimating a 1-minute time interval. Although not statistically significant, the results suggested that Type As were less distracted by the reading: signaling the passage of 1 m more closely than Type Bs (52.6 s versus 75 s).

The subjects in Price and Clarke's (1978) first experiment estimated the passage of five short time intervals (12 s, 60 s, 90 s, 110 s, and 135 s) under three levels of distraction: "no-tape"--control condition; "listen"--listening to a tape-recorded newspaper story; and "shadow"--repeating aloud a speaker's words as they were said. Subjects were also classified as Type A or B using the median split procedure on the student JAS.

As in the Burnam et al. (1975) study, the Type A subjects estimated the passage of time more accurately than the Type Bs, but only significantly at the 135 s interval (Type As--130 s versus Type Bs--180 s). Price and Clarke (1978, Experiment 1) also found a significant Condition x Time Interval interaction. Subjects of both types working in the shadow condition had the shortest time estimations for each interval, followed by the listen

group. Possible reasons for lack of an effect of type will be discussed in the Experimental Rationale.

Matthews and Brunson (1979) followed with three experiments that employed the Stroop Color-Word Interference task to study type behavior pattern differences in attention allocation. In Experiment 1, the Stroop task was the primary task in a dual-task paradigm, and the subjects were classified as Type A or B using the median split on the scores from the student JAS.

The secondary task consisted of a response to a light mounted in the subject's right field of view. During the 6 1/2-m trial, this light was activated 12 times, and time from light illumination to key press was recorded. The results showed that Type As had significantly more correct responses on the primary task (165 versus 107) but had greater average response times on the secondary task (4.14 s versus 1.97 s).

In Experiment 2, the Stroop task alone was used, and subjects were classified as Type A with a JAS score of 9.0 and above, and Type B with a score of 6.0 and below. However, in this experiment, the subjects were given a 5-m time period to perform the task, and half the subjects heard a 3000 Hz, 78 dB(A) noise distractor.

Matthews and Brunson (1979, Experiment 2) believed

that if the Type As attend less to peripheral events only because they concentrate more on central events, there should be no difference in performance between Type As with or without this peripheral stimulus. However, if Type As actively inhibit attention to the distractor, performance should be enhanced under the distractor condition. Also, because a specific time deadline had been set, it was postulated that no between-type differences should be found for the groups working without the distractor.

The results showed that the Type As working with the distractor performed better than the Type As without it, and performed better than either Type B group. In contrast, Type B performance under the distractor deteriorated. However, in Experiment 3, conducted under the same conditions, Type B performance remained unchanged between conditions but Type A performance with the noise stimulus was again superior. The results also showed no Type A/B performance differences under the no-distractor condition.

Strube et al. (1983) examined the effects of music patterns on Type A and B performance and mood states. This study was based partially on the Matthews and Brunson's (1979) research and partially on experiments which showed that soft, simplex music (a simple tonal

harmony with a simple progression and rhythm) led to a reduction in aggression, but loud simplex and all complex music (same note order and range as simplex, but maintained in a complex music form) intensified aggression in a previously aroused individual. The mood-changing effects of the music stimuli can only occur, Strube et al. argued, if attention is allocated to the stimuli. Thus, if Type As focus most of their attention on the primary task, as the Matthews and Brunson (1979) study indicated, they should not benefit from the positive effects of the soft, simplex music.

In the Strube et al. (1983) study, the subjects first completed the student JAS before working on a mood adjective checklist designed to make them more aware of their current mood state. Subjects with JAS scores of 9.0 and above were classified as Type A, and those with scores of 6.0 and below were classified as Type B.

The subjects were then given a list of 30 anagrams to solve in 20 minutes and were misinformed that most college students could solve at least 24 of these anagrams in that time. In actuality, a pilot study showed that college students could only solve 13 in the 20-m period because there was no consistent solution pattern. While performing this task, some of the subjects

were exposed to either the simplex or complex music played continuously through the test period at 70-75 dB, and some of the subjects had no music at all. Immediately following the first anagram task, subjects participated in a second anagram task which possessed a consistent solution. No music was played during this second task. A multiple-comparisons test revealed that the Type B simplex group out-performed both other Type B groups (16 versus 10 and 8 anagrams) and all three Type A groups (16 versus an average of 12 anagrams).

To summarize, Contrada et al. (1982) reported that Type As became more physically aroused than Type Bs when able to control the situation. Burnam et al. (1975) and Price and Clarke (1978) reported Type As were less distracted while estimating the passage of time. Matthews and Brunson (1979) reported that when no distraction was present, Type As and Bs performed equally well on a Stroop task. But, under a noise distractor, Type As performed better than other Type As without the distractor and both Type B groups. Finally, Strube et al. (1983) reported that initially frustrated Type Bs performed better when working with a stimulus previously shown to be relaxing than Type As exposed to the same stimulus and Type As and Bs exposed to other stimuli.

From the results of these studies, it is reasonable to hypothesize that individuals identified as hard-charging Type A possess a different attention-allocation strategy than do the more relaxed Type Bs.

CHAPTER III

Experimental Rationale

Although the Type A studies reviewed demonstrated a possible relation between the Type A and B behavior patterns and attention allocation, several methodological problems associated with these studies indicated that further study was needed.

The first methodological problem concerns possible misclassification of some of the subjects as Type A and B by using the median split method on student JAS scores. During validation of the original adult form of the JAS, Jenkins, Rosenman, and Zyzanski (1965) correlated type classification based on their new JAS scores and type classification with the better established structured interview. They reported that agreement between JAS score and interview classification was higher for individuals who scored at least one standard deviation (SD) from the mean on the JAS than for individuals who scored less than one SD from the mean (JAS score more than 1 SD--90% agreement, JAS score between 1/2 and 1 SD--75% agreement, JAS score less than 1/2 SD--50% agreement or chance level).

Price and Clarke (1978) summed up the possible effect of misclassification in their experiment by stating

only inconsistent, scattered differences were found on any measure. . . . By dividing the subject pool by the median score . . . underdeveloped Type As and Bs were likely included in the study. . . . [therefore] it was decided to drop from analysis subjects falling in the middle third of the distribution. (p. 412)

If the middle scores on the JAS provide only a chance classification of individuals as Type A or B, and Price and Clarke (1978) had to eliminate subjects who fell in this range from their own study, then the results of the other Type A studies into attention allocation may be inaccurate as all three studies used subjects who were on or close to the median.

The second methodological problem concerns the amount of practice given prior to introduction of the experimental condition. During initial practice of an unfamiliar task, subjects show large fluctuations in means and variances across trials. Generally, however, there comes a point after which practice no longer produces major changes: task performance has stabilized (Jones, 1979). Stable performance is important to examine the performance effects of the experimental variable without the complications introduced by varying individual improvement

in performance across trials.

The need for stable performance prior to the introduction of the experimental condition was not considered in three of the Type A studies of attention allocation. Burnam et al. (1975) gave no practice for the 1-m time-estimation task, and collected data for only one trial. Price and Clarke (1978) employed only one nonrepresentative practice trial (estimating 4 s) before the subjects performed one trial at each of five test intervals. Strube et al. (1983) gave no practice prior to recording data on the number of anagrams solved during the 20-m test periods. As neither the time-estimation task nor the anagram task is regularly performed by people, these tasks probably require more practice than was given before accurate performance data can be collected.

The final methodological problem concerns the nature of the tasks employed to analyze the subjects' attention allocation strategies. We know that certain well-practiced tasks, such as walking or riding a bike, can be done with minimal mental effort, or automatically. If such a task is performed concurrently with a second task that does not require all of a person's attention, both tasks can be performed together as well as when each is performed separately. In this case, it is difficult

to study an individual's attention-allocation strategy accurately, because sufficient capacity is available to perform both tasks.

Hasher and Zacks (1979) listed tasks requiring temporal processing, such as time estimation, as one type of task that can be performed automatically once practiced. A study by Damos and Bloem (1985) supported their belief. They found that estimating six 10-s intervals during a 1-m test period had no effect on the performance of difficult levels of a Sternberg task (5-item positive set) or a choice-RT task (8 alternatives).

If the nature of the task affects attention allocation, and there is strong evidence it does, this may explain why Price and Clarke (1978) did not find the interaction between distraction and the Type A and B behavior patterns that Matthews and Brunson (1979) found. Where Price and Clarke used a task that could be done automatically, time estimation, Matthews and Brunson used a primary task that could not be processed automatically, the Stroop task. Therefore, if Type As allocate attention differently than Type Bs in a multiple task situation, the Matthews and Brunson study would have been more likely to discover this difference.

Approach

To determine whether Type As employ a different allocation strategy than Type Bs in a multiple task situation, this experiment was conducted under tighter methodological controls. These controls included (a) studying only subjects with a more fully-developed Type A or B behavior pattern, (b) utilizing a combination of tasks proven to require full attention capacity when combined, and (c) giving subjects sufficient single- and dual-task practice to stabilize performance before presenting the distractor stimulus.

Subject selection. To qualify for this experiment, a person had to score approximately one SD from the mean on the student version of the JAS (11 and above--Type A [12 was one SD], and 6 and below--Type B [5 was one SD]). This approach was employed in previous experiments that examined other aspects of the Type A behavior pattern (Carver & Glass, 1978; Snow, 1978).

Paradigm. The purpose of this study was to determine whether Type As allocate attention differently than Type Bs when having to ignore a distracting stimulus. To accurately measure any shift in attention when the distractor was presented, I first had to establish some

accurate base measure of attention allocation. A single-task paradigm could not have provided this measure because there would have been no way of knowing how much of the subject's attention capacity was being used or how it was being allocated. Consequently, under a single-task paradigm, even if there were shifts in attention allocation before and during the distractor trials, they might go undetected.

One method suggested by both Kahneman (1973) and Wickens (1984) for determining a person's allocation strategy is the dual-task paradigm. If two tasks that together exceed the subject's capacity are combined, with one designated primary and the other secondary, performance on the combined task allows an accurate measure of attention allocation.

If the subjects actually treat the tasks as primary and secondary, performance on the primary task should not change when the tasks are combined; however, their secondary task performance should be degraded. By examining the subject's primary and secondary task performances for the trials before the distractor was introduced, some objective base measure of attention allocation could be obtained. Then, with full capacity demanded, allocation strategy established, and dual-task performance stabilized, performance changes due to the

distractor stimulus would be more accurately identified. Therefore, a dual-task paradigm was selected for this experiment.

Tasks. The dual-task method will only be as good as the tasks that comprise it. The use of automatically processed tasks would not ensure that full capacity is demanded and, therefore, would not accurately depict a subject's allocation strategy. In addition, the more similar the tasks, the more likely it is they will compete for common processing mechanisms. Wickens (1984) lists multiple-input encoding, transformations, response selection, and response execution as examples of mechanisms placing demands on the limited-capacity central processor. That is why a running difference task was chosen as the primary task and a vowel-consonant classification task was chosen as the secondary task.

Damos (1985b) showed that neither of these tasks was able to be practiced so well that they became automatic, and neither could be performed concurrently with other demanding cognitive tasks without some decrement. Also, both are processed verbally in short-term memory and should, if Wickens' (1984) hypothesis about mechanisms placing demands on the central processor is correct, together demand full attention capacity while being performed.

The running difference task is a continuous task requiring that two numbers be remembered at all times with one of the numbers changing with each response. This task is also discrete in that the numbers do not change until a response is made. Therefore, the subject can shift attention to the secondary task without drastically impacting accuracy; however, the shift would be detected in the change in the number of correct responses for each task during a trial. The running difference task was also used as a primary task by Damos in studying auditory versus visual inputs (1985a), and Type A performance under forced- versus self-pacing (1985b).

The secondary, vowel-consonant task is a discrete task that does not require memory but only requires a response to a pair of stimuli immediately present on the screen. Graphical analyses of studies by Damos (1985b) and, with a similar task, Damos (1978, 1980) showed that this task requires a measurable amount of cognitive processing and does not become automatic with practice. Together, the running difference and vowel-consonant tasks succeed in demanding full capacity while remaining sensitive to attention shifts.

Several steps were taken to ensure that the subjects would treat the tasks as primary and secondary:

1. The tasks were appropriately identified in the instructions and emphasized by comments from the experimenter throughout the study.

2. The primary task was practiced first under the single-task condition.

3. The primary task was presented in the right visual field and performed with the right hand by right-handed subjects.

4. The primary task was mentioned first throughout the dual-task instructions.

5. Feedback on the primary task was placed above the secondary during dual task.

6. The subjects were offered a bonus based on a score from their dual-task performance, with primary task performance contributing 75% and secondary task performance contributing 25% to the score.

Maintaining the primary/secondary task distinction was essential to identifying any pattern of effect in task processing under the distractor stimulus.

Distractor stimulus. A tape consisting of 10 segments of either hard-driving songs, or comedy routines, or horror stories, or pilots interacting during air-to-air combat training was selected as the distractor because previous studies have demonstrated that similar stimuli

affect attention. Matthews and Brunson (1979, Experiment 2) used a tape that contained ". . . sports broadcasts, brief verbal remarks, and a ticking clock" and found the attention allocation differences reported in the literature review. Hockey (1970, Experiment 1) used broadband noise played at 100 dB(A) and found a shift in attention between the central and peripheral components of the secondary task.

The tape of the distractor stimuli for this experiment was played over headphones during dual-task trials 16 through 25, with each segment just slightly longer than a trial. Because each trial's taped segment was different, or novel, it was expected to demand some processing attention from the subject (Broadbent, 1971). Also, because the tape was played at 90 dB(A) (+ or -5 dB), it was potentially arousing (Easterbrook, 1959; Poulton, 1976). Based on the findings from previous work, this stimulus should have affected performance (Easterbrook, 1959; Broadbent & Gregory, 1965; Norman & Heimstra, 1971; Hamilton, Hockey, & Quinn, 1972) in the following manner:

1. It should increase task complexity because if any of the tape segments were processed, they would have had to have been processed verbally as were both the primary and secondary tasks, and therefore caused some

interference.

2. It should increase arousal above whatever level was set by the challenging dual-task paradigm and the bonus incentive. This incentive is described in the Methods section.

If Type As are already at a higher base level of arousal (as predicted by previous studies) because of the challenging nature of the task, and they actively ignore potentially distracting stimuli as Matthews and Brunson (1979, Experiment 2) stated, than the addition of the distractor should shift their arousal level to a still higher level. From the Yerkes-Dodson law (Yerkes & Dodson as cited in Kahneman, 1973), this higher level should either result in better dual-task performance as arousal gets closer to some optimum level, or it should result in degraded performance, on one or both tasks, as arousal moves beyond optimum. Furthermore, if Type Bs maintain a broader span of attention, and process part or all of the distractor (as the previous Type A literature suggests), their performance on both tasks should decline because they will already be operating at full attention capacity.

Stabilized performance and the experimental condition.

The final methodological control was an attempt to stabilize performance before the experimental condition was introduced. Previous research by Damos (1985b)

utilizing the running difference and vowel-consonant tasks revealed that performance on both tasks became relatively stable after five trials under the single-task condition and after 15 trials under the dual-task condition. Pretesting indicated that these numbers of trials should be sufficient. Accordingly, each subject was given five trials of practice on each task separately (single-task) and 15 trials of dual-task practice before introducing the distractor stimulus.

To summarize, on the basis of previous Type A research of attention allocation, I believe that people identified as having the Type A behavior pattern allocate attention differently than people identified as having the Type B pattern. However, several methodological problems associated with these studies indicated the need for further research.

Predicted Results

The number of correct responses was chosen as the dependent variable. It was expected that all the groups would perform equally well on all trials without the distractor stimulus because of the well-defined task, the bonus incentive, and the accurate feedback (Matthews & Brunson, 1979, Experiments 2 and 3). On the 10 trials in which the distractor was played, however, the following

results were predicted:

1. The Type A distractor group would (a) have a greater number of correct responses on the primary task but fewer on the secondary task than the Type A no-distractor group, and (b) have a greater number of correct responses on the primary task but about the same on the secondary task as the Type B distractor group.
2. The Type B distractor group would have fewer number of correct responses on both tasks than either the Type A or B no-distractor groups.

Method

Tasks

Running difference. In this task, randomly selected digits between 0 and 8 were presented sequentially. The subject responded with the absolute difference between the digit currently on the screen and the immediately preceding digit. The possible responses consisted of the numbers 1 through 8. All nine input digits (0 through 8) were presented visually with approximately the same frequency, and a digit never followed itself in the series. A new digit was presented only after a response was made.

Responses were made manually by pressing one of eight keys on a keypad mounted on the right side of the

IBM PC-XT keyboard. The middle row, keys 4 through 6, was the base row for resting the fingers when not used for responding. Because the first digit had no preceding digit to take the difference, the response to the first digit of any trial was always "1." The number of correct responses and percent correct were presented as feedback after each single- and dual-task trial. (Reference Appendix A.)

Vowel-consonant classification task. For this task, two randomly selected letters from the set A, B, E, H, I, and J were presented simultaneously to the subject. The pair consisted of either two vowels, two consonants, or a vowel and a consonant. The subject's task was to indicate whether the letters in the pair were the "same" (both vowels or both consonants) or "different" (one vowel and one consonant) by pressing either the "F" key with the left index finger or the "D" key with the left middle finger. The "same" and "different" responses were equally probable, and within the "same" category, there was equal probability of seeing two vowels or two consonants. As soon as the subject responded, the pair was erased and a new pair was presented. The dependent variables recorded were the same as for the RD task, with the number of correct responses and percent correct

again given as feedback after each trial. (Reference Appendix B.)

Running difference and vowel-consonant tasks combined.

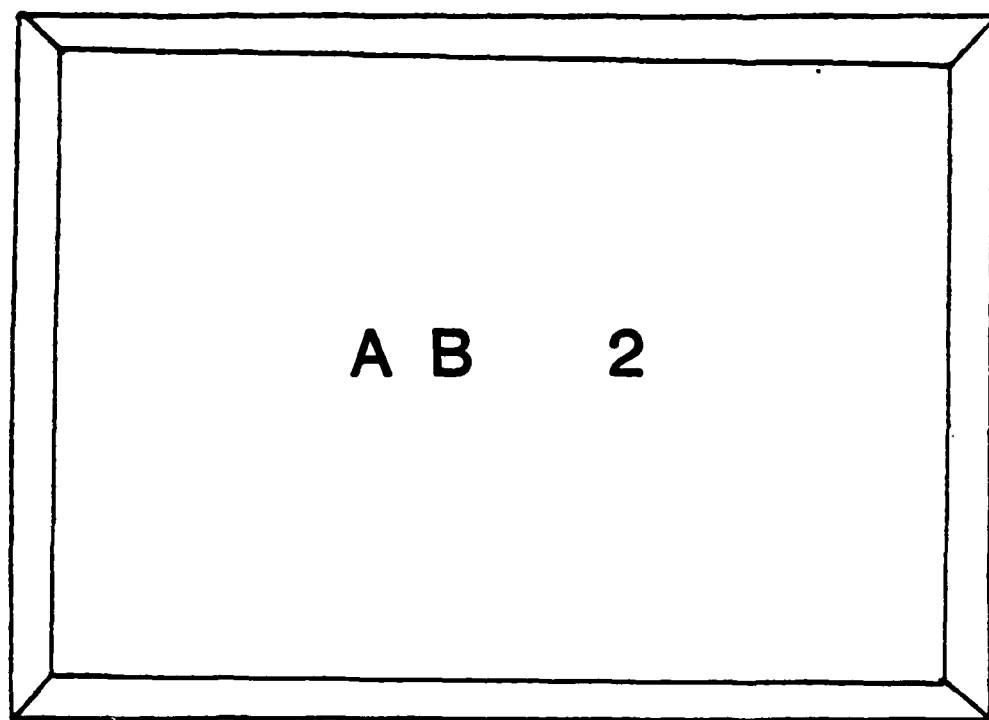
As mentioned above, the running difference task was designated as primary and its stimuli were presented on the right side of the screen, with a new digit presented only after a response was made on the keypad. The letters for the vowel-consonant task were presented on the left side of the screen and also remained displayed until a response was made. The subject used the same hand to respond to each task as in the single-task conditions, with each hand controlling only the responses for its particular task. The visual angle subtended by the digit and letter pair, based on a subject seating distance of 56 cm from the vide screen, was 2.6 degrees (Reference Figure 2). Again, the same dependent measurements were recorded and displayed as feedback as for the single-task trials. (Reference Appendix B.)

Distractor Stimulus

The verbal stimulus consisted of taped sounds played at 90 dB(A) (+ or -5 dB) through headphones during trials 16-25 of the dual-task condition. The taped material consisted of ten 100-s segments of either hard-driving songs, or comedy routines, or horror stories, or pilots

FIGURE 2

Dual-task stimulus display on videoscreeen
(at seating distance of 56 cm, angle
subtended is 2.66 degrees)



interacting during air-to-air combat training. There was 20 s of quiet between tape segments. The ambient decible level of the lab for the quiet condition was between 55 and 65 dB(A).

Apparatus

An IBM PC-XT computer with 256K storage capacity generated and displayed the task stimuli, performed all timing for the tasks, and recorded the responses. All responses were made by depressing keyboard keys as previously described. The verbal stimulus was played by a Panasonic portable cassette player, model RX-1960, through KOSS K/145 headphones. All sound pressure levels were measured by a Quest Electronics sound level meter, model 215.

Subjects

Forty-seven right-handed males were recruited from introductory psychology classes at Arizona State University, and received credit toward fulfillment of a course requirement. All subjects were between 18 and 35 years old and native English speaking. Selection for participation was based on scores from the student version of the JAS as outlined previously. Of these 47, the data from only 37 were used in the final analyses because

9 subjects' JAS retest scores fell out of the desired range, and one subject was found to be left-handed.

Incentive

To ensure that all subjects performed to their maximum abilities, an additional hour of experimental credit toward fulfilling the introductory psychology course requirement was offered as incentive. Although all subjects received the extra hour of credit, they were briefed in the informed consent form and it was reiterated in the dual-task instructions, that the incentive would be given only for meeting a specific criterion on their dual-task performance. They were also told that the running difference task performance constituted 75% of the score that would be compared to the criterion, and that the vowel-consonant task performance constituted the remaining 25%. (Reference Appendix A for the informed consent forms.)

Design

Single-task performance was analyzed using the number of correct responses as the dependent variable and a 2 x 2 (Type x Noise Condition) ANOVA for the test. Only the data from the last single-task trial were used.

Dual-task performance was also analyzed using the

number of correct responses as the dependent variable. However, for dual-task, performance was analyzed separately for each task: For the primary task, a $2 \times 2 \times 6 \times 5$ (Type $\times$ Noise Condition $\times$ Block $\times$ Trial) repeated measures ANOVA was used, and for the secondary task, a $2 \times 2 \times 3 \times 5$ (Type $\times$ Noise Condition $\times$ Block $\times$ Trial) repeated measures ANOVA was run on Blocks 3-5 and a $2 \times 2 \times 4 \times 5$ ANOVA was run on Blocks 5-8.

Procedure

All instructions for this experiment were typewritten and handed to the subject at the appropriate point in the experiment. The trials were 90 s long with a 45 s break between trials. When the subject arrived, he was asked to read a briefing sheet describing the experiment and to sign an informed consent form. The subject was then seated 56 cm from the IBM PC-XT vide screen and asked to read the instructions and perform five single-task trials of the VC task. When single-task training was complete, the subject read the instructions and practiced the dual-task combination for 10 trials followed by a 10-m break. After the break, all subjects put on the KOSS headphones and performed 20 more dual-task trials, the middle 10 with the auditory stimulus for the designated subjects. Upon completion of the dual-task testing, the subjects then retook the JAS and were debriefed. (Reference Appendix C.) The session lasted approximately 2.0 hours.

CHAPTER IV

Results

All ANOVAs reported were performed via the BMDP statistical package available on Arizona State University's main IBM computer. The programs used were BMDP2V and BMDP4V, both specifically designed to analyze repeated measures data.

Methodological Controls

Study only subjects with more fully-developed behavior patterns. The mean JAS score for the 430 Arizona State University's students who completed the introductory psychology questionnaire, the pool from which the subjects for this experiment were drawn, was 8.4 (out of a possible 21) with a standard deviation of 3.4. The average JAS score for the Type A groups was 13.6, with individual scores ranging from 11 to 17. The average JAS score for the Type B groups was 3.7, with individual scores ranging from 2 to 6. Only 5 of the 20 Type As had a score below 12 (one standard deviation above the mean), and only 2 of the 17 Type Bs had a score greater than 5 (one standard deviation below the mean). As the subject's retest JAS scores were also within the

established range, we were satisfied these subjects were accurately classified as Type A or Type B.

Utilize a set of tasks that require full attention capacity when combined. Figure 3 presents a comparison of the mean number of correct responses on each of the five single-task trials (Blocks 1 and 2) for each task, with each of the 5-trial blocks under dual-task for all groups combined. For the primary task, performance dropped slightly (20%) as the subjects went from the single to the dual task. However, by Block 5, the groups were performing at 93% of their single-task level. Radically different results are seen for the secondary task, for which a large decrease in performance from single to dual task (74%) was maintained throughout the remainder of the experiment. These results indicate that (a) the tasks could not be performed automatically when combined, (b) the dual-task condition demanded full attention capacity, and (c) the tasks were being properly treated as primary and secondary.

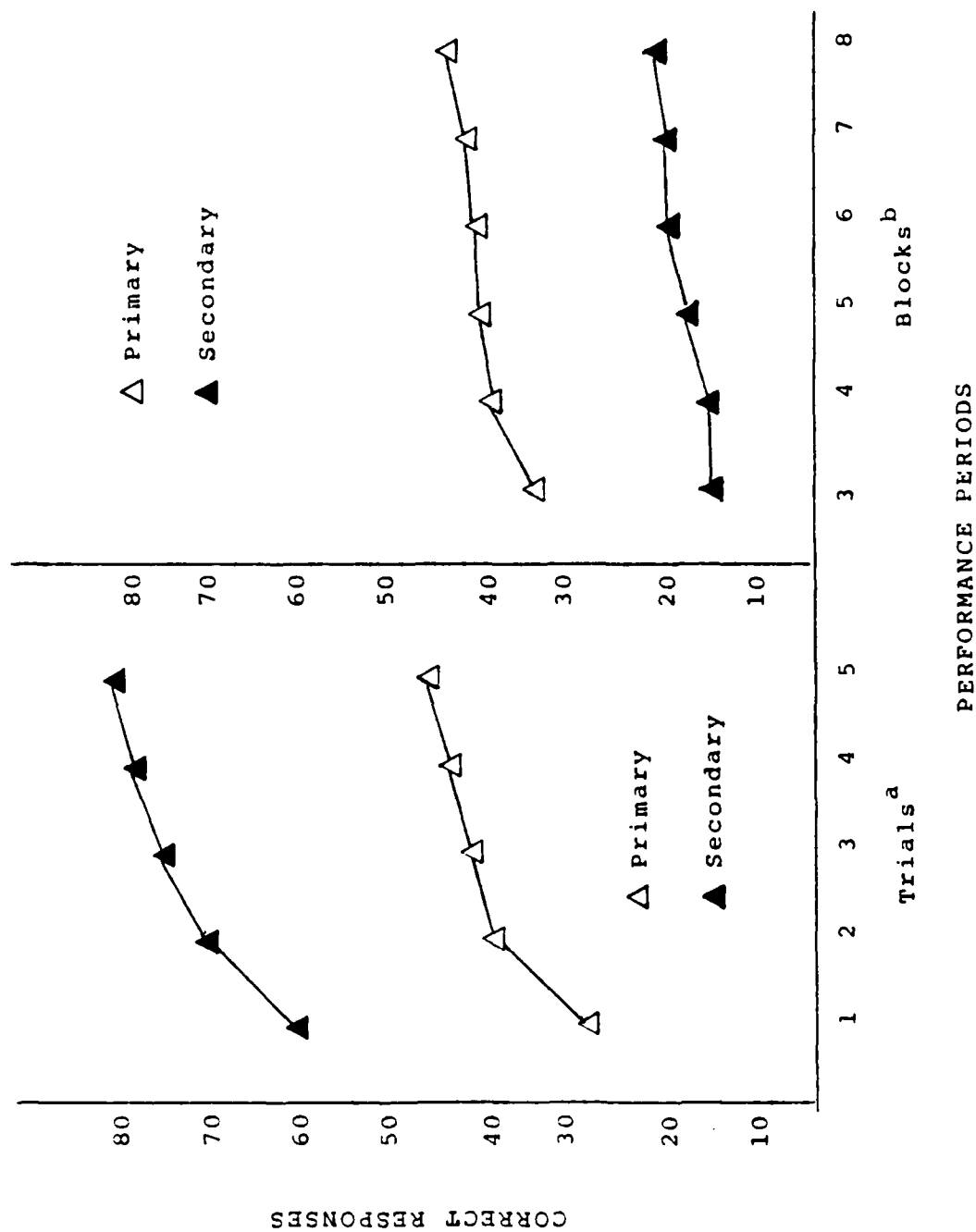
Obtain stabilized performance before introducing the distractor in Block 6. This goal was not achieved for either task. A $2 \times 2 \times 6 \times 5$ (Type $\times$ Noise Condition $\times$ Block [3 through 8] $\times$ Trial) repeated measures ANOVA on the primary task shows a significant main effect of Block ($F[5,165] = 38.77, p < .0001$). The same ANOVA on the

FIGURE 3

Comparison of the mean group performance
between the single-task and dual-task
conditions.

^aEach task was practiced for five trials by itself.

^bEach dual-task block consists of five 90-s trials.



secondary task yields a similar main effect ($F[5,165] = 10.25, p < .0001$).

Single-Task Performance

Figure 4 shows the mean number of correct responses per group for each task across the five single-task practice trials. It appears that performance is approaching stability for each group by Trial 5, though this goal was not achieved. A 2×2 (Type $\times$ Condition) ANOVA on this trial's data reveals no significant effects on either task.

Dual-Task Performance

Primary-task performance. Figure 6 compares the mean number of correct responses for groups across the six dual-task blocks for the primary task; each block score is the average performance over five trials. The distractor was presented to the noise groups during each of the trials of Blocks 6 and 7. Performance for all groups begins at about the same level in Block 3, and all the groups continuously improve performance throughout the remainder of the experiment. The $2 \times 2 \times 6 \times 5$ (Type $\times$ Noise Condition $\times$ Block [3 through 8] $\times$ Trial) repeated measures ANOVA reported above indicates the only significant effect is the main effect of Block.

Secondary-task performance. Figure 7 shows the mean

FIGURE 4

Mean group performances across
the five single-task practice
trials for the primary and
secondary tasks.

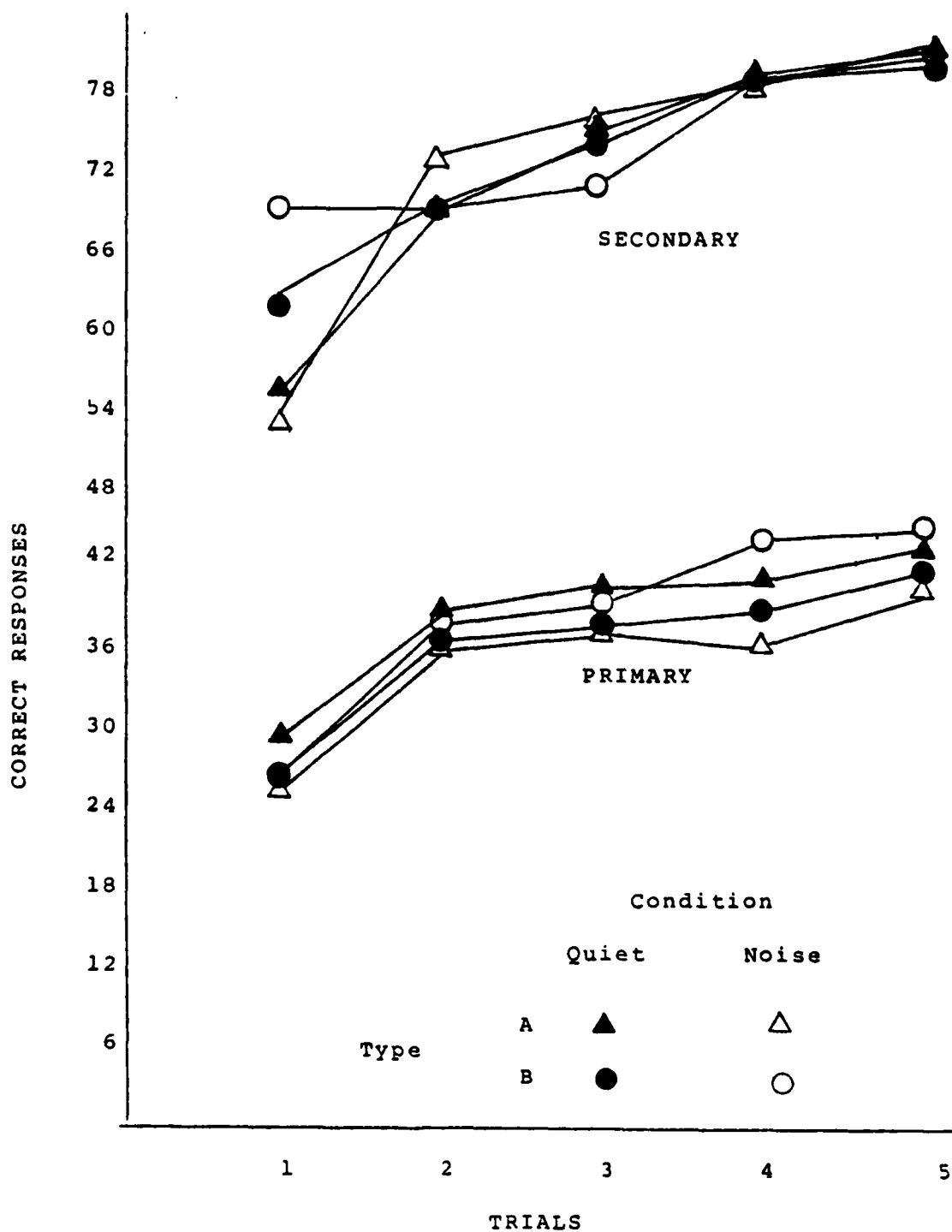
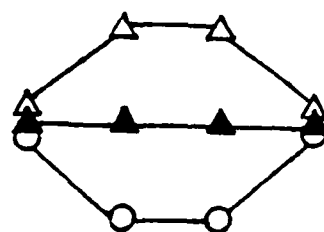


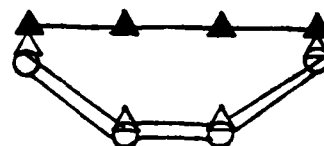
FIGURE 5

Predicted results under
Hypotheses 1 and 2 for
the primary and secondary
tasks.

CORRECT RESPONSES



PRIMARY



SECONDARY

Condition

Quiet

Noise

Type

A ▲

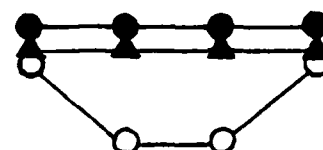
△

B ●

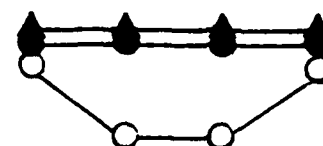
○

5 6 7 8

Hypothesis 1



PRIMARY



SECONDARY

5 6 7 8

Hypothesis 2

BLOCKS

FIGURE 6

Primary-task group performances
across the dual-task blocks.

(Each block contains five trials.

The distractor was played for the
noise groups during Blocks 6 and 7.)

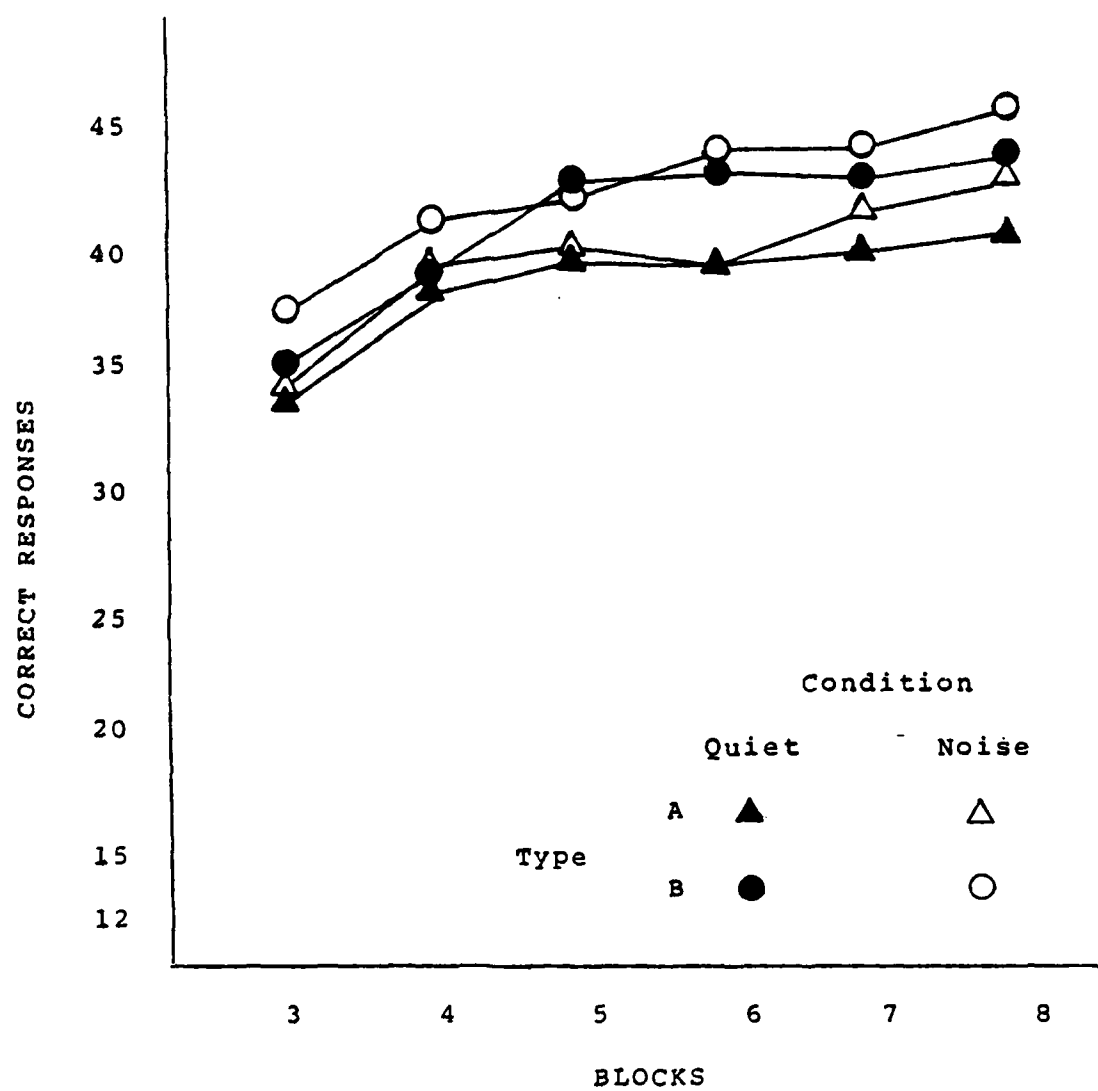
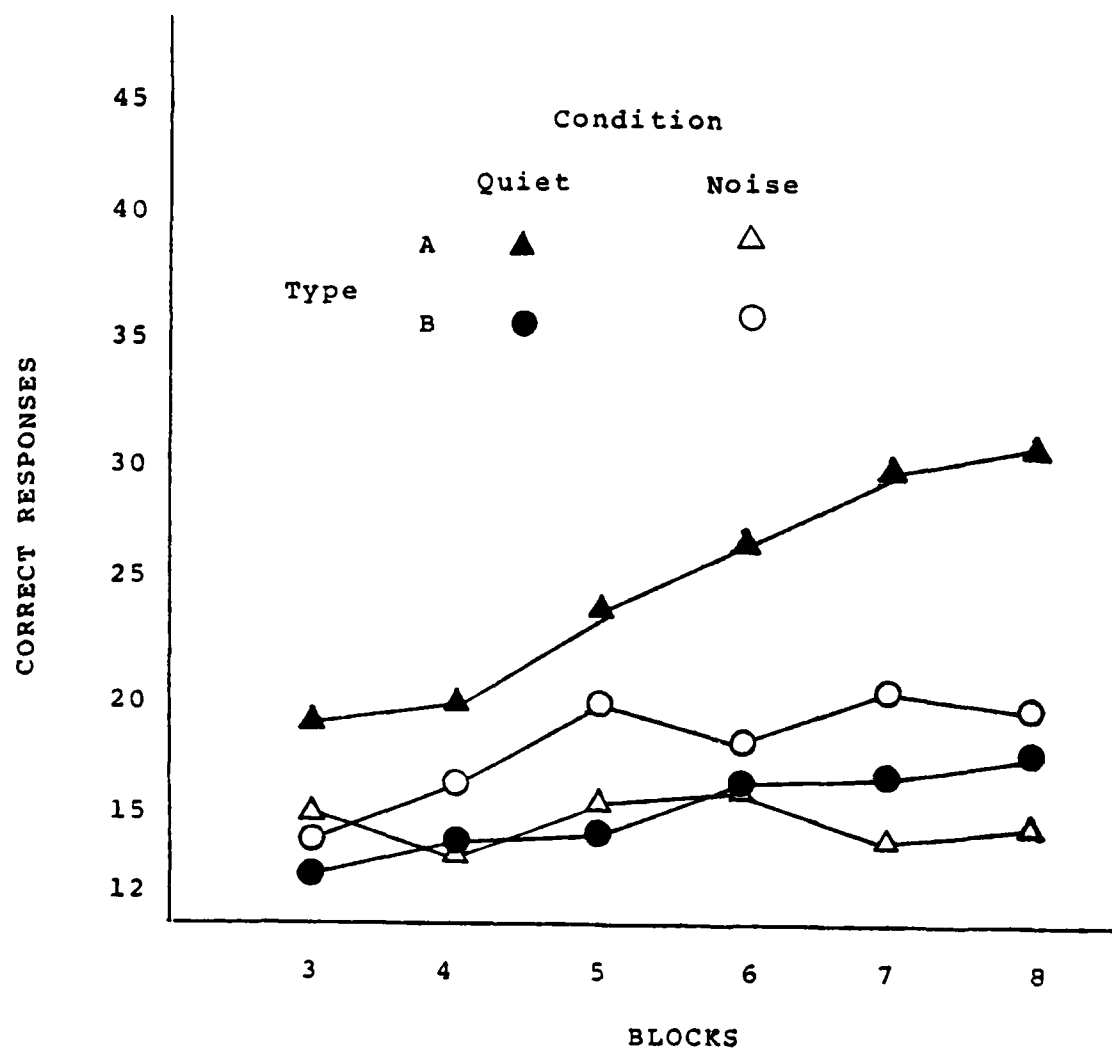


FIGURE 7

Secondary-task group performances
across dual-task blocks. (Each
block contains five trials. The
distractor was played for the noise
groups during Blocks 6 and 7.)



number of correct responses on the secondary task for each group across the six dual-task blocks. During this discussion, the groups will be identified as AQ (Type A, Quiet), AN (Type A, Noise), BQ (Type B, Quiet), and BN (Type B, Noise).

For Blocks 3 through 5, prior to the distractor, it can be seen in Figure 7 that performance for all the groups improved. A $2 \times 2 \times 3 \times 5$ (Type $\times$ Noise Condition $\times$ Block [3 through 5] $\times$ Trial) repeated measures ANOVA revealed only a main effect of Block ($F[2,66] = 7.54$, $p < .0001$). Thus, in spite of the apparent difference in performance of the AQ group compared to the other three groups, there was no significant difference in the groups' performance prior to the distractor.

In contrast, a $2 \times 2 \times 4 \times 5$ (Type $\times$ Noise Condition $\times$ Block [5 through 8] $\times$ Trial) repeated measures ANOVA revealed both a Type $\times$ Condition interaction ($F[1,33] = 6.7$, $p < .01$) and a Block $\times$ Condition interaction ($F[3,99] = 3.12$, $p < .03$). In Figure 7, we can see that the Type $\times$ Condition interaction is due to differences in the effect of the distractor on each type-group: the AQ and AN groups' performance diverge across these blocks versus the converging performances of the BQ and BN groups. In further examining the Type A groups' performance, we see that the AQ group's performance has improved considerably

from Blocks 5 to 8 (24.2 versus 31.1 correct responses) whereas the AN group's performance has leveled off (15.8 versus 15 correct responses).

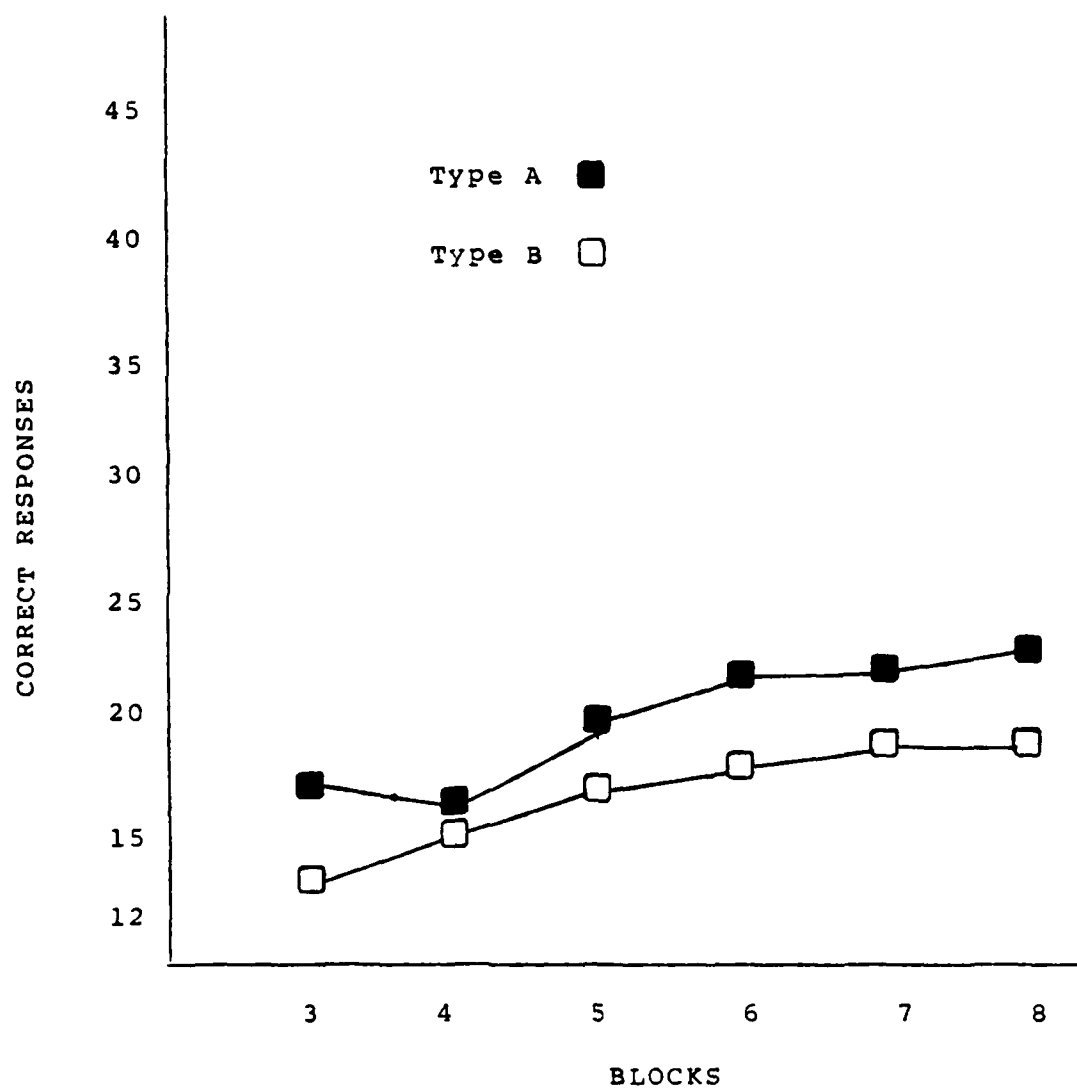
The second finding of this ANOVA test was a Block x Condition interaction. In Figure 7, we can see this effect is due to a difference in performance changes across Blocks 5 through 8 for the noise versus the quiet groups. (This difference was not seen for Blocks 3 through 5.) Where both quiet groups continued to improve performance across Blocks 6 through 8, the noise groups' performance leveled off (BN) or declined (AN).

A 2 x 2 x 6 x 5 (Type x Noise Condition x Block [3 through 8]) repeated measures ANOVA for the secondary-task across all dual-task blocks also revealed the main effect of Block ($F[5,165] = 10.25, p < .0001$), the Type x Condition interaction ($F[1,33] = 5.32, p < .03$), and the Block x Condition interaction ($F[5,165] = 2.74, p < .03$), found for the test on only Blocks 5 through 8. However, also found was a Type x Condition x Block interaction ($F[5,165] = 2.94, p < .01$) which reflects statistically what was discussed in the preceding two paragraphs.

Additional secondary-task analyses. In Figure 8, where the quiet and noise groups are combined within their respective type-groups, we see that both groups performed approximately the same across the six dual-task blocks.

FIGURE 8

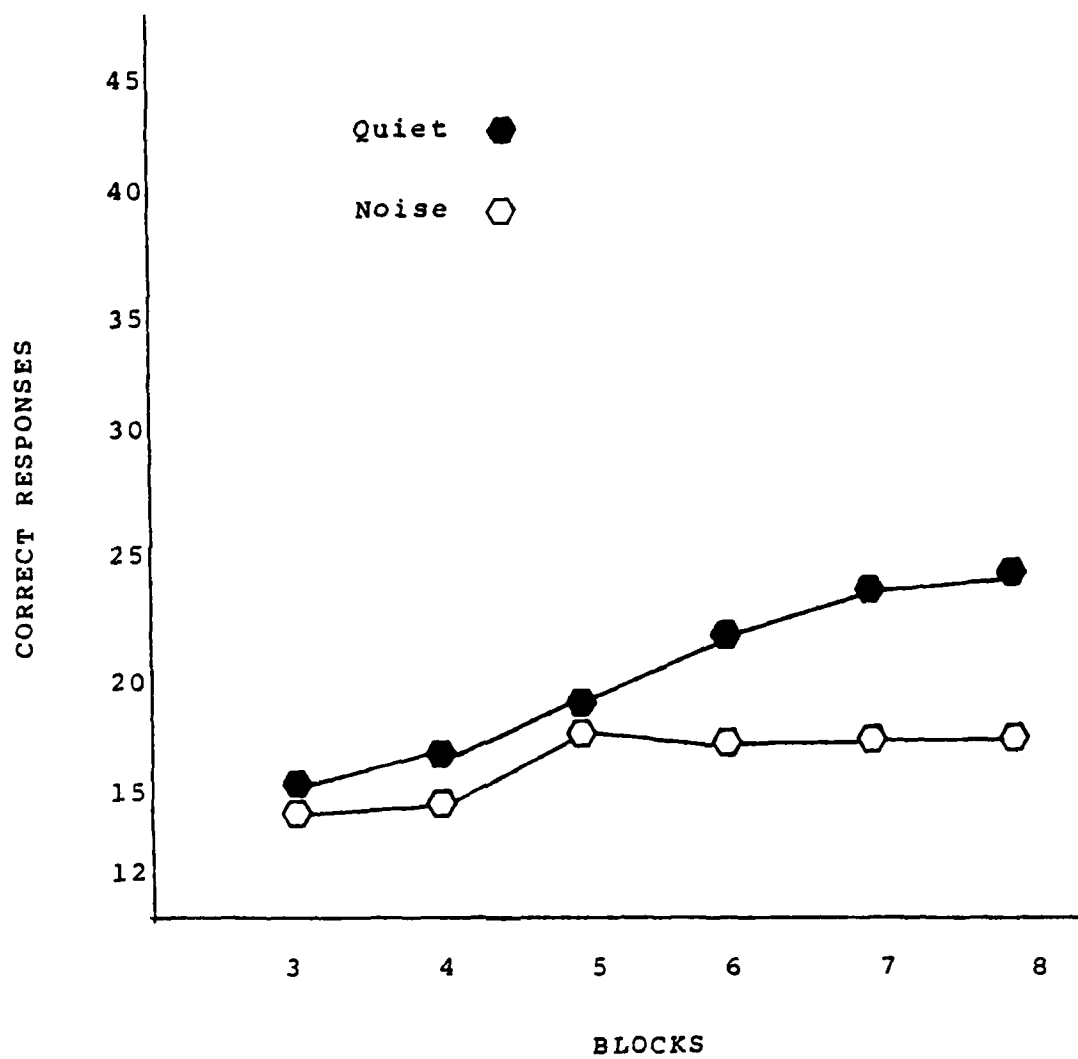
Secondary-task performance
comparing the combined
performances of the Type A
groups against the combined
performances of the Type B
groups.



Yet, in Figure 9, where both type-groups are combined under each condition, performances are different. Where the quiet groups continue to improve performance across the six dual-task blocks the noise groups' performance level off and remain constant for the remainder of the experiment. This difference between the noise and quiet groups is significant ($F[5,165] = 2.74, p < .02$).

FIGURE 9

Secondary-task performance
comparing the combined
performances of the two quiet
groups against the performances
of the two noise groups.



CHAPTER V

Discussion

This experiment examined the relation between goal-achievement behavior, as identified by the Type A/B behavior patterns, and attention allocation strategy. If there is a relation between the two, as postulated by previous studies, then further Type A research may reveal vital information for the designers of tomorrow's complex user/machine systems. However, within the sensitivity of this experiment, there was no support for the existence of a relation between goal-achievement behavior and attention allocation.

Two hypotheses were tested to arrive at this determination. In Hypothesis 1, the predicted performance differences between the AQ, AN, and BN groups did not materialize on either task. For the primary task, during Blocks 6 and 7, it was expected that (a) the subjects in the AN group would improve performance as they actively ignored the distractor, (b) the subjects in the BN group would perform more poorly as they attempted to process some of the distractor, and (c) the subjects in the AQ group would maintain a constant level of

performance as they should have stabilized by Block 5. However, Figure 6 and the ANOVA test on this data show these three groups, and the BQ group also, consistently and significantly improved primary task performance across all six dual-task blocks.

In Hypothesis 1, it was further predicted that during Blocks 6 and 7, both noise groups' performances would decline on the secondary task whereas the AQ group was again expected to maintain a constant level of performance. The AQ group, however, also significantly improved performance on the secondary task across the six dual-task blocks, and the noise groups' performances only leveled off instead of declining.

The same comments are applicable to the results predicted in Hypothesis 2. As mentioned above, all four groups performed roughly the same on the primary task across all six blocks. Furthermore, both quiet groups performed about the same on the secondary task, improving performance across the six blocks, and both noise groups performed about the same, improving performance through Block 5 and then leveling off.

These original hypotheses were strongly dependent on performance stabilizing prior to introduction of the distractor. However, both quiet groups improved performances on both tasks throughout this experiment. On the primary

task, this lack of stability may be suppressing a potential difference between the BN and BQ groups seen in Blocks 6 through 8, and a potential difference between the AN and AQ groups seen in Blocks 7 and 8 (Reference Figure 6).

(Neither of these differences are significant.) Where all four groups were improving at the same rate in Blocks 3 through 5, the improvement in the BN group's performance appears to have accelerated in Block 6 over the BQ group's improvement, and the same apparent change occurred between the AN and AQ groups in Block 7. But this potentially significant change in performance for the noise groups is being suppressed by the continued improvement of the quiet groups.

Lack of stability may be similarly influencing the results of the secondary task performance. It is possible that the leveling off seen in the noise groups' performance (Reference Figure 9) is the sum of an equal decline in performance caused by the distractor added to improved performance due to practice. If it were possible to partial out the practice effect, the original predictions might be obtained. Or, given the practice effect detected, weaker predictions might be that: (a) under distraction, the Type A noise group's performance would be better and the Type B noise group's performance poorer than the quiet groups on the primary task, and (b) under distraction,

both noise groups' performance would be suppressed on the secondary task.

Although this experiment did not support the previous Type A studies, it did support the cited studies on the effects of noise on performance (Broadbent & Gregory, 1965; Easterbrook, 1959; Hockey, 1970). In Figure 9, showing mean performance for the noise and quiet groups, there is an obvious change in performance during the distractor blocks. The noise and quiet groups are almost indistinguishable up to Block 5. However, during and for the block after the distractor (Block 8) the noise groups' performance level off but the quiet groups' performance continue to improve. Continued research in this area is strongly suggested.

Regardless of the argument used, however, the fact remains that in this study both the Type A and B noise groups and the Type A and B quiet groups performed the same throughout the dual-task blocks. While it is believed that such problems as subject misclassification, inappropriate tasks, and unequal group single-task processing ability did not affect this experiment, several other factors may have influenced the results:

1. There may not actually be a relation between attention allocation and goal-achievement behavior identified by the Type A/B construct, or, it may be so small as to

require many more subjects than was possible to run to detect it.

2. Lack of stabilized task performance prior to distraction.

3. Unequal group multiple-task processing ability.

A comment must also be made on the Block 8 performance of these groups. The prediction was that regardless of the noise condition exposed to in Blocks 6 and 7, all performance would be equal again in Block 8. This also did not happen. One possible explanation is that the subjects continued to be distracted because of an expectation that the noise would resume at any moment. Although the noise groups were briefed at the beginning of the experiment that the distractor would only be present during Blocks 6 and 7 (Reference Appendix A) the subjects may have forgotten this, or disbelieved the instructions and thought the distractor would be continued at a time when they were not supposed to be expecting it.

Another explanation, with far-reaching implications for dual-task learning, might be that the distractor prevented the noise groups from continuing to develop an effective multiple-task processing strategy. While the quiet groups were able to continue experimenting with a coping method, the noise groups attention-allocation

strategies had to accommodate another variable concurrently. Thus, it is possible that the noise groups were showing not only performance suppression, but also degraded dual-task strategy development.

Although the experiment has failed to demonstrate a relation between attention-allocation strategy and goal-achievement behavior, the potential value of such a finding suggests that further research is in order. Such research should be designed to eliminate some of the problems encountered here:

1. Subjects should be given enough practice to achieve stabilized performance prior to introducing the experimental variable.
2. Subjects should be matched through a pretest process to ensure equal dual-task processing abilities.
3. Use a different construct, characteristic, or measurement technique to identify goal-achievement behavior.
4. Use a different kind of distractor stimulus. The rock music, comedy routines, and pilot conversations used in this study, although distracting, may not be distracting enough to today's students to force a radical shift in attention allocation. Unpredictable, loud noises or some other highly distracting stimuli may prove to be better.

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APPENDICES

APPENDIX A

Informed Consent

(Quiet Groups and Noise Groups)

(Quiet Groups)

The experiment you are about to participate in is concerned with human information processing and will take about 2 hours. During this time, you will perform two tasks, separately at first and then together. The more important task is called the Running Difference task and will be practiced first. In this task, you will see digits from 0 through 8 presented on the screen one at a time. Your task is to remember the last digit you saw and respond with the difference between that digit and the one currently displayed on the screen.

During the secondary task, called the Vowel-Consonant task, you will see two letters side-by-side on the display. Your task will be to determine whether the letter-pair consists of two vowels, two consonants, or a vowel and consonant.

While performing the tasks together, you will be wearing headphones but nothing will be played over them. This is just to keep the conditions as close as possible to others who will hear a tape played over the headphones.

You are free to withdraw at any time. If you no longer wish to participate, just tell me and I'll terminate the session and credit you for your participation up to that point.

BONUS

However, if you complete the experiment, you may be eligible for a FREE THIRD HOUR OF CREDIT FINISHING THE COURSE REQUIREMENT. I will make this determination immediately after the experiment by scoring your performance on each task under the dual-task condition. The results from the Running Difference task will make up 75% of the score and the results from the Vowel-Consonant task will make up the other 25%.

BONUS

All your data will be kept confidential and any forms connecting you to the specific data will be destroyed when the experiment is complete.

I, _____, have read the description of the experiment and understand I may freely withdraw at any time.

(Signature)

(Date)

(Noise Groups)

The experiment you are about to participate in is concerned with human information processing and will take about 2 hours. During this time, you will perform two tasks, separately at first and then together. The more important task is called the Running Difference task and will be practiced first. In this task, you will see digits from 0 through 8 presented on the screen one at a time. Your task is to remember the last digit you saw and respond with the difference between that digit and the one currently displayed on the screen.

During the secondary task, called the Vowel-Consonant task, you will see two letters side-by-side on the display. Your task will be to determine whether the letter-pair consists of two vowels, two consonants, or a vowel and consonant.

While performing the tasks together, you will hear a tape over some headphones during trials 16-25; nothing will be heard over the headphones during the remainder of the trials. The tape consists of music, jokes, and conversations between pilots during simulated air-to-air combat. When you are finished reading this form, and before you sign it, I will play a sample of the tape for you.

You are free to withdraw at any time. If you no longer wish to participate, just tell me and I'll terminate the session and credit you for your participation up to that point.

***** BONUS *****

However, if you complete the experiment, you may be eligible for a FREE THIRD HOUR OF CREDIT FINISHING THE COURSE REQUIREMENT. I will make this determination immediately after the experiment by scoring your performance on each task under the dual-task condition. The results from the Running Difference task will make up 75% of the score and the results from the Vowel-Consonant task will make up the other 25%.

***** BONUS *****

All your data will be kept confidential and any forms connecting you to the specific data will be destroyed when the experiment is complete.

I, _____, have read the description of the experiment, heard the tape sample, and understand I may freely withdraw at any time.

(Signature)

(Date)

APPENDIX B

Tasks

Running Difference Task

As was mentioned in the form you signed when you first arrived, this experiment consists of a Running Difference task and a Vowel-Consonant task that will be performed separately and then together. You are now going to perform the Running Difference task which is the more important of the two, and will be treated as the primary task. In this task, you will see digits from 0 through 8 presented on the screen one at a time. Your job is to remember the last digit you saw, compute the difference between the last digit and the current digit, and then indicate the difference by pressing a button with your right hand.

The only possible correct answers are 1, 2, 3, 4, 5, 6, 7, and 8. To make a response, use buttons 1 through 8 on the computer keypad. Use your index finger to press the 1, 4, and 7 keys, your middle finger the 2, 5, and 8 keys, and your third finger the 3 and 6 keys. Please do not use your thumb to respond. Also, when not responding, rest your fingers on the middle row of keys, 4, 5, and 6. The computer will not present a new digit until after you have responded. ***YOUR JOB IS TO RESPOND AS QUICKLY AS POSSIBLE WHILE MAINTAINING 90% OR BETTER ACCURACY.*** Attached is a diagram to help you understand how the task works.

Each trial is 90 sec long with a 45 sec break between trials, and will be preceded by a "READY" prompt and tone 3 sec before the first digit. At the end of the trial, your number of correct responses and percent correct will be displayed so you can see how you are doing. Again, it is very important that you maintain 90% or better accuracy while responding as quickly as possible. Also, the response to the first digit will always be "1" because there is no preceding digit. Are there any questions?

Running Difference Task Example

Here is an example to help you understand the Running Difference task. The row labeled "Stimulus Number" is the order in which the computer might present the stimuli. The row labeled "Stimulus" represents possible stimuli the computer might present. And the row labeled "Response" would be the correct response for this experiment.

STIMULUS NUMBER	1	2	3	4

STIMULUS	3	7	5	0
RESPONSE	1	4	2	5

Suppose the first stimulus is a "3". Since there are no preceding stimuli, simply push button 1 on the keypad. The computer will then present the next stimulus, which in

this example is a "7". You would then respond with a 4 since that is the difference between 3, the last number you saw on the screen, and 7, the number you are now looking at. When you make this response, the computer will present the next stimulus, which in this example is "5". You would then respond with a 2 since that is the difference between 7 and 5, and so on. Remember, the response to the first stimulus will always be a 1.

Vowel-Consonant Classification Task

Now you will perform the Vowel-Consonant classification task which is the lesser important, secondary task for this experiment. During this task, you will see two letters side-by-side on the display. Sometimes both letters will be vowels (such as A and I) or consonants (such as B and H), and sometimes there will be one vowel and one consonant (such as A and B).

When both letters are the same, that is, when both letters are vowels or both consonants, press the "F" key with your left index finger. When one letter is a vowel and one a consonant, press the "D" key with your left middle finger (refer to the attached example). As soon as you respond, the pair will be erased and a new pair will be presented. Please keep your fingers on the keys at all times. ***Your job is to RESPOND AS QUICKLY AS POSSIBLE WHILE MAINTAINING 90% OR BETTER ACCURACY.***

Each trial will be 90 sec long with a 45 sec break between trials, and will be preceded by a "READY" prompt and tone 3 sec before the first letter-pair. At the end of the trial, your number of correct responses and percent correct will be displayed so you can see how you are doing. Even though this task is secondary, it is still important that you respond as quickly as possible while maintaining

90% or better accuracy. Are there any questions?

Vowel-Consonant Classification Task Example

Here is an example to help you understand the Vowel-Consonant task.

STIMULUS (LETTER-PAIR)

CORRECT RESPONSE

A I

"F"

(The correct answer is F because both letters are vowels.)

B H

"F"

(The correct answer is F because both letters are consonants.)

A B

"D"

(The correct answer is D because one letter is a vowel and the other is a consonant.)

Running Difference and Vowel-Consonant Tasks

Combined (Quiet Groups)

Now you will perform both tasks at the same time. As previously mentioned, the Running Difference task is primary and the Vowel-Consonant secondary and to be performed as often as you are able. The Running Difference task will be performed with the right hand; the Vowel-Consonant with the left. On the right side of the screen, you will see a digit between 0 and 8 for the Running Difference task, and on the left side of the screen, you will see the letter-pair for the Vowel-Consonant task. To start the Running Difference task, hit the "1" key on the keypad as you did under single-task. New stimuli will be presented separately for each task only after you have responded to that particular task.

As was mentioned in your original briefing, you may earn 1 extra hour of experimental credit, which completes the course requirement, through your performance on this task. I will make this determination after the experiment by scoring your performance on this combined task. The results from the Running Difference task will make up 75% of your score and the results from the Vowel-Consonant task will make up the other 25%.

During these dual-task trials, you will wear headphones but will not hear anything over them. This is just to keep

conditions as close as possible with others who will be listening to a tape while performing these same tasks. Remember, your bonus depends only on how you perform the tasks.

Your job is to respond to the stimuli as quickly and accurately as possible. On each trial, you should try to obtain a greater number of correct responses while maintaining 90% or better accuracy and treating the Running Difference task as primary.

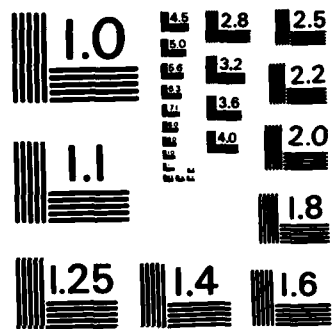
At the end of each trial, your number of correct responses and percent correct will again be displayed for both tasks with the Running Difference task results displayed on top. All trials will be 90 sec long with a 45 sec break between trials. You will also have the "READY" prompt and tone 3 sec before each trial begins. Are there any questions?

AD-A160 671 ATTENTION ALLOCATION DISTRACTION AND THE TYPE A/TYPE B 2/2
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WRIGHT-PATTERSON AFB OH A J GUARDINO AUG 85
UNCLASSIFIED AFIT/CI/NR-85-109T F/G 5/10 NL

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MICROCOPY RESOLUTION TEST CHART
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Running Difference and Vowel-Consonant Tasks

Combined (Noise Groups)

Now you will perform both tasks at the same time. As previously mentioned, the Running Difference task is primary and the Vowel-Consonant secondary and to be performed as often as you are able. The Running Difference task will be performed with the right hand; the Vowel-Consonant with the left. On the right side of the screen, you will see a digit between 0 and 8 for the Running Difference task, and on the left side of the screen, you will see the letter-pair for the Vowel-Consonant task. To start the Running Difference task, hit the "1" key on the keypad as you did under single-task. New stimuli will be presented separately for each task only after you have responded to that particular task.

As was mentioned in your original briefing, you may earn 1 extra hour of experimental credit, which completes the course requirement, through your performance on this task. I will make this determination after the experiment by scoring your performance on this combined task. The results from the Running Difference task will make up 75% of your score and the results from the Vowel-Consonant task will make up the other 25%.

Throughout the dual-task trials, you will wear headphones over which you will hear the tape described in the original briefing. The tape will be played during trials 16-25 and consists of music, jokes, and pilots talking during simulated air-to-air combat. You are to completely ignore this tape and concentrate on the tasks, as your score for the bonus-hour depends only on task performance. Nothing will be presented over the headphones during trials 1-15 or 26-30.

Your job is to respond to the stimuli as quickly and accurately as possible. On each trial, you should try to obtain a greater number of correct responses while maintaining 90% or better accuracy and treating the Running Difference task as primary.

At the end of each trial, your number of correct responses and percent correct will be displayed for both tasks with the Running Difference task results displayed on top. All trials will be 90 sec long with a 45 sec break between trials. You will also have the "READY" prompt and tone 3 sec before each trial begins. Are there any questions?

APPENDIX C

Debriefing

The experiment you just completed is concerned with how people classified as having either Type A or Type B pattern behavior allocate their attention when performing two tasks simultaneously. Half the subjects will also have had to try and ignore a moderately-loud tape of music, jokes, and excerpts from air-to-air combat engagements.

Under such a complex situation, some previous research suggests that Type A individuals will tend to focus more of their attention on the primary task, less on the secondary, and attempt to completely ignore the peripheral tape. Type Bs, on the other hand, will probably attempt to keep a broader focus of attention trying to process more from all three sources.

If these predictions prove correct, this information can be used to: (a) help design machines and workplaces to help the operator process critical information more efficiently; (b) select the best individuals to perform specific jobs; or (c) tailor an individual's training based on their characteristic way of focusing attention.

Thank you very much for your time and effort. If you have any questions, please contact Al Guardino at 965-3623.

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