SELECTION STRATEGIES AND PERFORMANCE ON ATTRIBUTE IDENTIFICATION TASK AS A FUNCTION OF TIME- AND ACCURACY-STRESSED INSTRUCTIONS AND LEVEL OF MOTIVATION

by

BOHDAN KAZIMIERZ WASILEWSKI

B.A., University of Manitoba, 1965

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF ARTS

in the Department

of

Educational Psychology

We accept this thesis as conforming to the

required standard

THE UNIVERSITY OF BRITISH COLUMBIA

August, 1970

In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the Head of my Department or by his representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Bohdan Kazimierz Wasilewski

Department of Educational Psychology

The University of British Columbia
Vancouver 8, Canada

Date 19 August, 1970.

Abstract

36 Ss randomly selected from 76 volunteers from Grade-X11 Richmond Secondary School were randomly assigned to six treatments in a 3 x 2 factorial design to test the effect of instructions (time-stressed, accuracy-stressed, or control) and level of motivation (high or low) on performance on three problems of a predetermined, conjunctive, attribute identification task, with stimuli (64 six-dimensional figures) containing the exemplars and non-exemplars of a bi-dimensional concept, and presented simultaneously; and measured in the postulated three phases by : time interval between reception of the task and selection of the first card (Phase 1 - analysis of the problem); index of dimensional change of attributes from the first exemplar (Phase 2 - selection or development of a strategy-plan); and average time per card choice (Phase 3 - execution of a strategy-plan). Two additional measures, number of cards to solution and total time to solution, were observed in order to confirm the successful manipulation of the instructional variable in terms of its behavioral effects. The results suggest that the manipulation of instructional variable was successful. The results indicate that Ss under

accuracy-stressed condition took significantly more time during the time interval (Phase 1) and spent significantly more time per card choice (Phase 3), than Ss without instructional treatment (control); and that Ss under time-stressed condition behaved in Phase 1 and 3 in the very same way as Ss without instructional treatment (control). It was observed that Ss under time-stressed condition spent about the same amount of total time to solution as Ss under accuracy-stressed condition, and since Ss under time-stressed condition spent significantly less time per card choice than Ss under accuracy-stressed condition, then these facts indicate that the accuracy-stressed instructions are responsible for the better performance of Ss under accuracy-stressed condition than Ss under time-stressed condition. This suggests that knowledge of the reason for ignoring the time and emphasis on accuracy may induce Ss to take time to analyze the problem and that this opportunity to follow the postulated logical sequence of behavior may improve execution (i.e., performance) on conceptual task. The results failed to confirm third hypothesis that motivation impairs performance under time-stressed condition and improves performance under accuracy-stressed condition. It was observed during the experiment that Ss shifted the focus card from the first exemplar to other positive instances previously identified, and since the focus card used by Ss can not be identified, the index of dimensional change can not be used as an indicator of the strategy-selection behavior in Phase 2.

Table of Contents

List of Tables

Acknowledgment

I wish to express my gratitude for the enlighting guidance and generous advise given to me by the members of the supervising committee in charge of this thesis, Drs. Wilson E. Schwahn, the chairman; Seong Soo Lee; and Robert F. Conry.

Selection Strategies and Performance on Attribute Identification Task as a Function of Time- and Accuracy-Stressed Instructions and Level of Motivation

Problem

The results of concept identification studies under experimental conditions indicate that the behavior of Ss during the period from the presentation of the task to the solution of that task involves cognitive activities which may be classified into types of operations on the basis of the method used by Ss to solve the problem. The interpretation of these methods led Bruner (Bruner, Goodnow, & Austin, 1956) to develop a set of ideal strategies for the most efficient solution of concept identification problems. Ss using conservative strategies accept all attributes of the first exemplar as relevant, and then test their relevance either one attribute at a time (focusing) or more than one attribute at a time (gambling), while keeping other attributes constant. In scanning strategies Ss reduce progressively all possible concepts hypothesized on the basis of the first exemplar by eliminating as many hypotheses as possible per each successive choice of instances (simultaneous), or test one hypothesis at a time by limiting their choices to those instances that provide a direct test of the hypothesis (scanning).

The review of literature reveals that it is often very difficult to identify Ss' behavior in an experimental situation with these ideal strategies (Klausmeier, 1964; Haygood & Bourne, 1965), and that this behavior is highly inefficient. Byers (1961) found that Ss ignored the optimal strategy for attribute testing (conservative focusing) and used instead gambling strategies which require varying amounts of risk-taking. In the Wisconsin studies (Klausmeier, 1964) 86% of Ss (N=64) used gambling strategies in preference to conservative focusing, although conservative focusing is considered the most efficient strategy in concept learning tasks (Bruner, et al, 1956; Byers, 1961; Klausmeier, 1964; Laughlin & Doherty, 1967). The writer observed that even graduate students (1st Year Architecture, University of British Columbia) performed unreasonably poorly on concept identification tasks. These Ss selected instances for testing without any apparent systematic plan of operations; failed to adhere to the principle of constancy of the untested dimensions (in attribute testing); failed to utilize all information offered by the instances tested; and tested attributes already confirmed by previous tests.

When attempts were made to classify Ss' behavior in terms of a continuum, with conservative focusing at one extreme, focus gambling at the other, and the strategies used by Ss corresponding to the points between these two extremes (Byers, 1961); or to quantify Ss' performance in terms of attributes accepted by Ss as relevant from the first positive instance (Bourne, 1963); it was found that Ss fail to maintain a fixed focus and fail to keep the untested attributes constant, thus violating the prerequisites for efficient attribute testing strategy.

It therefore seems legitimate to ask why these Ss behaved in such a disorganized manner when they were faced with a concept identification task in a laboratory-type experimental situation ?

The reason for this inefficient performance may well lie in the two conditions inherent in the standard experimental situation : stress on the speed of solution, and previously developed habit of performing as quickly as possible in any experimental or test-like situation. Most of the experimental studies with the selection strategies used time-to-criterion as measure of performance efficiency; it is therefore possible that in those studies, time-stressed instructions forced Ss into the execution of a hastily-constructed strategy-plan, or into action without a strategy-plan (trial-and-error behavior). Gardner (1953) noted that Ss are normally given relatively little time to make their judgments in the experimental situation, and observed :

> ..." that to allow all subjects identical, brief periods in which to make judgments would have been to obtain from one of them a fairly accurate picture of how he preferred to organize the stimuli; from another, an incomplete stage of approximation in making the judgment; from still another, a guess "
>
> (Gardner, 1953, p.217)

Siegel proposed that time to criterion need not correlate highly with trials to criterion, and that it may reflect something quite different; yet experimental studies with time-stressed instructions as independent variable and trials to criterion as dependent variable, do not show significant difference in performance between time-stressed and time-not-stressed treatments (Siegel, 1964; Laughlin, 1964). The analysis of time to criterion studies reveals however that Ss behave as if time was vital even when they are instructed that speed of solution is of no importance.

In order to analyze the effect of time on the performance in a concept identification situation, it is proposed that the logical sequence of behavior in that situation should consist of three phases :

a. Phase 1. S considers factors relevant to his task and thoroughly analyzes the problem.

b. Phase 2. S formulates a strategy-plan for solving the problem.

c. Phase 3. S executes the strategy-plan.

If this logical sequence is followed by Ss, it would facilitate selection of the optimal strategies for the concept identification tasks, and consequently, it would improve Ss' performance on those tasks. The review of literature, however, reveals that this sequence of behavior is not normally present under standard experimental conditions. The reason for this absence of logical sequence may be the lack of opportunity in the standard experimental situation, to analyze the problem (Phase 1) and to formulate a strategy-plan (Phase 2). It appears from previous studies (Siegel, 1964; Laughlin, 1964) that telling Ss that speed of solution is of no importance is not enough. In order to change the habitual behavior in the test-like experimental situation, it may be necessary to give Ss the reason for the unimportance of speed of solution, and to place them in a condition where they can utilize that information, i.e., take time to analyze the problem and formulate a strategy-plan. Then it could be expected that Ss in time-not-stressed or accuracy-stressed condition will utilize the optimal strategy more, and will consequently perform better, than Ss in time-stressed condition.

The results of Laughlin's study (1964) also indicate that accuracy- and time-stressed instuctions should be explicitly differentiated in future concept-attainment research. In order to ensure that these instructions are successfully instated in Ss, it may be necessary to introduce a motivational variable. Consider how a variation in the degree of motivation may affect performance under time-stressed condition in comparison with performance under accuracy-stressed condition. It has been observed by Deese and Hulse (1967) that if motivation directed toward a particular goal is high, then the probability of occurance of the behavior designed to achieve that goal is also high. Since the goal in time-stressed condition is to accomplish the task as quickly as possible, it follows that motivated Ss in that condition should attempt to accomplish their tasks more quickly than less motivated Ss. But if speed of performance makes the analysis of task (Phase 1) and the formulation of strategy-plan (Phase 2) less probable, and consequently, if it impairs the execution (Phase 3), then it seems that motivated Ss in time-stressed condition should perform less efficiently than less motivated Ss in that condition. On the other hand if the goal in accuracy-stressed condition is to accomplish the task with as few card choices as possible, Ss in that condition should be fully aware that speed of performance will impair their efficiency. It follows that motivated Ss in the accuracy-stressed condition should attempt to accomplish their tasks more slowly and with greater accuracy than less motivated Ss in that condition; and if this emphasis on accuracy and disregard for time makes the analysis of task (Phase 1) and the formulation of strategy-plan (Phase 2) more probable, and consequently, if it improves the execution (Phase 3), then it seems that motivated Ss in accuracy-stressed condition should perform more efficiently than less motivated Ss in that condition.

It is hypothesised that, if pressure of time through time-stressed instructions prevents Ss from analyzing the problem (Phase 1), and from formulating a strategy-plan designed to solve that problem (Phase 2), and if it impairs execution of the strategy-plan (Phase 3), then Ss in a time-stressed condition will:

a. Phase 1 : use significantly less time between reception of the task and selection of the first instance for testing;

b. Phase 2 : obtain significantly larger index of dimensional change (the sum of attributes changed on each card choice from the first exemplar, divided by total number of card choices to solution); and

c. Phase 3 : use significantly less average time per card choice;

than Ss in a control condition.

The second hypothesis is that, if knowledge of the reason for unimportance of speed of solution induces _Ss_ to analyze the problem (Phase 1), and to formulate a strategy-plan (Phase 2), and if it improves execution of the strategy-plan (Phase 3), then _Ss_ in an accuracy-stressed condition will :

a. _Phase 1_ : use significantly more time between reception of the task and selection of the first instance for testing;

b. _Phase 2_ : obtain significantly smaller index of dimensional change; and

c. _Phase 3_ : use significantly more average time per card choice;

than _Ss_ in a control condition.

The third hypothesis is that, if high motivation impairs performance in the time-stressed condition, and improves performance in the accuracy-stressed condition, then

a. highly motivated _Ss_ in time-stressed condition will in _Phase 3_ use significantly less average time per card choice than less motivated _Ss_ in time-stressed condition; whereas

b. highly motivated _Ss_ in accuracy-stressed condition will in _Phase 3_ use significantly more average time per card choice than less motivated _Ss_ in accuracy-stressed condition.

Method

Design. A 3 x 2 factorial design was used with independent variables : type of instructions (time-stressed; accuracy-stressed; or control), and level of motivation (high, through instructional inducement or low, without instructional inducement); with additional variables : problem (a sequence of three different problems of attribute identification of a conjunctive concept), set (two sets of two dimensions, A and B - see Stimulus Materials), and order (three conceptual problems presented in three different orders in a 3 x 3 Latin square design). Three dependent measures, that is, time interval between reception of the task and selection of the first card, index of dimensional change, and average time per card choice, were taken. Two additional measures, number of cards to solution and total time to solution, were observed for the use of confirming the successful manipulation of the instructional variable in terms of its behavioral effects.

Subjects. Ss were 36 students (18 boys, 18 girls), randomly selected from 76 volunteers (obtained by the principal through a Public Address request for volunteers for a " concept learning project ") out of a population of 381 (47.5% boys, 52.5% girls) Grade-X11 students at Richmond Secondary School, Richmond, B.C..

Ss were randomly assigned to six treatments, each of which contained 6 Ss (3 boys and 3 girls).

Stimulus Materials. The stimuli were 64 white $2\frac{1}{2}$-in by $3\frac{1}{2}$-in paperboard cards, containing all possible combinations of six binary dimensions : number of figures (one or two); size (small or large); color (red or blue); texture (solid or slashed); shape (triangular or circular); and border (solid or broken). The cards were randomly arranged in eight rows and eight columns on a $24\frac{1}{2}$-in by $32\frac{1}{2}$-in board. The board contained 16 exemplars and 48 non-exemplars of any binary conjunctive concept based on the above dimensions. A set of values of each dimension and the other set of complementary values of the six dimensions were referred to as Set A and Set B, respectively. Three conjunctive conceptual problems were constructed on the basis of randomly selected two binary dimensions, within each set (i.e., Set A and B). As a result the focus card for Set A, given to 18 Ss, had attribute values : one, large, red, slashed, triangular figure, with solid border, and the focus card for Set B, given to the other 18 Ss, had their complementary attribute values. Three conceptual problems in Set A were : one slashed figure, large triangular figure, and large figure with solid border; and the other three conceptual problems in Set B were : two solid figures, small circular figure, and small figure with a broken border. Ss were randomly assigned to sequences (one S in each set of each treatment group to one sequence).

Procedure. As each S reported to the laboratory set up in the school, he was seated at the table in front of the stimulus board, which contained 64 cards. A set of instructions, appropriate for each treatment condition, was read to the S by the E who was standing behind the S. Each set of instructions was composed of three parts : Part 1 for manipulating the instructional variable, Part 2 for general learning instruction including practice/warm-up, and Part 3 for manipulating the motivational variable as related to Part 1. Each of three specific variations in Part 1 (i.e., time-stressed, accuracy-stressed, and neutral as control) and each of two specific variations in Part 3 were combined and resulted in six sets of instructions, each corresponding to one of the six treatment combinations as shown in Appendix A. After the appropriate instructions were read to the S, E answered the questions, if raised by the S, by reading appropriate part of instructions again. Immediately after these instructions S was given a series of three conceptual problems. Choice of each stimulus card was made by S at his own rate. Upon selection of each card E designated whether it is an exemplar or nonexemplar of the concept that S had to identify. The choice of stimulus cards, one by one, continued until S correctly verbalized the concept. Two stop-watches were used : one for taking the time interval elapsed between the presentation of the focus card and the selection of the first instance by S; and the other for taking the total amount of time to the solution of each conceptual problem. The first watch was stopped when S selected the first card, and the second watch was stopped when S reached a criterion of solution. Each card choice made by S was recorded on a protocol sheet. When S completed a conceptual problem, he proceeded without pause to the next problem, until he solved all the three problems. Then he was asked not to discuss the experiment with other students until the whole experiment is completed.

Results

Ss' responses were observed in terms of time interval for Phase 1, index of dimensional change for Phase 2, and average time per card choice for Phase 3.

Examination of validity of the assumption of instrumental variable's manipulation.

Since the present study is primarily concerned with the functional change in selection strategies and performance as a result of instructing Ss in certain way (i.e., time-stressed vs accuracy-stressed), it appears necessary to confirm the validity of the assumption that the manipulated instructional variable was behaviorally effective. To this end two additional measures, total time to solution and cards to solution, were observed; and are presented in Table 1 in terms of observed means.

Table 1

Observed Means of Total Amount of Time in Seconds and Cards to Solution by Treatment Combinations

	Time-stressed		Accuracy-stressed		Control	
	High	Low	High	Low	High	Low
Time to Solution	306.2	248.4	331.7	359.7	198.9	292.2
Cards to Solution	18.83	14.22	6.67	7.78	10.67	19.17

MS Error for Time to Solution =57062
MS Error for Cards to Solution=82.01

Two analyses of variance were performed on the data collected in the 3 x 2 major part of the design with three control-variables (i.e., set, problem, order) in terms of total amount of time and number of cards to solution. Results of the analyses are presented in Appendix B-1 and B-2. Hypothesis tests for the above purpose were carried out at the overall Type 1 Error of .05.

If the time-stressed instructions were behaviorally effective it should be reflected in the measure of total time to solution, such that Ss under time-stressed condition should spend the least amount of time, whereas Ss under accuracy-stressed condition should spend the most amount of time, as compared to control Ss. The observed means for the time-stressed, accuracy-stressed, and control conditions are 277.3, 345.7, and 245.6, respectively. Although the relative magnitude of the first two means was in the expected direction, the main effects due to the instructional variable were found non-significant, $F(2,18)=1.65$, $p > .05$.

If the accuracy-stressed instructions were behaviorally effective it should be reflected in the measure of number of cards to solution, such that Ss under accuracy-stressed condition should select the least cards to solution, whereas Ss under time-stressed condition should select the most cards to solution, as compared to control Ss. The observed means for the time-stressed, accuracy-stressed, and control conditions are 16.53, 7.23, and 14.92, respectively. The main effect due to the instructional variable was significant, $F(2,18)=10.85$, $p < .05$. Two individual contrasts, one between accuracy-stressed condition and control condition and the other between time-stressed condition and control condition were found to be non-significant, $F(1,18)=4.28$, $p > .025$

and $F(1,18)=.21$, $p > .025$. However, the contrast between time-stressed and accuracy-stressed condition was significant, $F(1,18)=6.32$, $p < .025$.

These results are partially as expected with regard to accuracy-stressed instructions; but however, because Ss under control condition appear to act in the very same way as Ss under time-stressed condition, the effect of time-stressed instructions appears to be minimal. In summary, the fact that observed means of three instructional conditions in terms of both measures are partially as expected suggests that manipulation of instructional variable was effective.

Analysis of data concerning Phase 1 (i.e., analysis of the problem).

Ss' responses for Phase 1 were observed in terms of time interval elapsed between the presentation of the focus card and selection of the first instance by S, and are presented in Table 2 in terms of observed means.

Table 2

Observed Means of Time Interval in Seconds

Instructions	Motivation	Problems 1st	2nd	3rd	Marginal Mean
Time-stressed	High	7.67	3.67	6.17	5.83
	Low	7.67	7.00	5.17	6.61
Accuracy-stressed	High	19.33	18.33	22.33	20.00
	Low	38.33	18.17	16.67	24.39
Control	High	9.33	10.00	7.33	8.89
	Low	9.50	6.33	7.83	7.89

MS Error for Time Interval =90.43

The analysis of variance was performed on the data and is presented in Appendix B-3. Hypothesis tests were carried out at the overall Type 1 Error of .05.

It was hypothesized that if pressure of time through time-stressed instructions prevents Ss from analyzing the problem, and if knowledge of the reason for unimportance of speed of solution induces Ss to analyze the problem, then it should be reflected in the amount of time interval, such that Ss under time-stressed condition should spend the least amount of time, whereas Ss under accuracy-stressed condition should spend the most amount of time, as compared to control Ss. The observed means for the time-stressed, accuracy-stressed, and control conditions are 6.22, 22.19, and 8.39, respectively. The main effect due to the instructional variable was significant, $F(2,18)=29.88$, $p < .05$. The individual contrast between time-stressed condition and control condition was found to be non-significant, $F(1,18)=.31$, $p > .05$. However, the individual contrast between accuracy-stressed condition and control condition was found to be significant, $F(1,18)=12.82$, $p < .05$. These results are as hypothesized with regard to accuracy-stressed instructions; but however, because Ss under control condition appear to act in the very same way as Ss under time-stressed condition, the effect of time-stressed instructions appears to be minimal. In summary, the fact that Ss under accuracy-stressed condition spend significantly more time between presentation of the focus card and selection of the first instance than Ss under control condition, suggests that knowledge of the reason for unimportance of speed of solution induces Ss to analyze the problem. It appears that when Ss are not told the reason for unimportance of speed of solution (i.e., control Ss), then their responses for Phase 1 seem to be the very same as the responses of Ss under time-stressed condition.

Analysis of data concerning Phase 2 (i.e., selection of a strategy-plan).

Ss' responses for Phase 2 were observed in terms of index of dimensional change of attributes from the first exemplar, and are presented in Table 3 in terms of observed means.

Table 3

Observed Means of Index of Dimensional Change

Instructions	Motivation	Problems 1st	2nd	3rd	Marginal Mean
Time-stressed	High	2.48	2.32	2.15	2.32
	Low	1.62	1.81	2.15	1.86
Accuracy-stressed	High	2.02	1.80	2.47	2.09
	Low	1.96	2.08	2.12	2.05
Control	High	2.15	2.23	2.12	2.17
	Low	2.22	2.38	2.65	2.42

MS Error for Index of Dimensional Change =.3730

The analysis of variance was performed on the data and is presented in Appendix B-4. Hypothesis tests were carried out at the overall Type 1 Error of .05.

It was hypothesized that if pressure of time through time-stressed instructions prevents Ss from formulating a strategy-plan, and if knowledge of the reason for unimportance of speed of solution induces Ss to formulate a strategy-plan, then it should be reflected in the index of dimensional change, such that Ss under time-stressed condition should have higher index of dimensional change, whereas Ss under accuracy-stressed condition should have lower index of dimensional change, as compared to control Ss. The observed means for the time-stressed, accuracy-stressed, and control condition are 2.09, 2.07, and 2.29, respectively. The main effect due to the instructional variable was non-significant, $F(2,18)=1.45$, $p > .05$. These results are not as hypothesized.

Analysis of data concerning Phase 3 (i.e., execution).

Ss' responses for Phase 3 were observed in terms of average time per card choice, and are presented in Table 4 in terms of observed means.

The analysis of variance was performed on the data and is presented in Appendix B-5. Hypothesis tests were carried out at the overall Type 1 Error of .05.

Table 4

Observed Means for Average Time per Card Choice in Seconds

Instructions	Motivation	Problems 1st	2nd	3rd	Marginal Mean
Time-stressed	High	17.10	14.25	10.49	13.95
	Low	19.79	18.80	13.41	17.34
Accuracy-stressed	High	38.53	38.31	40.88	39.24
	Low	50.12	34.60	37.33	40.68
Control	High	18.15	23.16	11.27	17.53
	Low	22.37	14.52	11.09	15.99

MS Error for Average Time per Card Choice =244.6

It was hypothesized that if pressure of time through time-stressed instructions impairs the execution of a strategy-plan, and if knowledge of the reason for unimportance of speed of solution improves the execution of a strategy-plan, then it should be reflected in the amount of average time per card choice, such that Ss under time-stressed condition should spend the least amount of time, whereas Ss under accuracy-stressed condition should spend the most amount of time, as compared to control Ss. The observed means for the time-stressed, accuracy-stressed, and control condition are 15.65, 39.96, and 16.76, respectively. The main effect due to the instructional variable was significant, $F(2,18)=27.24$, $p < .05$. The individual contrast between time-stressed condition and control condition was found to be non-significant, $F(1,18)=.029$, $p > .05$. However, the individual contrast between accuracy-stressed condition and control condition was found to be significant, $F(1,18)=12.96$, $p < .05$. These results are as hypothesized with regard to accuracy-stressed instructions; but however, because Ss under control condition appear to act in the very same way as Ss under time-stressed condition, the effect of time-stressed instructions appears to be minimal. Furthermore, according to the results of the two contrasts it is clear that Ss under time-stressed condition spent significantly less amount of time per card choice than Ss under accuracy-stressed condition. In summary, the fact that Ss under accuracy-stressed condition spent significantly more time per card choice than Ss under control condition, suggests that knowledge of the reason for unimportance of speed of solution improves the execution of a strategy-plan (i.e., performance). It appears that when Ss are not told the reason for the unimportance of speed of solution (i.e., control Ss), then their responses for Phase 3 seem to be the very same as the responses of Ss under time-stressed condition.

It was also hypothesized that, if high motivation impairs performance in the time-stressed condition, and improves performance in the accuracy-stressed condition, then it should be reflected in the amount of average time per card choice, such that highly motivated Ss under time-stressed condition should spend the least amount of time as compared to less motivated Ss under time-stressed condition; whereas highly motivated Ss under accuracy-stressed condition should spend the most amount of time as compared to less motivated Ss under accuracy-stressed condition. The observed means are presented in Table 4. The main effect due to the motivational variable was non-significant, $F(1,18)=.13$, $p > .05$. These results are not as hypothesized.

Discussion

It was assumed that when Ss are aware, through accuracy-stressed instructions, of the reason for the unimportance of speed of solution in a test-like experimental situation involving a conceptual task, that they will follow the postulated logical sequence of conceptual behavior and consequently their performance will be improved. The results do confirm this hypothesis. They indicate that Ss under accuracy-stressed condition took more time during the interval between presentation of the focus card and selection of the first instance (Phase 1), and spent more time on each card choice (Phase 3), than Ss without instructional treatment (control). It was also observed that Ss under time-stressed condition spent about the same amount of total time to solution as Ss under accuracy-stressed condition. Nevertheless, as revealed by the analysis of the average time per card choice, Ss under time-stressed condition spent significantly less time per card choice than Ss under accuracy-stressed condition. These facts indicate that the accuracy-stressed instructions are responsible for the better performance of Ss under accuracy-stressed condition than Ss under time-stressed condition. This suggests that knowledge of the reason for ignoring the time and emphasis on accuracy may induce Ss to take time to analyze the problem and that this opportunity to follow the logical sequence of behavior may improve the execution (i.e., performance).

It was also assumed that under the pressure of time through time-stressed instructions, Ss would not follow the logical sequence and that consequently their performance will be impaired. The results do not confirm this hypothesis. They indicate that Ss under time-stressed condition behaved in Phase 1 and 3 in the very same way as Ss without instructional treatment (control). This suggests that lack of knowledge of the reason for ignoring the time and no emphasis on accuracy may force those Ss who are told that speed is important, and also those Ss who are not told that speed is important, into the execution phase without analyzing the problem, and that this lack of opportunity to follow the logical sequence of behavior may impair the execution (i.e., performance).

The results support Siegel's (1964) proposition that time to criterion (total time to solution) need not correlate highly with trials to criterion (cards to solution). They also indicate that merely telling Ss that time is of no importance (Siegel, 1964; Laughlin, 1964) is apparently not enough in a test-like experimental situation, and that in order to change Ss' habitual behavior which impairs performance, Ss must understand the reason why speed of solution is not important. It is interesting to note that the highly significant difference in performance was apparently caused by a variation of four sentences in the instructional treatment. One may speculate on the magnitude of the effect of an intensive and prolonged instructional treatment on performance in the attribute identification task. It is suggested that the evidence from the present study casts some doubt on the validity of using time to solution as the only criterion of conceptual performance.

The results did not bear out the contention that a thorough analysis of the problem results in a selection of the optimal strategy for that particular problem, because the measure, index of dimensional change, designed to evaluate the strategy used, failed to perform its function. Index of dimensional change was to calculate the average number of attributes changed by S on each card choice from the first exemplar card. This condition was specified in the procedural instructions and emphasised in the practice/warm-up task. Ss nevertheless switched their focus card back and forth, from the first exemplar to the immediately preceeding positive card choice, or to any other exemplar previously tested. Since the focus card used by Ss can not be identified, the analysis of Phase 2 performance as measured by index of dimensional change is meaningless and has to be discarded. This is disappointing, because without this information it is impossible to evaluate the strategy-plans used by Ss and to infer from these strategy-plans what behavior took place during the analytical and planning phases (Phase 1 and 2). It is suggested that the failure of index of dimensional change can be prevented in future attribute identification research by the use of a reception model where only the first exemplar is available to the S for comparison; or by the use of a report form the S indicating the exemplar used as focus on each card choice. The report may be further supported by an eye-marker camera of the type used by Mackworth and Thomas (Bandura & Walters, 1967).

The analysis of Ss' responses in Phase 3 failed to confirm the third hypothesis that motivation impairs performance under time-stressed condition, and that it improves performance under accuracy-stressed condition. This failure may be due to the ineffectiveness of the method used for the inducement of motivation, and it also may be due to the already existing high level of motivation in the sample, since it was a volunteer group. The significant effect of problem on time interval may be the result of fatigue or boredom on the third problem.

It was observed that the procedural instructions, although extensive and encompassing a practice period, apparently failed to ensure that all Ss begin their tasks with a thorough understanding of the task and with a good familiarity with the stimulus materials. This could have been prevented by pre-testing all Ss on these two prerequisites.

These results have a definite educational implications. They indicate that the importance of the speed of solution on a conceptual task seems to be implied in a test-like situation, and that this may deteriorate learners' performance. Classroom conditions where students are constantly competing against each other, tend to create a test-like situation; and it is suggested that this prevents the students from following the postulated logical sequence of conceptual behavior, and forces them into the execution without an appropriate strategy-plan of action, resulting in a poorer performance than they are capable of. In order to eliminate this extraneous variable from the conceptual learning situation, time-stress, whether actual or implied, must be removed from the classroom.

References

Bandura, A., & Walters, R.H. Social Learning and Personality Development. New York, Holt, 1967, 76-77.

Bourne, L.E. Factors affecting strategies used in problems of concept formation. American Journal of Psychology, 1963, 76, 229-238.

Bruner, J.S., Goodnow, J., & Austin, G.A. A Study of Thinking. New York, Wiley, 1956, 83-90.

Byers, J.L. Strategies and learning set in concept attainment. Dissertation Abstracts, 1961, 21, 1904.

Deese, J., & Hulse, S.H. The Psychology of Learning. New York, McGraw-Hill, 1967, 208-218.

Gardner, R.W. Cognitive styles in categorizing behavior. Journal of Personality, 1953, 22, 214-233.

Haygood, R.C., & Bourne, L.E. Attribute- and rule-learning aspects of conceptual behavior. Psychological Review, 1965, 72, 175-195.

Klausmeier, H.J. Strategies in Concept Attainment. Summary review of personal correspondence, 1964.

Laughlin, P.R. Speed vs minimum-choice instructions in concept attainment. Journal of Experimental Psychology, 1964, 67, 596.

Laughlin, P.R., & Doherty, M.A. Discussion vs memory in cooperative group concept attainment, Journal of Educational Psychology, 1967, 58, 123-128.

Siegel, P.S. Concept formation's response-time considerations. Psychological Reports, 1964, 14, 435-442.

Appendix A

Instructions

1. <u>Time-stressed high motivated (TSHM)</u>.

<u>Part 1</u>. This study is concerned with how students learn concepts. Your task is to identify the characteristics of three concepts as quickly as possible. Time is of vital importance.

<u>Part 2</u>. I shall now demonstrate to you what is a concept. Look at this board in front of you; it contains 64 cards, and each card is composed of six characteristics. For example : this card (<u>E</u> points to a card in the first row, second column) has the following characteristics : one, large, solid, red, circular figure, with a broken border. If your task is to identify the concept " large red figure " then this card is an example of the concept " large red figure " since it contains both characteristics of the concept : large and red. If you will look now at this card (<u>E</u> points to a card in the fourth row, first column), you will notice that it has : one, large, solid, blue, circular figure, with a broken border. This card is not an example of the concept " large red figure " since it does not have both characteristics of the concept : large and red. Now, using the pointer which lies in front of you, please indicate to me all the cards on this board which are examples of the concept " large red figure ".

(<u>E</u> ensures that <u>S</u> identifies all exemplars). Listen carefully now, and I shall explain to you how we will conduct this game. I will point to you one card that is an example of the concept which you have to identify. This card will contain six characteristics, and two of them will form your concept. In order to determine which two characteristics form your concept, you should test the characteristics of other cards on the board in relation to the characteristics of the example card which I will point out to you. You will indicate to me with the pointer the cards which you want to check, and I will say " yes " if the card is an example of the concept, or I will say " no " if the card is not an example. When you think that you know what is the concept, tell me, and if it is correct I will say " yes " and your task on that concept is completed; if it is not correct I will say " no " and you will continue selecting cards until you will identify your concept. You can offer only one solution on each card choice.

<u>Part 3</u>. This study has already been conducted in Vancouver schools, and based on that we have established a record time to completion of the task. Now we would like to see whether this record can be broken by Richmond students. Your school has been selected, and you are one of the few students who will have now the opportunity to help your school in breaking this record.

Since all students were selected randomly, you are competing with an average Vancouver student. Please remember that speed is very important in this game. Your principal is very interested in this project, and asked me to show him all the results from this study. You see, your performance on these tasks will indicate to us how well you can think.

2. Time-stressed low motivated (TSLM).

Part 1. (Same as for TSHM).

Part 2. (Same as for TSHM).

Part 3. Please remember that speed is very important in this game.

3. Accuracy-stressed high motivated (ASHM).

Part 1. This study is concerned with how students learn concepts. Your task is to identify the characteristics of three concepts with as few card choices as possible. Time is of no importance.

Part 2. (Same as for TSHM).

Part 3. This study has already been conducted in Vancouver schools, and based on that, we have established a record of minimum cards to completion of the task. Now, we would like to see whether this record can be broken by Richmond students. Your school has been selected, and you are one of the few students who will now have the opportunity to help your school in breaking this record. Since all students were selected randomly, you are competing with an average Vancouver student. Please remember that speed is of no importance, and that the vital thing in this game is that you identify the concepts with as few card choices as possible. If you hurry, you will not be able to complete your tasks efficiently. Your principal is very interested in this project, and asked me to show him all the results from this study. You see, your performance on these tasks will indicate to us how well you can think.

4. Accuracy-stressed low motivated (ASLM).

Part 1. (Same as for ASHM).

Part 2. (Same as for ASHM).

Part 3. Please remember that speed is of no importance, and that the vital thing in this game is that you identify the concepts with as few card choices as possible. If you hurry, you will not be able to complete your tasks efficiently.

5. Control high motivated (CON-HM).

Part 1. This study is concerned with how students learn concepts. Your task is to identify the characteristics of three concepts.

Part 2. (Same as for TSHM).

Part 3. This study has already been conducted in Vancouver schools. Now, we would like to see how Richmond students learn concepts in comparison to Vancouver students. Your school has been selected for this comparison, and you are on of the few students who will represent your school in this study. Since all students were selected randomly, you are competing with an average Vancouver student. Your principal is very interested in this project, and asked me to show him all the results from this study. You see, your performance on these tasks will indicate to us how well you can think.

6. <u>Control low motivated (CON-LM)</u>.

<u>Part 1</u>. (Same as for CON-HM).

<u>Part 2</u>. (Same as for CON-HM).

<u>Part 3</u>. (Eliminated).

Appendix B-1

Table 5

Analysis of Variance for Total Time to Solution

	Source	Error	F	Mean Square	df	Significance	p
*	Instruction (I)	S(IMO)	1.65	94233	2	n/s	> .05
	Motivation (M)	S(IMO)	.21	12096	1		
	Order (O)	S(IMO)	4.39	250690	2		
	Problem (P)	SP(IMO)	.45	37386	2		
	I x M	S(IMO)	.91	51698	2		
	I x O	S(IMO)	1.46	83538	4		
	M x O	S(IMO)	.33	18613	2		
	I x P	SP(IMO)	.64	52490	4		
	M x P	SP(IMO)	.18	14952	2		
	O x P	SP(IMO)	.93	76368	4		
	I x M x O	S(IMO)	.73	41836	4		
	I x M x P	SP(IMO)	1.22	100378	4		
	I x O x P	SP(IMO)	1.21	99920	8		
	M x O x P	SP(IMO)	.41	33874	4		
	S(I x M x O)			57062	18		
	I x M x O x P	SP(IMO)	.64	52737	8		
	S x P(I x M x O)			82352	36		

* indicates that the effect estimated is of interest only

S = subject

Appendix B-2

Table 6

Analysis of Variance for Cards to Solution

Source	Error	F	Mean Square	df	Significance	p
* Instruction (I)	S(IMO)	10.85	890.36	2	s	$< .001$
Motivation (M)	S(IMO)	.91	75.00	1		
Order (O)	S(IMO)	2.09	171.69	2		
Problem (P)	SP(IMO)	.74	53.69	2		
I x M	S(IMO)	4.74	388.86	2		
I x O	S(IMO)	2.35	192.56	4		
M x O	S(IMO)	2.49	204.19	2		
I x P	SP(IMO)	.17	12.06	4		
M x P	SP(IMO)	1.71	123.86	2		
O x P	SP(IMO)	3.18	230.51	4		
I x M x O	S(IMO)	1.19	97.55	4		
I x M x P	SP(IMO)	2.22	161.39	4		
I x O x P	SP(IMO)	1.61	116.83	8		
M x O x P	SP(IMO)	1.43	104.01	4		
S(I x M x O)			82.02	18		
I x M x O x P	SP(IMO)	.62	45.04	8		
S x P(I x M x O)			72.57	36		

* indicates that the effect estimated is of interest only

S = subject

Appendix B-3

Table 7

Analysis of Variance for Time Interval

Source	Error	F	Mean Square	df	Significance	p
Instruction (I)	S(IMO)	29.88	2702.4	2	s	$< .001$
Motivation (M)	S(IMO)	.57	52.1	1		
Order (O)	S(IMO)	1.46	132.3	2		
Problem (P)	SP(IMO)	5.67	250.0	2		
I x M	S(IMO)	.75	67.9	2		
I x O	S(IMO)	.88	79.4	4		
M x O	S(IMO)	1.62	146.6	2		
I x P	SP(IMO)	2.05	90.5	4		
M x P	SP(IMO)	4.01	176.8	2		
O x P	SP(IMO)	.55	24.2	4		
I x M x O	S(IMO)	1.19	107.5	4		
I x M x P	SP(IMO)	4.06	178.9	4		
I x O x P	SP(IMO)	2.08	91.8	8		
M x O x P	SP(IMO)	.43	19.2	4		
S(I x M x O)			90.4	18		
I x M x O x P	SP(IMO)	.15	6.6	8		
S x P(I x M x O)			44.1	36		

S = subject

Appendix B-4

Table 8

Analysis of Variance for Index of Dimensional Change

Source	Error	F	Mean Square	df	Significance	p
Instruction (I)	S(IMO)	1.45	.5412	2	n/s	> .05
Motivation (M)	S(IMO)	.50	.1858	1		
Order (O)	S(IMO)	.89	.3325	2		
Problem (P)	SP(IMO)	2.73	.4301	2		
I x M	S(IMO)	3.07	1.1439	2		
I x O	S(IMO)	.41	.1520	4		
M x O	S(IMO)	.09	.337E-01	2		
I x P	SP(IMO)	.55	.859E-01	4		
M x P	SP(IMO)	1.80	.2816	2		
O x P	SP(IMO)	1.60	.2512	4		
I x M x O	S(IMO)	2.86	1.0678	4		
I x M x P	SP(IMO)	2.40	.3771	4		
I x O x P	SP(IMO)	.61	.967E-01	8		
M x O xxP	SP(IMO)	1.67	.2626	4		
S(I x M x O)			.3730	18		
I x M x O x P	SP(IMO)	1.00	.1578	8		
S x P(I x M x O)			.1572	36		

S = subject

Appendix B-5

Table 9

Analysis of Variance for Average Time per Card Choice

Source	Error	F	Mean Square	df	Significance	p
Instruction (I)	S(IMO)	27.74	6785.1	2	s	$<.001$
Motivation (M)	S(IMO)	.13	32.5	1	n/s	$>.05$
Order (O)	S(IMO)	2.78	679.9	2		
Problem (P)	SP(IMO)	2.02	433.4	2		
I x M	S(IMO)	.23	55.3	2		
I x O	S(IMO)	1.06	259.5	4		
M x O	S(IMO)	.39	95.1	2		
I x P	SP(IMO)	.42	89.4	4		
M x P	SP(IMO)	.87	185.7	2		
O x P	SP(IMO)	1.17	250.3	4		
I x M x O	S(IMO)	1.09	266.3	4		
I x M x P	SP(IMO)	.41	88.6	4		
I x O x P	SP(IMO)	1.32	283.3	8		
M x O x P	SP(IMO)	.14	30.1	4		
S(I x M x O)			244.6	18		
I x M x O x P	SP(IMO)	.28	60.7	8		
S x P(I x M x O)			214.0	36		

S = subject