1969

Effect of knowledge of results on the acquisition of prose material: Various levels of knowledge of results implemented

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THE EFFECT OF KNOWLEDGE OF RESULTS ON THE ACQUISITION OF PROSE MATERIAL: VARIOUS LEVELS OF KNOWLEDGE OF RESULTS IMPLEMENTED

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Presented in partial fulfillment of the requirements for the degree of

Master of Arts

UNIVERSITY OF MONTANA

1969

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Aug 28, 1969
Date

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8-29-69

INTRODUCTION

The most consistent finding of Knowledge of Results (KR) studies is that KR has a positive influence upon learning and performance. The majority of these studies have been conducted within the framework of acquisition of motor skills (Underwood, 1966).

Ammons, in his 1956 review of the KR literature covering studies from 1922 to 1952, made the generalization that KR positively affects rate of learning and level of learning reached. Bilodeau and Bilodeau (1961) include later studies where findings support the Ammons generalization.

Although most studies define KR as an "all or none" situation (i.e., Ss receiving KR always receive 100% KR), McCormack et al. (1963) in a study of reaction time where the Ss depressed a switch in response to onset of a light, discovered that partial KR groups (30%, 50%, 70%) performed at the same level statistically as did the 100% KR group. These groups differed significantly from the 0% KR group.

The majority of KR studies have been experiments dealing with the acquisition of motor skills, and have followed a general design. Ss are assigned to two groups, usually at random. Ss perform a single task over repeated trials, the only difference between the groups being that one receives KR while the other receives no KR (NKR). KR may be given after each trial, or cumulatively after a group of trials. One of the major dependent variables is time, measured as latency of response. The studies indicated

that NKR results in the latency either remaining constant or increasing, while KR results in latency either remaining constant or decreasing; the conclusion is that KR has a positive influence upon learning and performance.

Application of the methodology developed in the motor-skills studies to the important area of learning of prose materials has not been extensive. Rothkopf (1965, 1966) tried to determine the influence of KR on retention of prose material. His stimulus material was paragraphs from a 5000-word passage out of Rachel Carson's The Sea Around Us. Ss were divided into six groups, with several variables in the presentation of questions and of answers (KR), including placement of questions and answers in the sequence and whether or not answers (KR) were presented. He used a retention test at the end of the experiment to obtain his data. Rothkopf concludes that questions facilitate acquisition and retention and that a possibility exists of interaction between KR and position of questions, but that this relationship is unclear.

In a follow-up study which attempted to clarify Rothkopf's results regarding the effect of KR upon retention, Frase (1967) employed a 1000-word passage from Miller's Psychology: the Science of Mental Life. Rothkopf's design was essentially repeated, but Frase introduced the variable of different paragraph length (10, 20 and 40 sentences in length).

From the results of his study, Frase concluded that KR has a facilitating effect upon acquisition and retention, as indicated by a retention test immediately following the entire passage.

These three studies deviated in significant aspects from the methodology generally employed by the KR studies which dealt with acquisition of motor skills. Time as the primary dependent variable was replaced by retention. The deletion of a time measure for individual trials excludes the possibility of investigation of inter-trial differences. No overt indication of S's performance on questions during S's exposure to the stimulus material was provided for. Ss were instructed to make a covert response when the questions were originally presented. The only measure of S's acquisition of the material was an inferred one from the retention test administered at the end of the experimental procedure. No attempt was made to assess long-term retention.

The intent of the present study is to make a more rigorous application of the methodology from the acquisition of motor skills studies to the learning of prose materials. The emphasis on time from the acquisition of motor skills experiments was included in this study. Length of time permitted for reading of the prose paragraph was controlled by the E and was standard across all groups. A measure

of time spent reading and overtly responding to a presented question was obtained. A measure was also obtained of the amount of time S spent studying the answer (KR) to a preceding question. It was hypothesized that those Ss receiving KR would spend more time reading and responding to a presented question than Ss receiving NKR. The Ss receiving KR were divided into two groups, one of which received 100% KR and another which received partial KR (PKR), a blank space sometimes being administered to the PKR group in place of an answer. The NKR group had only blank spaces in place of answers. It was expected that these KR groups would not differ significantly in the amount of time spent on answer (KR) even though the PKR group did not always receive an answer; whereas the KR group would spend significantly less time between questions.

To obtain a measure of Ss' performance during their exposure to the stimulus material, Ss were required to formulate written answers as the questions were presented. It was expected that the three groups would not differ significantly in the correctness of their written answers (this differs from the acquisition of motor skills studies in that there is no repetition of a single task and therefore no expectation of the significant differences between experimental and control groups found in the acquisition of motor skills studies).

Long-term retention was assessed one week after the initial exposure to the stimulus material. It was expected that those groups receiving KR would perform significantly better on a long-term retention test.

METHOD

Subjects

Ss were 45 male and female undergraduate students enrolled in an introductory Psychology course, divided at random into three groups of 15 students each.

Apparatus

S was seated at a table facing a projection screen. On the table was a Sawyer Rotomatic 600 slide projector which had a manually operated advance button. As the S activated the advancing mechanism, the armature removed the exposed slide and projected the next slide on the screen. As the armature removed each exposed slide, it depressed a micro-switch, completing a circuit which activated the recording needle on an Esterline Angus, Type AV (120v. AC) continuous recorder (chart speed of the recorder was 12in./60sec.). Distance between pen-activation indicated the length of exposure time of each slide. Ss were given an answer sheet (Appendix I) on which to record their responses to questions.

Procedure

The experiment was run on two different days, with a one-week interval between sessions. Ss were randomly assigned to one of three groups for the first day, but all received an identical retest on the second.

Stimulus material was 18 prose passages taken from a syllabus on Ancient History used at Hobart College (1961). All presented material was placed on individual 35-millimeter slides. Each prose passage slide was followed by a series of three question slides. After each question slide, there was either an answer slide (KR) or a blank slide (NKR), depending upon which of the three groups S had been assigned to (sequence: prose passage - question - answer or blank slide - question - answer or blank slide - question - answer or blank slide). E controlled the duration of exposure of each prose passage; S controlled duration of exposure of all other slides.

Whether or not a S received an answer slide (KR) or a blank slide (NKR) depended upon the group to which he had been assigned. Group I (KR group) received an answer slide (KR) for every question. Group II (PKR group) received an answer slide after each of the first three questions and then a blank slide after question number four; on the remainder of the question-answer pairings NKR (0) and KR (1) were introduced in the following pattern: 1-0-1-0-0-1-0-1-0-1-1-0-1-0-0-1-0-0-1-1-1-1-0-0-1-0-1-0-0-1-0-1-0-1-1-0-1-0-0-1-0-0-1-1-1-1-0-0-1-0 (Wagner, 1959). Group III (NKR group) received only a blank slide after each question.

Aside from the indicated differences between the groups

(KR or blank slides), all Ss went through the same procedure. Each S was tested individually. S was seated at a table facing a projection screen. S was given an answer sheet (Appendix I). E remained in the room throughout the experimental session. S was read the standard instructions (Appendix II) and any questions which S had were answered by E's re-reading of the relevant part of the standard instructions.

After the first prose paragraph was presented for the controlled period of time (30 seconds), the S was instructed to go on to the next slide. The next slide presented a question based on the information in the prose paragraph, which was to be answered by the S on the answer sheet which he had been given (Appendix I). When the S was ready, he pressed the advance button on the slide projector, removing the question and presenting the next slide. The content of this slide depended upon whether S was receiving KR (answer) or NKR (blank slide). Again, when S was ready, he pressed the advance button on the slide projector, removing the slide and presenting the next question. S determined his own rate of speed through the slides, with the exception of the prose paragraphs, which were always removed after the 30 seconds.

At the end of the experimental session, S was given a written reminder to return in one week. S was not

informed that he would be retested on the material when he returned for this second session. Retest consisted of a mimeographed sheet (Appendix III) of the questions from the slides in the first session. The only instruction given was that S was to write the answers in the spaces allotted on the mimeographed question sheet.

RESULTS

An attempt was made in this study to apply to the learning of the prose materials aspects of methodology employed in the investigation of the effect of KR on the acquisition of motor skills. Performance and level of learning were major concerns in this study. Measurements of time and number of correct answers were taken, in the expectation that they would reflect the effect of KR on performance and level of learning.

It was hypothesized that those groups receiving KR (KR and PKR groups) would spend a longer time formulating their answers than would the group not receiving KR (NKR group). This would be reflected in the amount of time that S exposed the question slide (while the question slide was exposed, S read the question, determined his answer, and recorded this answer on the answer sheet). Although differences between groups did appear in the predicted direction, they did not prove to be statistically significant (KR:NKR, $CD(44) = 104.73$, $p = < .05$, KR:PKR, $CD(44) = 14.33$, $p = < .05$, PKR:NKR, $CD(44) = 80.40$, $p = < .05$. All statistics from "studentized" t test).

It was hypothesized that the groups which received KR (KR and PKR groups) would spend significantly more time on those slides where KR was administered than the NKR

group would spend on the blank slides which they received in place of answer slides. This hypothesis was statistically verified (KR:NKR, CD(44) = 188.87, $p \geq .05$; PKR:NKR, CD(44) = 123.07, $p \geq .05$. All statistics from "studentized" t test).

It was predicted that there would be no significant difference between the two groups receiving KR (KR and PKR groups) in time spent on slides following questions, despite the fact that some of these were blank for the PKR group while all contained answers for the KR group. This prediction was not supported in that statistical analysis indicated a significant difference in the direction of the KR group spending more time (KR:PKR, CD(44) = 65.80, $p \geq .05$, statistic from "studentized" t test). However, on slides where PKR group did receive the answer, there was no significant difference between the KR and PKR groups on length of time spent on the slides (KR:PKR, t(28) = .9915, $p \leq .05$). This finding is interpreted to indicate that, when KR was available, the PKR group used it.

As was predicted, there was no significant difference among the three groups in terms of the number of correct answers produced on test (PKR:KR, CD(44) = 2.90, $p \leq .05$, KR:NKR, CD(44) = .20, $p \leq .05$, PKR:NKR, CD(44) = 3.10, $p \leq .05$, all statistics from "studentized" t test).

On the retest, it was hypothesized that both of the groups receiving KR would score significantly higher than

the NKR group, while not differing from one another. These hypotheses were supported with the exception that the predicted significant difference between the PKR and NKR groups was not verified by statistical analysis (PKR: NKR, $CD(44) = 3.87$, $p =< .05$, statistic from "studentized" t).

A Point Biserial correlation was performed on each of the groups separately, correlating the amount of time spent on the questions with the number of correct answers.

Table I

Group	Eta	Weight	t	p
KR	.50	6.11	3.550	.005
PKR	.38	5.70	2.17	.025
NKR	.48	6.46	3.10	.01

It was found for each group that there was a significant (direction predicted) positive correlation between the time spent on a question and the correctness of the response to that question, but that there was no significant difference among the correlations of the three groups. The lack of significant differences among the correlations tends to eliminate the possibility of attitude differences among the three groups based on the amount of KR received.

In order to determine whether any particular schedule of KR (KR, PKR, or NKR groups) placed any one group at a disadvantage in number of correct answers, a graphic item

difficulty index was plotted. Although differences in item difficulty were indicated, these appeared, by visual inspection, to be consistent across all groups (See graph I).

Using PKR may result in inconsistencies in the data of that group that could be further analyzed for their importance. A t test was performed comparing the PKR and NKR groups on those questions which followed a blank slide for the PKR group. It was hypothesized that the PKR group would spend more time on the questions following blank slides (no KR) than the NKR group would spend on the same questions. The t test resulted in a $t(28)=2.73$, $p=.01$, with the PKR group spending more time, verifying the hypothesis.

It was hypothesized that a PKR schedule might facilitate S's production of correct answers on certain questions. To investigate this, a t test was performed on the retest data of the PKR group, on those questions which followed a blank slide (no KR) on test; this was compared with retest data on the same questions from the NKR group. The results were $t(28)=6.06$, $p=.001$, with the PKR group producing significantly more correct answers on these questions.

It was hypothesized that there would be differences between the groups receiving KR (KR and PKR groups) in certain aspects of the data. On those questions where

KR was administered to both KR and PKR groups, t tests were performed on the number of correct answers to those questions on test and also on retest. The results on the test data were $t(28)=2.13, p=.05$, with the PKR group producing significantly more correct answers. The results on the retest data were $t(28)=.964, p=<.05$, which were interpreted as indicating no significant difference between the groups.

It might be hypothesized that any differences between PKR and NKR groups encountered on retest were due to the fact that the PKR group received two exposures to the correct answer (prose paragraph slide and answer slide) on some questions, while the NKR group received only one exposure on all questions. To deal with the possibility, two t tests were performed (test and retest data) on those questions for which neither group received KR in the test. The results of the data from the test were $t(28)=4.29$, $p=.001$, with the PKR group scoring significantly higher in number of correct answers. The results of the data from the retest were $t(28)=2.58, p=.02$, with the PKR group scoring significantly higher in number of correct answers.

DISCUSSION

It was the intent of this study to attempt to apply the reported methods from those studies where the effects of KR have been indicated to be beneficial. This study has attempted to apply to the learning of prose material the methodology of studies where KR was applied to the acquisition of motor skills. It was felt that if the transition from acquisition of motor skills to an educational setting (learning of prose material) could be made, the application of this procedure would prove valuable in situations where an individual needs acquisition and retention of prepared materials.

As in the area of motor skill acquisition, time and level of performance were relevant measurements to indicate the effect of KR on a group performing a learning of prose materials task. This effect was measured by comparison with a group which performed the same task without influence of KR.

A third group (PKR group) was included to determine if the results that McCormack et al. (1963) obtained in the area of acquisition of motor skills, which indicate that a partial KR (PKR) is as effective as a 100% KR, would apply in the design of this study.

It was hypothesized that those groups receiving KR

(KR and PKR groups) would spend a longer time formulating their answers than would the group not receiving KR (NKR group). This hypothesis was based on the reported beneficial effect of KR on performance and level of learning. This hypothesis was not confirmed in the interpretation of the data analysis based on the overall results. Consideration of the overall data tends to mask certain differences between groups on certain areas of the data. On those questions which followed a blank answer slide for both the PKR group and NKR group it was found that the PKR group spent significantly more time in responding to those questions. The lack of overall difference in the amount of time spent on responding to the questions leads to the question as to whether the present situation is analogous to the motor skill acquisition situation.

There was found no significant difference between the three groups with respect to the number of correct answers produced on test. Although this finding was encountered in consideration of the overall data there were important differences within the data. In comparing the PKR and NKR groups on questions following blank answer slides it was found that the PKR group produced significantly more correct answers than did the NKR group.

There was found to be some beneficial effect of KR on retention although not all hypotheses were supported.

These findings indicate the possibility that the second exposure (information slide and then the answer slide) to the correct answer is the contributing factor to the differences between the groups on retest. This hypothesis gains support from the fact that the groups arranged themselves with regard to the number of correct answers produced on retest in direct relationship to the number of answers which they had received two exposures to the correct answer (NKR PKR KR).

The effect of PKR on the group experiencing it seems to be important within certain areas of the data as is indicated above. It is possible that the use of a PKR schedule adds a short-term effect to the performance of the group experiencing it. The stipulation with regard to a short-term effect is based on the findings which indicated that although there are areas where the performance of the PKR group is superior to the other two groups this superiority is not maintained over the duration of the test and is not reflected on retest.

The data on the PKR group indicates a possible beneficial effect on S's performance and level of learning, but this effect seems to be short-term. It is possible that manipulation of the schedule could result in a longer duration of this effect, yielding results which more closely mimic the effect that the full KR had on the group experiencing it.

APPENDIX I

Programmed Learning

INFORMATIONAL SLIDE #1

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #2

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #3

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #4

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #5

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #6

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #7

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #8

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #9

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #10

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #11

Answer 1. _____

2. _____

3. _____

INFORMATIONAL SLIDE #18

Answer 1. _____

2. _____

3. _____

APPENDIX II

Standard Instructions

You will be presented informational material on slides that will be projected on the screen in front of you, one at a time. The informational material will be visible for a certain length of time* and I will indicate when you are to move to the next slide, but every other slide will be presented for as long as you want it to be. After each informational slide you will control the length of time each slide is exposed. There will be three questions after each informational slide, with other slides which may be blank...(Pause) between each question slide. The questions asked on the slides are to be answered by you on the answer sheet you were given. After you answer the question, press the button and expose the next slide; this is the one that may be blank. After you are finished with that slide, press the button and expose the next question. When you finish all the slides concerned with one information slide, another informational slide will be exposed. I will indicate when you are to go on to the next slide after the informational slide. Be sure that you keep your answers in order. I am interested

*The "certain length of time" referred to in the instructions was 30 seconds.

in your answers because I am doing research on different types of teaching and the effectiveness of each as compared to the others. Do not worry about the spelling of your answers; if the spelling is close enough so that I will know what you are referring to, that is all that is necessary. Are there any questions...(Pause). All right, I will expose the first slide; then, when I tell you to expose the next slide by pressing the button, you may proceed at your own rate to expose the rest. Until you reach the next informational slide you will control the length of time each slide is exposed.

APPENDIX III

Group 1 - Referring to the unification of Israel

1. When did David become King of Israel? (date)_____
2. What caused Israel to become a political power?_____
3. In what area is Israel located?_____

Group 2 - Referring to the creation of the city-states

1. What rights did the common people have in the city-states?_____
2. What is the difference between the old cities and the new city-states?_____
3. When did the change to the city-states occur?_____

Group 3 - Referring to the achievements of a certain period

1. What period is being discussed?_____
2. What was one of the achievements of this period?_____

Group 4 - Referring to how people lived

1. What were the houses usually like?_____
2. Where could the men usually be found?_____
3. Who stayed indoors mostly?_____

Group 5 - Referring to the characteristics of the city-state

1. What was the characteristic Greek form of social life?_____
2. How did the Greeks think of the city-state?_____
3. What is the city-state comparable to today?_____

Group 6 - Referring to the Festivals

1. What type of festivals were frequent?_____
2. What type of performances were given at the theaters?_____
3. Who is the goddess mentioned in the passage?_____

Group 7 - Referring to the voice that the common people obtained in the government

1. When did the economic crisis occur?_____
2. The two developments led to what change for the common man?_____
3. What was the second factor mentioned?_____

Group 8 - Referring to Athens as a democracy

1. Under whom was Athens a democracy?_____
2. When was Athens a democracy?_____
3. What did this mean in terms of participation?_____

Group 9 - Referring to the unification of Egypt

1. When did the Pharoah become a god on earth?(date)__
2. Who united Egypt?_____
3. Previous to the unification, what were the two areas of Egypt?_____

Group 10 - Referring to David before he was king

1. Whom did David replace as king?_____
2. Whom did David originally fight for?_____
3. What was the name of his capital city?_____

Group 11 - Referring to Delphi

1. Where is Delphi located?_____
2. What is Delphi?_____
3. To whom did the Greeks dedicate Delphi?_____

Group 12 - Referring to the Greek wars and the reaction

1. Who suffered during the war because of his association with the philosophers?_____
2. Who was put to death as an intellectual?_____
3. Why was Socrates put to death?_____

Group 13 - Referring to the ideas of Socrates

1. Whose ideas are discussed in the passage?_____

2. Did he believe that man has a natural knowledge of virtue?_____

3. How did he try to bring out this "Natural knowledge"?_____

Group 14 - Referring to the history of Thucydides

1. Who wrote a history before Thucydides?_____

2. What was his approach to the writing of history?_____

3. What did Thucydides feel that a history should do?_____

Group 15 - Referring to the effects of the Peloponnesian Wars

1. How was the war decisive?_____

2. When did Sparta and Athens defeat the Persian empire?_____

3. What other strife was occurring at the same time?_____

Group 16 - Referring to Homer

1. Which is older, the Odyssey or the Iliad?_____

2. Did the same person write both?_____

3. Who is Homer?_____

Group 17 - Referring to the spread of civilization

1. Civilization emerged when? (date)_____

2. Where did civilization emerge?_____

3. To what area did it ultimately spread?_____

Group 18 - Referring to war and writing

1. What writing form came about at this time?_____

2. What other event accompanied the new prose form?_____

3. What was the new interest that developed?_____

APPENDIX IV

Time	KR	PRK	NKR
On questions overall			
Mean	929.06	904.73	824.33
Variance	154,903.79	52,166.33	47,761.29
On questions following NKR			
Mean		411.20	364.87
Variance		7,707.89	8,369.32
On answers overall			
Mean	281.47	215.67	92.60
Variance	2.112.28	2,467.29	716.37
On KR answers			
Mean	147.90	142.00	
Variance	602.80	1,381.47	
Answers Correct			
Answers correct overall on test			
Mean	41.40	44.33	41.20
Variance	52.37	19.82	46.96
Answers correct overall on retest			
Mean	25.73	22.47	19.60
Variance	279.84	33.58	39.04
Questions KR test			
Mean	20.47	22.00	
Variance	20.52	8.67	
Questions KR retest			
Mean	13.20	12.40	
Variance	29.18	10.40	
Questions NKR test			
Mean		22.33	20.27
Variance		3.69	8.99
Questions NKR retest			
Mean		10.07	8.6
Variance		11.26	11.71
Questions following NKR test			
Mean		20.20	19.13
Variance		86.40	177.73
Questions following NKR retest			
Mean		10.7	9.07
Variance		6.59	8.59

Point Biserial Correlation

	KR	PKR	NKR
Time on questions	642.27	714.73	587.33
with correct answers	-271.40	-190.00	-237.00
Time on questions on NKR trials, correct answers on NKR trials		367.53 -58.60	

Treatment x Subject EX^2

	KR	PKR
Test	7,390	7,537

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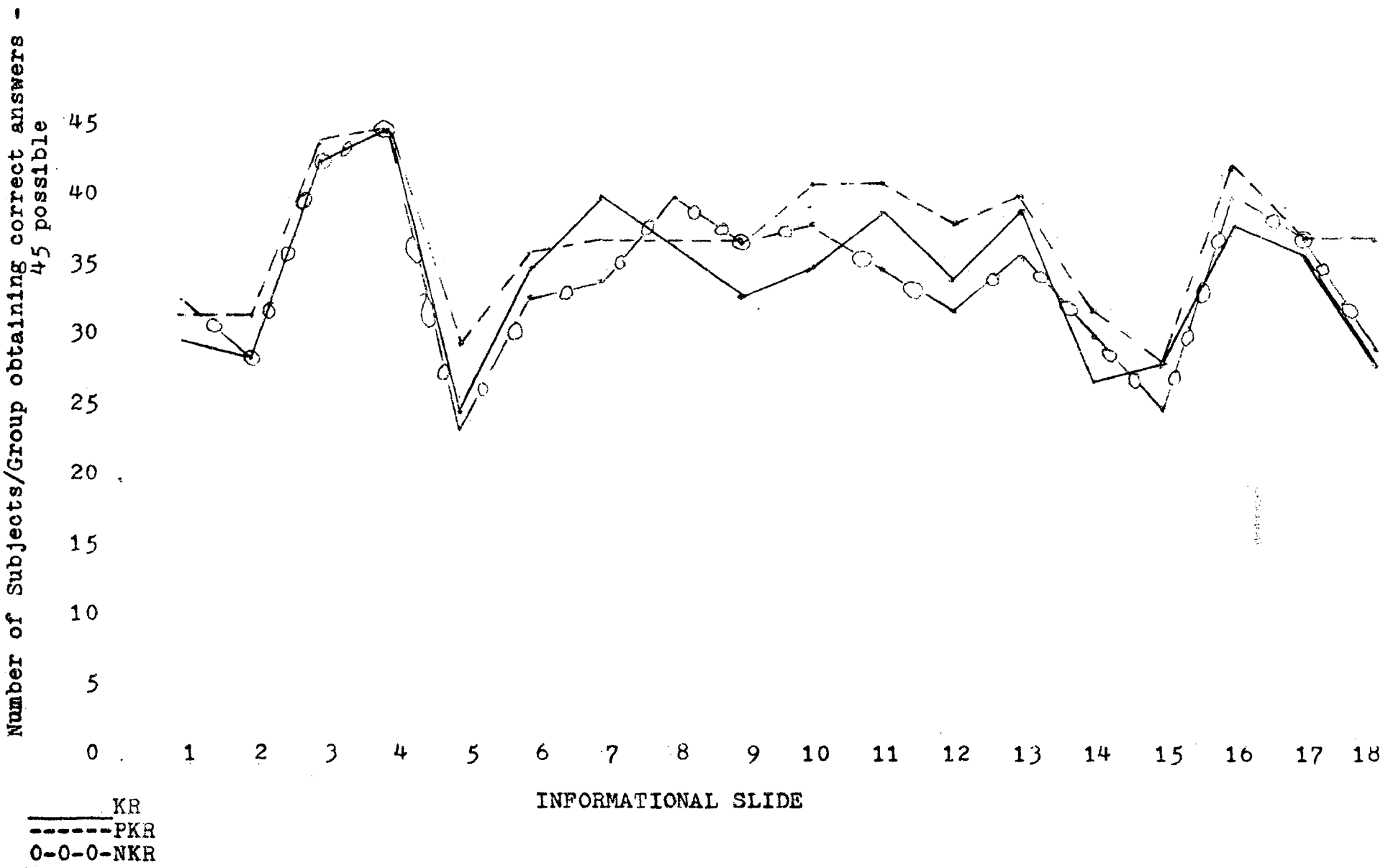
Number of Subjects/Group obtaining correct answers - 45 possible
45
40
35
30
25
20
15
10
5
0
1
2
3
4
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INFORMATIONAL SLIDE
KR
PKR
NKR