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ABSTRACT

Three design strategies directly related to the development of instructional materials for rule learning were investigated. In the first of two experiments using both male and female tenth grade students, the degree of divergence between instances showed that contrasting irrelevant features resulted in better performance than matching irrelevant features. The data analysis from experiment 2 showed that when two contextually similar rules were learned simultaneously, student performance was superior to that of students who learned the rules successively. When the students were provided with an analysis of how a given instance represented the application of a grammatical rule, performance was better than without this analysis. The results were discussed in relationship to a prescriptive theory of instruction. (Author/LL)

Rule Acquisition Design Strategy Variables: Degree of Instance Divergence, Sequence, and Instance Analysis

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Running Head: Rule Acquisition Design Strategy Variables

Abstract

Three design strategies directly related to the development of instructional materials for rule learning were investigated. In the first of two experiments, the degree of divergence between instances showed that contrasting irrelevant features resulted in better performance than matching irrelevant features ($p < .001$). The data analysis from experiment two showed that when the two contextually similar rules were learned simultaneously, student performance was superior to that of students who learned the rules successively ($p < .001$). When the 10th grade students were provided with an analysis of how a given instance represented application of a grammatical rule, performance was better than without it ($p < .05$). The results were discussed in relationship to a prescriptive theory of instruction.

Rule Acquisition Design Strategy Variables: Degree of Instance Divergence, Sequence, and Instance Analysis

In their review of instructional development Merrill and Boutwell (1973) emphasize the lack of research directly related to the learning of complex cognitive behaviors, such as rule using. Scandura (1970) recommends, in his extensive analysis of discovery learning, the need for research on learning rules from stimulus instances. The purpose of this study was to investigate three design strategies that would facilitate rule acquisition by manipulating the relationship of stimulus instances. The design strategies are extensions from both concept (Tennyson, Woolley, & Merrill, 1972; Houtz, Moore, & Davis, 1973; Tennyson, 1973; and Klausmeier, Ghatala, & Frayer, 1974; Tennyson, Steve, & Boutwell, 1975) and rule (Traub, 1966; Guthrie, 1967; Scandura & Durnin, 1968; Guthrie & Baldwin, 1970; Scandura & Voorhies, 1971; and Thatcher, 1972) acquisition research.

An early rule acquisition study directly investigating the relationship of instances according to stimulus properties or features was Traub's (1966) research on problem heterogeneity. In one condition, heterogeneous, the instructional problems had contrasting irrelevant features (characteristics of a particular instance not associated with the rule statement); while the second condition, homogeneous, had problems with identical or similar irrelevant features. Results of the data analysis showed that the group receiving the former treatment had superior performance. A range of differing irrelevant features illustrated the scope of the rule's application—an especially important element for solving newly encountered problems—and focussed the learner's attention to the relevant stimulus properties.

The use of negative instances in rule learning has yet to be adequately tested. In concept acquisition research a negative instance is simply a positive instance of another concept class. But in the rule learning research paradigm a negative instance is an incorrectly solved problem. Guthrie's (1967) study of pairing correct solutions with incorrect solutions is an example of this methodology. Thatcher's (1972) study is representative of investigations which have applied both Traub's (1966) concept of heterogeneity of positive instances and Guthrie's (1967) concept of pairing incorrect solutions with correct—the results continue to be that incorrect solutions do not significantly affect the learning of rules.

Scandura and Durnin (1968) demonstrated the importance, to transfer, of information specifying the application of a particular form of a rule to specific instances. Klausmeier et al. (1974) also specified a concept attainment situation where, even if given additional information (e.g., prompting and/or feedback; see Merrill & Tennyson, 1971), learners may not recognize the defining characteristics of a concept as represented in an example if they do not recognize the critical attributes. Klausmeier et al. proposed that an explanation describing the critical attributes be given prior to presentation of the conventional forms of instructional help, e.g., prompting (cf. Carroll, 1966).

Independent Variables

Three independent variables, design strategies for the development of instructional materials, were defined according to the relationship of instances and the manipulation of stimulus materials. The first design strategy, degree of divergence, was a replication of previous research (Traub, 1966; Guthrie, 1967; Scandura & Durnin, 1968; Thatcher, 1972; Tennyson et al., 1972) dealing with the relationship of instances according to stimulus properties. Two conditions of this variable were tested. For the first, contrasted, the instances were selected to represent the scope of a given rule's application. Instances were presented in dichotomous pairs so that a wide range of irrelevant features would be demonstrated for each display. In the second condition, matched, the irrelevant features of paired instances were identical or similar so that each pair of displayed instances represented only a small portion of the rule's scope. It was hypothesized that contrasted instances would focus learner attention more effectively on the relevant features of a rule than matched instances, resulting in superior performance.

The second design strategy, sequence, dealt with the question of the use of negative instances in rule learning. Three conditions of this variable were tested. In the first condition, simultaneous, two contextually similar rules were presented concurrently such that an instance from one rule was paired to an instance of the second rule by matching irrelevant features. The second condition, random, was a sequence in which the rules were presented concurrently, but instances were paired randomly with no attempt at relating one to another. For the third condition, successive, the rules were presented separately, i.e., all instances representing the first rule were presented prior to presentation of instances representing the second rule. The two-fold hypothesis was that presenting rules simultaneously would facilitate rule acquisition more than presenting the same rules successively because learner attention would be directly focused on the differences of application between rules, and if the between rule instances within a simultaneous sequence had matched irrelevant features the resulting group's performance would be superior to that of a group receiving randomly paired instances.

The third design strategy involved an analytic description of how a rule applied to a particular stimulus instance. For the purposes of rule using, the third design strategy applied both Scandura and Durnin's (1968) premise of additional specific information and Klausmeier et al.'s (1974) notion of explaining attributes of a given instance. This design strategy, analytical explanation, utilized an analysis statement of each stimulus instance which identified the relevant features and explained their applications. To test this variable, two conditions were used: one with the analytical explanation and a second without it.

Two experiments were conducted. Experiment I tested the degree of divergence variable at two conditions—contrasted and matched—and the second variable, sequence, at two conditions—simultaneous and random. Experiment II tested the simultaneous and successive conditions of the sequence variable and added the third design strategy, analytical explanation, at two conditions—with the additional information and without it.

Method

Students

Participants in Experiments I (total 58) and II (total 60) were tenth grade male and female students enrolled at the Florida State University Developmental Research School and the Florida A & M University Laboratory School. Both experiments were conducted concurrently with students randomly assigned to one of the eight treatment conditions.

Learning Task

Two transformational syntax rules were used in the learning task: extraposition and it-deletion. The behavioral objective of the task was stated as follows: Given nongrammatical sentences, the students will write grammatical sentences by applying either the extraposition or it-deletion transformational syntax rule.

<u>Rule statements</u>. The rule statements were developed according to the structure of a rule as defined by Scandura (1970) and Merrill (1973). That is, the relevant features of the two rules could be characterized as having a domain, operation, and range. The domain of each rule is a set of sentences having a specified form; the range is the corresponding set of transformed sentences; and the operation is the transformation by which this change takes place. In addition to each rule statement, an example sentence was given with an analysis explaining the relevant features of the rule in reference to the specific stimulus instance. The extraposition rule statement and example were:

> Extraposition is an optional rule which may be applied whenever a sentence follows the pronoun "it" in a noun phrase. The clause immediately after "it" may be moved to the end of the sentence in which it is embedded. Here is an example.
>
> It that he was a good sport pleased his father.
>
> <u>That he was a good sport</u> tells the meaning of "it". The meaning of "it" is included when showing the deep structure. When we say the sentence, we may be able to leave out "...that he was a good sport" if the reader or listener already knows what we are talking about. For example:
>
> person # 1 - John is a good sport.
>
> Person # 2 - I know, it pleases me.
>
> person # 1 - It pleased his father.
>
> As you can see, there is no problem knowing what "it" means in the last line, but the meaning of "it" may be added to the end of the sentence.

The rule statement for it-deletion and its example were:

Whenever the conditions for extraposition exist, but this transformation is not applied, the pronoun "it" must be dropped. Here is the same example demonstrating it-deletion:

(It) That he was a good sport pleased his father.

(dropped)

The sentence, after dropping "it," is grammatical.

Let us put this sentence into a conversation:

person #1 - Why was his mother so happy?

person #2 - I don't know.

person #1 - That he was a good sport pleased his father.

The "it" is not necessary when the meaning has to be carefully expressed.

For the extraposition and it-deletion rules, there is only one correct way that they can be applied to sentences. You will not need to choose an answer, but apply each rule in the only way it can be used in each situation.

Instances In developing instances from the extraposition rule statement, sentence pairs were selected by contrasting such irrelevant features as subject and syntax. An example of contrasting irrelevant features for a pair of sentences is the following:

*It that she is sick worries me.

It worries me that she is sick.

*John wrote it that the car is new is exciting.

John wrote, "It is exciting that the car is new."

The asterisk refers to the nongrammatical form of the sentence, while the succeeding sentence demonstrates the correct application of the rule. In the design of the sentences, instance pairs were classified as easy or hard according to complexity of the irrelevant features per instance. It was assumed that the ability to apply the rule would be increasingly difficult when the structure of the sentence was more complex (cf. Merrill & Boutwell, 1973; Klausmeier et al., 1974). The it-deletion rule instances were developed using the same method. An item pool of 20 paired instances was developed for each rule.

A two-step format for display of instances was designed: The first, expository, displayed the nongrammatical sentence and grammatical sentence at the same time (see above). The second, inquisitory, featured a practice frame in which students were required to write the appropriate transformation of a nongrammatical sentence. Students checked their responses to the inquisitory instances by referring to the correct form on the succeeding page in the booklet. In summary, the basic learning task consisted of an introduction to transformational syntax, a presentation of the two rule statements with examples, an easy set of expository and inquisitory instances followed by a hard set of each presentation format.

Treatment Programs

Experiment I. Two design strategies, degree of divergence (contrasted and matched) and sequence (simultaneous and random), were tested. The four treatment programs developed from the factorial crossing of the two levels of each design strategy are illustrated in Table 1 and described below:

Insert Table 1 about here

Contrasted-Simultaneous Program 1 was composed of extraposition rule instances that were paired by contrasting the irrelevant features. In addition, the it-deletion rule instances were presented simultaneously with the extraposition instances. Since the it-deletion rule must be applied when the extraposition rule is not, the nongrammatical sentences for both rules were the same.

Matched-Simultaneous In Program 2, the extraposition rule instances had matched irrelevant features. The it-deletion rule instances were presented simultaneously with the extrapositions as in Program 1.

Contrasted-Random For Program 3, the extraposition rule instances were contrasted; the same sentences as in program one were used here, However, the it-deletion rule instances were randomly selected from the item pool for pairing with the extraposition rule instances.

Matched-Random In Program 4, the matched extraposition rule instances from Program 2 were presented with randomly selected it-deletion rule instances.

Experiment II

This second experiment replicated and extended the first by investigating the design strategies of sequence and analytical explanation. In the first variable the simultaneous condition was identical to that of the first experiment, while in the second condition, successive, instances of each rule were presented separately. The analytical explanation variable provided the student with an analysis of the relevant features of the rule in relation to a specific stimulus instance. The two conditions of the analytical explanation variable were with and without the additional information. Treatment programs developed for this experiment used the same two rule statements and instances as the previous experiment. The four programs were:

Simultaneous-With In Program 1, using contrasted within rule instances, the instances between the two rules were presented simultaneously with the analytical explanation added to both the easy and hard sets of expository instances. Below is a set of instances illustrating the analytical explanation variable:.

Extraposition Rule:

*It that Sebastian was her brother was obvious to Viola.

It was obvious to Viola that Sebastian was her brother.

That Sebastian was her brother is the embedded sentence which re-names it. To apply extraposition, move that clause to follow Viola.

It-deletion Rule:

*It that Sebastian was her brother was obvious to Viola.

That Sebastian was her brother was obvious to Viola.

When the extraposition rule is not applied, it-deletion may be applied. In this case, remove the it before that Sebastian.

Extraposition Rule:

*He said it that you needed money was expected.

He said, "It was expected that you needed money."

When the extraposition rule is applied, the sentence may be structured as a direct quotation as it is here. The sentence is then reporting exactly what the speaker said. That you needed money is placed after the verb expected.

It-deletion Rule:

*He said it that you needed money was expected.

He said, "That you needed money was expected."

If the it-deletion rule is applied, the sentence may also be in the form of a direct quotation reporting the speaker word for word. But the it before the embedded sentence must be deleted.

Successive-With For Program 2, the two rules were presented successively, i.e., the entire set of contrasted it-deletion rule instances were presented first, followed by the contrasted extraposition rule instances. Instances for both rules were presented with the analytical explanation material.

Simultaneous-Without Program 3 was the same treatment condition as in Program 1/Experiment I. That is, the contrasted instances for the two rules were presented simultaneously without the analytical explanation material.

Successive-Without The fourth program presented the two rules successively, the same as Program 2/Experiment II. Although the within rule instances were contrasted, they were displayed without the analytical explanation material.

Tests

A premeasure on verbal comprehension (Factor V-2, Vocabulary; French, Ekstrom, and Price, 1963) was administered prior to treatment for use as a covariate in the data analysis.

The posttest was composed of 20 previously unencountered nongrammatical sentences ranging from easy to hard according to complexity of the stimulus properties. Directions for the posttest required the students to apply the given rule by writing the grammatical form for each item. Difficulty of the it-deletion instances was increased by using sentences with the word "it" appearing twice.

Procedure

Programs for the eight treatments in both experiments followed the same format display; general directions, premeasure on verbal comprehension, learning task, and posttest. Students were randomly assigned to one of the eight treatments from the two experiments. Following the general directions, which were read aloud by the experimenter while students read silently, the students were administered an 8-minute, 36-item vocabulary test. They were then directed to turn to the first page of the booklet and follow while the experimenter read aloud specific directions on how to proceed through the program. Students were then directed to turn to the next page in the booklet and begin the task. There was no time limit on the task. When they finished the instructional materials, they continued to the posttest. Students were allowed to return to any part of the instructional section until they began the posttest. The experimental sessions averaged 50 minutes each.

Results

An analysis of covariance was used in both experiments to test the defined research hypothesis. The covariate was a 36-item test measuring verbal comprehension. The tests for homogeneity of regression of within-class and between-class linearity were nonsignificant ($p > .05$). The dependent variable was number of correct responses on the 20-item posttest. A two-way factorial design with two levels for each main effect was used for the data analysis.

Experiment I

For the first experiment the design strategies were: (a) degree of divergence and (b) sequence. The means and standard deviations for the four treatment groups are given in Table 2.

Insert Table 2 about here

The degree of divergence main effect resulted in a significant F-test ($F = 28.33$, $df = 1, 57$, $p < .001$). Although the difference between means (contrasted, $M = 14.2$; matched, $M = 10.9$) was slightly less than four points, student performance was better with instances that had different irrelevant features than with instances that had similar irrelevant features. The sequence effect likewise had a significant difference between the two treatment conditions ($F = 49.12$, $df = 1, 57$, $p < .001$). The two simultaneous groups had a four-point higher performance mean score ($M = 14.7$) than the two random groups ($M = 10.3$).

Two secondary hypotheses were tested between the assumed least effective treatment (matched-random; see Table 1) and the two conditions with one or the other most effective treatment factors (matched-simultaneous and contrasted-random). A least significant difference (LSD) test showed that of the two groups that had matched within rule instances but differing degrees of similarity of irrelevant features between instances of two rules, the matched-simultaneous group had a significantly ($p < .05$) higher correct score mean than the matched-random group. On the second LSD test, controlling the effect of the random presentation of between rule instances, the matched-random group's performance score was again significantly ($p < .05$) lower than the other comparison group, contrasted-random.

Experiment II

The second experiment extended the sequence variable by comparing the simultaneous display of two rules' instances with a successive condition in which each rule was presented separately. The third design strategy variable of the study, analytical explanation, presented additional information which related the relevant features of the rule statement to the stimulus instance. Group means and standard deviations are given in Table 3.

Insert Table 3 about here

Data analysis on the sequence variable showed highly contrasting means significant beyond .001 (F = 205.83, df = 1, 59). The two groups receiving a simultaneous presentation of instances for the two transformational syntax rules had a correct score mean (M = 17.2) of almost double that of the two successive groups (M = 9.1) which had the rules presented separately. In this experiment analytical explanation seemed to have less effect as an instructional variable than the other two design strategies, with a significant F test at the .05 level (F = 4.80). The two main effect means were separated by only a point and a half (with, M = 13.8; without, M = 12.5). However, a LSD test between the two simultaneous groups showed that the students presented with the analytical explanation did significantly ($p < .05$) better than the group without it.

Discussion

Our purpose in this study was to investigate design strategies that would demonstrate acquisition of rules at a mastery level of learning, i.e., the students, when presented with new problems would apply the rules correctly. In addition, we specified treatment programs from the manipulation of the design strategies that were logical representations of instructional methods. The research literature does demonstrate that students learn from instances (see Scandura, 1970). This study, however, investigated a prescriptive set of instructional variables that defined both the conditions for an effective presentation of the stimulus and the appropriate behavioral outcome (see Bruner 1966; Glaser & Resnick, 1972).

The concept research of Tennyson, M. Merrill, and Klausmeier (a complete review of this research is in Klausmeier et al., 1974), and the rule learning work of Scandura and P. Merrill led us to propose that rule learning depends upon the ability of students to recognize the application of the relevant features in newly encountered instances. Instructional procedures were prescribed to focus students' attention on the relevant features of the stimulus instances.

The two degree of divergence conditions, contrasted and matched, indicated that an analysis of the instructional instances is a necessary extension of the conventional task analysis procedures, e.g., Gagne (1970). A task analysis establishes the relevant features of a rule statement (Ehrenpreis & Scandura, 1974) and the parameters of application; an instance analysis provides the selection criteria and the characteristics of the stimulus display. Learning is a result of exposure to a stimulus (Gagne, 1970); the design purpose of an instance analysis is to refine the type of stimulus from which the student learns. Students in the contrasted programs had performance scores averaging over 80%, while the students receiving the matched stimulus instances performed at the 50% level. Since all instances were carefully analyzed, the design strategy of contrasting irrelevant attributes appears to be the prescriptive factor in determining the students behavioral outcome. Furthermore, the contrasting strategy is a deductive learning process where the student applies the rule statement to stimulus properties of uniquely different instances. And, after the instructional stimulus is removed the student applies an inductive process by transferring to new instances (cf. Carroll, 1966). In the matched relationship of instances the deductive process is handicapped by a limited range of exposure to irrelevant features, resulting in a low ability to transfer rule use to newly encountered instances.

Sequencing of rules simultaneously by matching irrelevant features of instances facilitates rule acquisition because the rules are learned in the context of the content structure rather than by single units. Performance results between the two sequence presentations—simultaneous and successive—were striking even though we hypothesized a significant difference. When the two rules were displayed separately, performance was below 50%, an indication that minimal learning occurred, especially when compared with the 86% performance of the simultaneous condition. Because of the structural similarity of the two rules' relevant features, the simultaneous presentation exposed students to the differences between each rule's application. In summary, the simultaneous design strategy met the behavioral objective of rule learning while maintaining the integrity of the context (see Pepper, 1970, for an introduction to contextualism).

The final variable investigated, analytical explanation, was first used in an applied situation when we were selecting instances for a concept learning program and found that for difficult examples it was necessary to write down how the critical attributes were represented in each of those examples. Because of that experience, and from the results of a subsequent research study on concept acquisition (Tennyson, Steve, & Boutwell, 1975), we assumed that in rule learning students who did not understand how the relevant features of a given instance were applied would benefit from receiving additional information. The data analysis showed that the condition with the analytical descriptions resulted in significantly better student performance than the condition without it. However, the observable magnitude of the mean differences indicates that further refinement of the variable is necessary. Continued study of this design strategy should include documentation of the cognitive processes used by authors in the task development itself. Our cumulative research and development experiences show that describing to the student the processes used in deriving the structure of the stimulus materials might be a highly significant variable in instructional design.

Certainly, the results of this study need replication with a variety of subject matters and with other conditions, but when reviewed in reference to the total research effort in concept learning (e.g., the work of Tennyson, M. Merrill, Klausmeier, Davis, and Moore) and rule learning (e.g., the work of Scandura and P. Merrill) the impact on instructional design can be immediate. This extension of the task analysis methodologies to include the analysis, selection, and presentation strategies of the stimulus materials does represent progress towards a prescriptive theory of instruction.

References

Bruner, J. S. Toward a theory of instruction. Cambridge, Massachusetts: Harvard University Press, 1966.

Carroll, J. B. Words, meanings, and concepts: Part II. Concept teaching and learning. In J. P. DeCecco (Ed.) The psychology of language, thought and instruction. New York: Holt, Rinehart, and Winston, 1966.

Ehrenpreis, W. & Scandura, J. M. The algorithm approach to curriculum construction: A field test in mathematics. Journal of Educational Psychology, 1974, 66, 491-498.

Gagne, R. M. The conditions of learning. (2nd ed.) New York: Holt, Rinehart & Winston, 1970.

Glaser, R. & Resnick, L. B. Instructional psychology. In P. H. Musser & M. R. Rosenzweig (Eds.), Annual review of psychology. Vol. 23. Palo Alto, California: Annual Reviews, Inc., 1972.

Guthrie, J. T. Expository instruction versus a discovery method. Journal of Educational Psychology, 1967, 58, 45-49.

Guthrie, J. T. & Baldwin, T. L. Effects of discrimination, grammatical rules, and application of rules on the acquisition of grammatical concept. Journal of Educational Psychology, 1970, 61, 358-364.

Houtz, J. C., Moore, J. W., & Davis, J. K. Effects of different types of positive and negative instances in learning "Nondimensioned" concepts. Journal of Educational Psychology, 1973, 64, 206-211.

Klausmeier, H. J., Ghatala, E. S. & Frayer, D. A. Conceptual learning and development, A cognitive view. New York: Academic Press, 1974.

Merrill, M. D. Content and instructional analysis for cognitive transfer tasks. AV Communication Review, 1973, 21, 109-125.

Merrill, M. D. & Tennyson, R. D. The effect of types of positive and negative examples on learning concepts in the classroom. Washington, D. C.: U.S. Department of Health, Education, and Welfare, Office of Education, Bureau of Research, 1971.

Merrill, M. D. & Boutwell, R. C. Instructional development: Methodology and research. In F. Kerlinger (Ed.), Review of research in education. Itasca, Illinois: Peacock, 1973.

Pepper, S. C. World hypotheses. Berkeley: University of California Press, 1970.

Scandura, J. Role of rules in behavior: Toward an operational definition of what (rule) is learned. Psychological Review, 1970, 77, 516-533.

Scandura, J. M. & Voorhies, D. J. Effects of irrelevant attributes and irrelevant operations on rule learning. Journal of Educational Psychology, 1971, 62, 352-356.

Tennyson, R. D. Effect of negative instances in concept acquisition using a verbal learning task. Journal of Educational Psychology, 1973, 64, 247-260.

Tennyson, R. D., Steve, M. & Boutwell, R. C. Analysis of attribute representation in instances and task sequence in concept acquisition. Manuscript submitted for publication, 1975.

Tennyson, R. D., Woolley, F. R. & Merrill, M. D. Exemplar and nonexamplar variables which produce concept classification behavior and specified classification errors. Journal of Educational Psychology, 1972, 63, 144-152.

Thatcher, D. L. The use of examples and nonexamples in principle learning behavior. Unpublished manuscript, Brigham Young University, 1972.

Traub, R. E. Importance of problem heterogeneity ot programmed instruction. Journal of Educational Psychology, 1966, 57, 54-60.

Table 1

Experiment I: Treatment Programs

Degree of Divergence	Sequence	
	Simultaneous	Random
Contrasted	Page 22	Page 24
Matched	Page 23	Page 25

Editor: Because of the spacing requirements necessary for this table, the four treatment programs are typed separately on the following four pages. The above table identifies the appropriate page number and placement of each treatment program.

Table 1

Experiment I: Treatment Programs

Degree of Divergence	Sequence: Simultaneous
Contrasted	Contrasted Extraposition Rule: *It that she is sick worries me. It worries me that she is sick. It-deletion Rule: *It that she is sick worries me. That she is sick worries me. (Simultaneous) Extraposition Rule: *John wrote it that the car is new is exciting. John wrote, "It is exciting that the car is new." It-deletion Rule: *John wrote it that the car is new is exciting. John wrote, "that the car is new is exciting." (Simultaneous)

Table 1

Experiment I: Treatment Programs

Degree of Divergence	Sequence
	Simultaneous
Matched	[Matched] Extraposition Rule: [Simultaneous] *It that she is sick worries me. It worries me that she is sick. It-deletion Rule: *It that she is sick worries me. That she is sick worries me. Extraposition Rule: [Simultaneous] *It that he is healthy pleases me. It pleases me that he is healthy It-deletion Rule: *It that he is healthy pleases me. That he is healthy pleases me.

Table 1

Experiment I: Treatment Programs

Degree of Divergence	Sequence
	Random
Contrasted	[Contrasted] Extraposition Rule: [Random] *It that she is sick worries me. It worries me that she is sick. It-deletion Rule: *It that the book was lost cost the school $10.00. That the book was lost cost the school $10.00
	Extraposition Rule: [Random] John wrote it that the car is new is exciting. John wrote, "It is exciting that the car is new." It-deletion Rule: *It that the fish were biting added to their success. That the fish were biting added to their success.

Table 1

Experiment I: Treatment Programs

Degree of Divergence	Sequence: Random
Matched	Matched: [Random: Extraposition Rule: *It that she is sick worries me. It worries me that she is sick. It-deletion Rule:] *It that the book was lost cost the school $10.00. That the book was lost cost the school $10.00. [Random: Extraposition Rule: *It that he is healthy pleases me. It pleases me that he is healthy. It-deletion Rule:] *It that the fish were biting added to their success. That the fish were biting added to their success.

Table 2

Experiment 1

Adjusted Correct Score Means and Standard Deviations for Degree of Divergence and Sequence

Degree of Divergence		Sequence	
		Simultaneous	Random
Contrasted	M	17.0[a]	12.5
	S.	2.2[b]	3.4
Matched	M	11.4	9.2
	SD	2.9	3.3

~~[a]Adjusted correct score means~~

[b]Standard deviations

Table 3

Experiment 2

Adjusted Correct Score Means and Standard

Deviations for Sequence and Analytical Explanation

Analytical Explanation	Sequence	
	Simultaneous	Successive
With	18.2[a]	9.4
	2.1[b]	2.6
Without	16.3	8.8
	2.0	3.9

[a]Adjusted correct score means

[b]Standard deviations

Footnote

The authors gratefully acknowledge the extensive reviews of the manuscript by Joseph M. Scandura, Edward C. Caldwell, and C. Victor Bunderson.