

Differential effects of rule-example order as a function of learner Conceptual Level*

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ABSTRACT

To test the Conceptual Level matching model, the concept of "cognitive dissonance" was taught to groups of high school students, matched for sex and school class, but varying in Conceptual Level (CL). Treatments varied in structure from low (Example only) to high (Rule-example). It was predicted from the model that low CL Ss would profit more from increased structure, while high CL Ss would show less effect from treatment variations, but would tend to perform best in low structure. These predictions were clearly supported by a significant CL \times Treatment interaction and mean scores in the predicted pattern.

When summarizing evidence on the general effect of various orders of rule and example in a recent *Annual Review of Psychology*, Anderson stated:

"In summary, the research of recent years on the effects of presenting rules or the effects of the order in which the rules and examples are presented confirms that rule-example procedures produce faster or more error-free acquisition and better retention than other procedures. This result can be regarded as rather well established since it has been obtained across a broad range of tasks by experimenters employing diverse methods." (Anderson, 1967, p. 155.)

The technique of providing the learner with a rule before he is given examples may indeed be generally superior to other procedures; the question remains, however, whether this superiority also obtains across a wide variety of learners, i.e., its differential effectiveness. To take a differential approach means asking different questions and generating principles in a different form. Rather than ask whether one educational approach is generally better than another, one asks "Given this kind of person, which of these approaches is more effective for the given objectives?"

The present study investigated the effect of varying orders of rule and example (e.g., rule-example, example-rule) upon different kinds of

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learners. To present the learner with the rule before he receives examples of the rule would represent generically the advance organizer approach advocated by Ausubel (1968), while the example-first procedure may be considered generically similar to the discovery approach advocated by Bruner (1966). These two treatments may also be considered to vary on a dimension of degree of structure from low (example-first) to high structure (rule-first).

Since these procedures vary in degree of structure, it seemed logical to select a learner characteristic likely to interact with, or respond differentially to, such variation in the structure of presentation. Learner Conceptual Level (Hunt, 1970) was selected because, on both theoretical and empirical grounds, learners low in Conceptual Level (CL) should require a more structured approach than learners high in CL.

CL was originally based on a theory of conceptual development (Harvey, Hunt, & Schroder, 1961) which hypothesized that, under ideal training conditions, a person develops from a low level of conceptual organization in which he is cognitively simple, dependent, and not capable of generating his own concepts, to a higher level in which he is more cognitively complex, independent, and capable of generating his own concepts. More recently, CL has served as the basis for deriving a matching model (Hunt, 1970) which specifies prescriptions for optimal person-environment combinations. This Conceptual Level matching model hypothesizes a relation between structure of presentation and CL on the basis that the low CL person will need more structure because of his relative incapacity to generate concepts, while the high CL person should require less structure since he is capable of generating his own concepts.

The first empirical support for the CL matching model came from a study which investigated the effects of homogeneous classroom grouping; results indicated that high CL students profited more from independent study than from formal instruction while lower CL students profited more from a structured presentation (Hunt, 1966). Construct validity for the model was next obtained from a rather unlikely source, the national evaluation of Project Upward Bound (pre-college enrichment programs for culturally disadvantaged us high school students). When students' gains in attitude and motivation during the summer were considered for possible differential effects, the pattern was exactly as predicted by the model: when the majority of students in a program were low in CL, they gained more when the approach was structured than when the approach was flexible, and when the majority of students in a program were high in CL, they showed the opposite pattern, making greater gains with a flexible approach than with a structured approach (Hunt & Hardt, 1967).

It was also noted that differences in approach affected the high CL student less than the low CL student.

Using a matching model to examine the differential effectiveness of educational approaches is metatheoretically similar to what Cronbach (1967) has called the "Aptitude-Treatment-Interaction" (ATI) approach in which one searches for combinations of learner aptitude and educational treatment which will produce differential effects as revealed in ordinal or disordinal interactions. In both matching and ATI, the results which support differential effects are potentially translatable into a variety of educational decisions and plans, such as individualizing instruction, homogeneous classroom grouping, etc.

Three treatment variations thought to vary in degree of structure were devised: (1) low structure in which the examples were presented first and the rule or principle was presented some time later; (2) intermediate structure in which the examples were presented first followed almost immediately by the rule or principle, and (3) high structure in which the rule, or principle, was presented before the examples in the material. The task, developed specifically for this investigation, required the student to learn the concept of "cognitive dissonance" (Festinger, 1957). Students' concept learning was evaluated in terms of multiple criteria: definition of concept, recall of examples, and production of new examples. Effect of treatments was recorded immediately after the treatment, one day later, and one week later. In addition, students indicated their degree of interest in the task.

The major hypothesis concerned an interaction effect of treatment and CL in which low CL students would profit more from increasing task structure, performing best on high structure, while high CL students would show less effect from variation in treatment, but would tend to perform better under low or intermediate structure.

Since there remains a question of whether a student's interest (or satisfaction) parallels his performance, the interest measure was also considered, both in relation to the concept learning measures and in terms of interactive effects.

METHOD

Subjects

The initial group tested consisted of 160 Grade 11 students in an Ontario high school from which the experimental groups were selected.

Measurement of CL

Each student was given the Paragraph Completion Test (Hunt, et. al, 1968), respond-

TABLE 1
Mean CL scores

CL level	Sex	Treatment			Total
		Example only	Example-rule	Rule-example	
High	Female	2.14	2.18	2.18	2.17
	Male	2.46	2.34	2.34	2.38
	Total	2.30	2.26	2.26	2.27
Low	Female	1.44	1.38	1.48	1.43
	Male	1.16	1.16	1.12	1.15
	Total	1.30	1.27	1.30	1.29

ing to six general topics, e.g. "What I think about rules," "When I am criticized," etc. Each response was then coded for CL on a scale from 0-3 (Hunt et al., 1968). A student's CL score was the average of the highest three scores. All protocols were scored by two raters with a reconsideration of responses on which raters disagreed. Inter-rater reliability for the manual used ranges from .80 to .90.

Formation of CL Groups

Initially, ten students were assigned to each of the twelve cells: structure of presentation (high-intermediate-low) \times Sex (male-female) \times CL (high-low). Initial assignment attempted to equate all high and all low CL groups and to equate all twelve cells on curriculum major within Grade 11. Because the experiment continued over three sessions, several students missed one or more of the sessions. The lowest number of students in the twelve cells who were present at all three sessions was 5; therefore, students in other cells were dropped until there were five in each, such elimination being made to retain the characteristics of the initial groups. Table 1 indicates the mean CL score for each of the experimental groups.

Materials

Rule. Cognitive dissonance was defined by the following rule:

Cognitive Dissonance is a concept used to refer to the state of discomforting tension felt by a person when he experiences a contradiction within himself. This contradiction may be between attitudes or beliefs he holds or decisions he makes; in general a person tries in various ways to reduce any cognitive dissonance he may experience.

Four aspects of the rule were considered for scoring purposes: cognitive elements, contradiction, discomforting tension, and attempted resolutions.

Examples. Several examples of the principle were included in a four-page excerpted narrative which contained a fictional description of two college boys.

Experimental Treatment

Treatments were administered to groups of approximately 30-40 students. (These treatment sessions were conducted during the first three periods of the same day to minimize the possibility of communication.) The three treatments were designed simply to vary the order and timing of the rule and examples as follows:

Rule-examples (High structure). The student first received the rule, which he had to retain for two minutes, and then was given the text containing the examples with instructions to look for examples of the rule (cognitive dissonance) although he did not

have the definition available while reading the narrative. After ten minutes (sufficient for the average Grade 11 student to read the passage twice) the narrative was exchanged for the sheet containing the definition available, the student wrote down the examples of cognitive dissonance he had found in the narrative.

Examples-rule (Intermediate structure). The student was first instructed to read the narrative and "to look for recurring instances of similar types of personal experience." After ten minutes, the narrative was exchanged for the definition, the rest of the procedure being identical to the Rule-example treatment.

Examples only (Low structure). The student in this treatment was allowed ten minutes to read the narrative, with instructions as in Example-rule treatment, but after this he was asked to describe similar types of personal experience of the kind he had noted in the narrative.

Following these variations, all three groups were treated identically. Towards the conclusion of the initial session, the sheets containing the definition were distributed again (although, for students in Examples only treatment, it was the first time), and all students received a short oral exposition of the examples in the narrative, and of the ways in which these met the terms of the definition of cognitive dissonance. Rationale for this "common treatment" was Cronbach's comment "Surely it is good pedagogy to apply a further treatment to the child who fails to discover" (1966, p. 83). Finally, each student was asked to indicate his degree of interest in the experience by responding to a 5-point scale from "very interesting" to "very boring," and to give, in his own words, a definition of "cognitive dissonance."

Post-test Procedure

One-day post-test. On the day following the treatment, students were re-assembled (Session 2) and each was instructed to write the following: (1) definition of cognitive dissonance, (2) examples of the principle from the narrative (text examples) and (3) examples of the principle he could think of besides those in the text, which could involve either himself or others (transfer examples).

One-week post-test. The same procedure was followed one week after the initial treatment (Session 3). At the end of this final session the Wunderlic Personnel Test, Form B was administered to provide a measure of general intelligence.

Scoring Definitions and Examples

Definition. Each definition was scored for the four aspects tested above (0-4). Inter-rater reliability was 95 per cent.

Examples. The same procedure was used in scoring examples, and at each session, a student's score was the highest one received among the several examples. Both text and transfer examples were scored in this fashion.

A composite score was calculated for each one of the three sessions which averaged these three scores for each student. In addition an overall composite score was calculated which was an average of the three sessions' scores.

RESULTS

The effect of intelligence was removed from each cell by means of a linear regression model, and the adjusted scores subjected to analysis of variance (completely randomized, fixed effects model, cf. Guenther, 1964).

TABLE 2

One week post-test scores

CL level	Sex	Treatment			Total
		Example only	Example-rule	Rule-example	
High	Female	2.63	3.07	2.37	2.69
	Male	2.60	2.36	2.37	2.44
	Total	2.62	2.72	2.37	2.57
Low	Female	2.20	2.10	2.86	2.39
	Male	1.67	1.70	2.43	1.93
	Total	1.93	1.90	2.65	2.16
Total		2.28	2.31	2.51	

Composite scores for one-week post-test served as the major dependent variable to test the hypothesis, because it was felt that this was the best indicator of the concept learning which had occurred. These results are shown in Table 2 and Figure 1.

The results of the analysis of variance in Table 3 indicate a significant CL \times treatment interaction. Multiple comparisons among mean group scores for low and high CL in each of the three treatments (collapsing across sex) by means of the Newman-Keuls procedure (Winer, 1962)

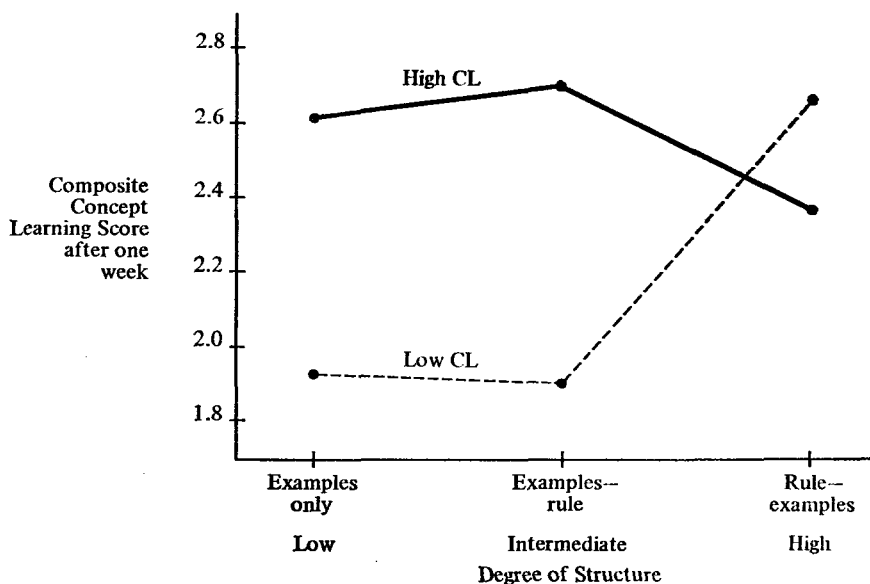


FIGURE 1

Concept learning as a function of rule-example order and learner CL.

TABLE 3

Analysis of variance of one week post-test scores

Source	<i>DF</i>	<i>MSS</i>		<i>F</i>
CL	1	2.4676	**	8.35
Sex	1	1.83297	**	6.20
Treatment	2	0.31333		1.06
CL \times sex	1	0.16634		.56
CL \times treatment	2	1.79523	***	6.08
Sex \times treatment	2	0.15794		.53
CL \times sex \times treatment	2	0.24672		.83
Error	48	0.29548		

** $p < 0.01$.*** $p < 0.005$

indicated that the low CL group in the Rule-example treatment were significantly high ($p < 0.05$) in comparison with both the low CL group in the Example-rule treatment and the low CL group in the Examples-only treatment. No significant differences were found among the three high CL groups, but the high CL group was significantly higher than the low CL group ($p < 0.05$) in both Examples-rule and Examples-only treatments. Although the high CL group was slightly lower than the low CL group in the Rule-example treatment, this difference was not significant.

Table 3 also indicates a CL effect favoring high CL and a sex effect favoring females. When the composite scores which combined immediate, one-day, and one-week post-test scores were considered, the pattern was identical to that in Tables 2 and 3.

Finally, the analysis of variance of the adjusted interest scores revealed only a very complex sex \times treatment interaction effect. No relation was found between interest and any of the dependent variables.

DISCUSSION

The results of the present study emphasize how important it is to consider the differential effectiveness of educational procedures upon different kinds of learners. Following Cronbach's (1966) comments, it is clear that the short-term nature and the restricted content area of the present study require us to exercise considerable restraint in drawing any educational implications from these results. Nonetheless it is suggested that some of the disagreement between "conflicting" educational theories might be resolved, and the effect of the theoretically-derived treatment better understood, if considered in terms of differential effectiveness.

The fact that interest scores neither related to any of the dependent variables nor followed the pattern expected in the matching hypothesis

may have been due to the method of assessing interest, which was very simple. In any case, the relation between affective and cognitive measures requires much more intensive investigation. The main effect of CL was anticipated because of the cognitive nature of the dependent variable; the sex effect was not anticipated, and may reflect the interpersonal nature of the material (cf. Tomlinson, 1969).

Two final conclusions seem warranted: First, attempts to answer questions regarding which of two educational approaches is most generally effective (e.g. rule-example vs example-rule, discovery vs expository) are likely to be unproductive unless they take account of differential effects both in terms of learner characteristics and the measure of educational achievement. Second, the CL matching model shows sufficient promise to warrant expanding the investigation of matching effects to the consideration of longer-term procedures involving a variety of content areas.

RÉSUMÉ

Examen du modèle de pairage du niveau conceptuel, par une technique consistant à enseigner le concept de dissonance cognitive à des groupes d'étudiants (niveau secondaire) jumelés quant au sexe et à l'année scolaire mais de niveau conceptuel (CL) différent. L'expérience comporte une condition de degré structural (faible : exemple seulement, ou fort : règle-exemple). La prédiction faite à partir du modèle voulait que les sujets de faible CL profitent davantage d'un accroissement structural alors que les sujets de fort CL soient moins affectés par les conditions expérimentales mais tendent à mieux réussir dans la condition de faible structuration. La prédiction se confirme nettement, comme le montrent l'interaction significative CL \times traitement expérimental et les résultats moyens dans le pattern prévu.

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