

THE EFFECT OF COGNITIVE STYLE ON READING AND WRITING IN SCIENCE MATERIALS

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In recent years language researchers have given increasing attention to exploring a number of variables associated with the reading and writing processes. In particular, Bruce, Collins, Rubin, & Genter (1978); Flower (1979); and Flower & Hayes (1977) have examined certain cognitive variables associated with the writing process, attempting in their studies to characterize cognitional relations between reading and writing. Atwell (1980) and Shanklin (1981) have gone so far as to assert that the same cognitive variables underlie both the reading and writing processes. The study reported here attempted to shed light upon this area of inquiry by examining the effect of one cognitive dimension upon the discourse processing operations involved in reading and writing, that of cognitive style.

Santostefano, Rutledge, & Randall (1965) characterize cognitive style as . . . "When perceiving, an individual's cognition is active, not passive, selecting, sorting and organizing information according to particular system principles which are influenced by motivational and personality factors" (p. 58). One inference that may be drawn from the concept of cognitive style is that the manner in which individuals process discourse in reading and writing will necessarily be influenced by their own stylistic patterns of cognition.

Field dependence-independence is one dimension of cognitive style that may influence how individuals process discourse. It refers to the characteristic modes of functioning which individual demonstrate in their cognitive activities. Witkin, Moore, Goodenough, & Cox (1977) described field-dependent persons as individuals who have difficulty with problems whose solutions depend on taking some critical element out of the context in which it is presented and restructuring it in some alternative way. Field-dependent persons tend to use a field as they find it, to make less use of surrounding information in processing a problem, and to have more difficulty in analyzing it. They experience separate parts of a perceptual field as fused; i.e.,

they are unable to differentiate parts from the total organization. On the other hand, field-independent persons are able to experience elements of a total organization as separate entities and are more likely to depart from the context of a given problem to generate a solution in an analytical, problem-solving fashion.

Of particular relevance to the present study is previous research carried out by Kagan (1980) and Spiro and Tirre (1979) which examined the correspondence between field dependence-independence and reading and writing. In a study using community college students, Kagan (1980) found that field dependence-independence correlated significantly with syntactic complexity. Specifically, she found that field-independent subjects were better able to embed coordinations and clauses within sentences and wrote significantly longer sentences than their field-dependent counterparts. Kagan concluded that field dependence-independence was clearly associated with the ability to manipulate language effectively.

Spiro & Tirre (1979), again using college students, examined the relation between field dependence-independence and subjects' ability to recall information from text. They found that field-independent subjects were better able to recall text by selectively applying relevant schemata to the text passages. Spiro and Tirre concluded that field dependence-independence is associated with the ability to capitalize on prior knowledge to increase recall of information, particularly when required to separate certain aspects of the text from the total context.

Birnbaum (1980) suggested the possibility that cognitive style is also related to differences observed in the rate of processing and reporting information in a study examining the composing and reading behaviors of fourth and seventh grade students. Therefore, the present study was undertaken to verify this suggestion and to extend the findings of Kagan (1980) and Spiro and Tirre (1979) to public school students. The major guiding question of this study was: To what extent can the character of a person's discourse processing operations be predicted by cognitive style? More specifically, the following research questions were posed:

- 1) To what extent does the measured level of field dependence-independence predict the syntactic complexity of written discourse?
- 2) To what extent does the measured level of field dependence-independence predict readers' engagement with text as reflected by the quality of the semantic content of their written recall of textual materials?

METHOD

Subjects

Subjects were 70 eighth-grade students from a school district in the Southeastern United States. Drawn from a predominantly middle socioeconomic population, the sample included approximately an equal number of blacks/whites and male/females. All subjects were considered to be good readers (70% or better national percentile) for their grade placement according to results of the *California Achievement Test*, Form 17C (1977).

Instruments

Field dependence-independence was measured by the *Group Embedded Figures Test* (GEFT). The GEFT (Oltman, Raskin, and Witkin, 1971) is a timed, group administered test consisting of 18 items which require test-takers to disembed figures from a field. The GEFT classifies individuals as field-independent or field-dependent according to the total number of correct responses.

To obtain samples of subjects' writing with science materials, O'Donnell and Hunt's *Aluminum* paragraph (Hunt, 1970) and Smith's *Bee* paragraph (Smith, 1972-73) were used. These passages were used to minimize syntactic variance attributable to content. Each paragraph consisted of a number of short, choppy kernel sentences. Subjects were directed to rewrite

the paragraphs, making it better and leaving out no information. Words could be added or omitted at the writer's discretion.

To obtain samples of subjects' recall, the eighth grade prototypes of the *Aluminum* and *Bee* paragraphs (Smith, 1971; 1972) were used. These paragraphs were written according to the data derived from Hunt (1970) and were typical of the syntactic characteristics exhibited by average eighth-graders. Thus, the difficulty level of these paragraphs insured that reading ability was not a factor in measuring recall. Subjects were directed to read the paragraphs and try to remember everything they could about it. Then they were asked to write down all they recalled, not worrying about spelling, punctuation, or grammar.

Procedure

Subjects were administered the GEFT to determine field dependence-independence. Those scoring between 1 and 9 were classified as field-dependent; those scoring between 10 and 18 were classified as field-independent. Scores ranged from 1 to 18. Two groups of 35 subjects resulted from the GEFT administration.

Both field-dependent and field-independent subjects were randomly assigned to one of two groups. One group was given the *Aluminum* passage to reconstruct in writing followed by the *Bee* passage to read and recall. In order to counterbalance for passage effect, the second group was given the *Bee* passage to reconstruct in writing followed by the *Aluminum* passage to read and recall. Thus, the first group consisted of 17 field-independent subjects and 18 field-dependent subjects. The second group consisted of 18 field-independent and 17 field-dependent subjects. Total data collection took approximately 60 minutes in two sessions.

Syntactic complexity of subjects' writing was determined by using the *Syntactic Density Score* (SDS) developed by Golub and Kidder (1974). This called for analyzing the texts for the presence of ten sentence variables, tabulating their frequency of occurrence, and computing them according to a weighted formula.

In order to provide a model against which to compare subjects' recall protocols, a template text base was prepared for each passage according to procedures detailed by Turner & Greene (1977). Each protocol text base was scored by comparing it to its template text base and examining it for the degree of similarity of recalls. Propositions of each protocol text base were then identified as either text reproductions, which repeated propositions in the template text base, or reader-based inferences, which were thematically related to the topic but possessing no other connection to it. Frequency of both text reproductions and reader-based inferences were tabulated.

Data Analysis

Data obtained were first analyzed using *t*-tests to examine differences between field-dependent and field-independent subjects in their performance on the two passages. No significant differences were found in the performance of field-independent subjects in syntactic complexity, text reproductions, and reader-based inferences on either the *Aluminum* or *Bee* passages. On the other hand, significant differences were found in the performance of field-dependent subjects on syntactic complexity only ($t(17)=2.32, p < .05$) for the passages.

Statistically significant differences were also found between field-independent and field-dependent subjects on syntactic complexity across groups. Field-independent subjects produced syntactically more complex reconstructions of both the *Aluminum* and *Bee* passages ($t(17)=3.46, p < .01$; $t(17)=2.26, p < .05$) than their field-dependent counterparts.

Data were then analyzed using a stepwise regression analysis. Results of this analysis revealed that performance on the GEFT was significantly related to syntactic complexity ($F(1/68)=$

15.04, $p < .001$), accounting for 18% of variance. Zero-order correlations, showed significant correlations between GEFT score and total number of words ($r=.37, p < .01$), total number of *t*-units ($r=.45, p < .0001$), main clause length ($r=.33, p < .01$), and number of unbound modifiers ($r=.31, p < .01$). Performance on the CAT also was related to syntactic complexity ($F(2,67)=9.79, p < .001$), accounting for an additional 5% of the variance. Thus, the best predictor of performance in manipulating language structures was found to be the GEFT score. A significant correlation was also found between the GEFT score and number of text reproductions indicating that field-independent subjects recalled more text propositions than field-dependent subjects ($r=.28, p < .05$).

DISCUSSION

The most significant finding resulting from this study is that field-independent individuals have an advantage over field-dependent individuals in their ability to deal with the structures of language. The ability to utilize subordinate language structures may be analogous to disassociating a figure from a complex field.

The findings of this study with eighth grade students show some similarity to the findings of Kagan (1980) with college level students. Field-independent subjects, regardless of grade level, seem better able to write significantly longer and syntactically more complex sentences than their field-dependent counterparts. However, while Kagan found that field-independent college students generated more clauses per T-unit, longer subordinate clauses, and a higher frequency of T-unit coordinations (use of *and* within the T-unit), field-independent eighth grade field-independent subjects showed more facility with unbound modifiers, while Kagan's college subjects did not. It may well be that college level field-dependent students have achieved sufficient facility with unbound modifiers through maturation to diminish such differences. This possibility could be tested through a training study using younger field-dependent subjects.

No differences were found in field independent subjects' performance on syntactic complexity across the two passages. However, differences were found with field-dependent subjects. This differential performance could be explained by assuming that field-dependent individuals do not process and restructure text as readily as field-independent individuals. A more plausible explanation is that field-dependent individuals will process text differently depending upon the amount of prior knowledge they bring to the restructuring situation. Field-dependent subjects, apparently possessing more prior knowledge about bees than aluminum, are more readily able to utilize that knowledge in developing more complex syntactic structures. This concurs with the evidence supplied by Spiro & Tirre (1979) that field-dependent subjects less readily apply prior knowledge to textual situations.

This evidence also applies to the finding of this study that field-dependent individuals were able to produce more text-based propositions in recall. Additionally, such individuals, by definition, are more able to disassociate propositions from the total context for recall purposes than are field-dependent subjects.

Finally, performance on the GEFT seems to be a much better predictor of performance in manipulating language structures than either reading achievement or language achievement as measured by standardized tests. The data suggest that is not sufficient to examine reading or language achievement scores and conjecture about quality of writing performance. Field dependence-independence is a more reliable predictor of writing maturity.

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