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ABSTRACT

A study focused on how the writer's knowledge of the language and use of a prewriting strategy for planning ideas affect the quality and efficiency of the writing. Three hypotheses were developed about how knowledge and strategy might influence writing performance: (1) independence (predicts that knowledge and strategy will independently improve writing performance); (2) compensation (contends that content or knowledge and tactics or strategy are two paths leading to the same destination); and (3) enabling (postulates that knowledge and strategy interact, but not in a compensatory manner). College students were given writing problems (adapted from the Law School Admissions Test) that called for analytic thinking and informative writing. Judges then rated the documents for content quality and style quality. The conclusions of the analysis showed that: the results best conform to the independence hypothesis; outlining, but not clustering, is an effective prewriting strategy; and outlining improved the quality of written documents and enhanced the fluency of language production during drafting. (Eight figures and two tables are included, and 15 references are appended.) (MS)

Knowledge and Strategy in Writing

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I am interested in the relation between knowledge and cognitive strategies in intellectual tasks. Studies of problem solving have demonstrated the value of possessing a high degree of domain specific knowledge (Larkin, 1985). Other studies have emphasized the value of using cognitive strategies, such as means end analysis, in solving problems (Atwood & Polson, 1976). Previous work has not settled whether knowledge and strategy exert independent influences on thinking performance or whether they interact in some fashion. In my presentation today, I will suggest that examining the potential interaction of knowledge and strategy is central to cognitive psychology and applications in cognitive process instruction, and I will present relevant data from a writing task that seems well suited for the study of this issue.

Having a college student write an informative essay strikes me as an excellent task for studying the potential interaction of knowledge and strategy. The complex processing required by writing makes it a good if not prototypical example of thinking and intelligent behavior (See Figure 1). Collecting involves reading, experiencing, and storing information for future use. Planning text

involves creating sophisticated concepts, organizing the tangled web of relations among these concepts and setting goals about the genre, style, and tone to be achieved in a document. Language production or translation of one's plans into a form that communicates with others is obviously also involved. Finally, writing calls for constant review and revision of the mental and physical products of thinking. It seems that these elements of collecting, planning, translating, and reviewing are characteristic of intellectual tasks in general.

Insert Figure 1 about here

Another advantage to studying writing in pursuit of a theory of human intelligence is that it is methodologically handy. Knowledge of language, topic, or audience (Applebee, 1982) can be manipulated, as can prewriting, drafting, or revising strategies. Thinking performance can be measured in terms of both the quality of the written product and the efficiency of the composing process.

The present study focused on how the writer's knowledge of the language and use of a prewriting strategy for planning ideas affected the quality and efficiency of writing. College students who scored either high or low on the verbal component of standardized achievement tests were assigned to one of three prewriting conditions: control, cluster, or outline. The control subjects employed no prewriting

strategy; they began composing their essays immediately after receiving the topic. The cluster subjects spent 10 minutes of prewriting time using a technique called clustering (Rico, 1983), in which they brainstormed, jotted down ideas, circled the ideas, and drew links between related ideas. The resulting cluster was a network representation of their writing plans. The outline subjects spent 10 minutes working on a standard hierarchical outline for their writing plans. Recent research has shown outlining to be an effective strategy (Kellogg, in press), previous studies have not examined clustering. All subjects then composed a short informative essay in 30 minutes. Writing efficiency was examined by analyzing the number of words composed per minute and writing quality was assessed by looking at ratings provided by independent judges.

I now turn to my three hypotheses about how knowledge and strategy might influence writing performance. Each hypothesis reflects a different view of how intelligence guides thinking skill in general. For ease of communication I label these hypotheses with three adages: 1) The more, the better; 2) All roads lead to Rome; and 3) The rich get richer. I wish to explain each hypothesis briefly before presenting my results.

The More, the Better: The Independence Hypothesis

The basic assumption of the independence hypothesis is that the more intellectual resources an individual can bring to bear on a task, the better his or her performance should be. Raymond Nickerson (1981), David Perkins (1987) and

others have characterized intelligence and thinking skills in terms of at least three dimensions. Intelligence as content or knowledge refers to the role of domain specific knowledge in thought. Intelligence as methods or tactics refers to the role of strategies in retrieving and applying knowledge to a given intellectual problem. Finally, intelligence as power refers to the neurological fitness that underlies speed of encoding, pattern matching and other basic cognitive components. Intelligent performance may best be viewed as an additive function of these. The present study tests part of this formulation. The more, the better hypothesis predicts that knowledge and strategy will independently improve writing performance (See Figure 2).

Insert Figure 2 about here

All Roads Lead to Rome: The Compensation Hypothesis

This hypothesis contends that content or knowledge and tactics or strategy are two paths leading to the same destination. Either one or the other path can lead to good writing performance, according to this view (see Figure 3); but there may be little gained in traveling both paths. Verbal protocol studies of problem solving in physics have suggested that novices show more controlled problem solving strategies than do experts (Simon & Simon, 1978). Experts appear to draw on their extensive knowledge base and produce a solution automatically. In absence of this extensive

knowledge, novices may compensate through strategy use. In contrast to the additive formulation of intelligence, the all roads lead to Rome hypothesis suggests that one aspect of intelligence can compensate for another aspect. From a practical standpoint it would make sense to instruct low knowledge students in the use of strategies, but high knowledge students would not need such tactics as an aid to good writing.

Insert Figure 3 about here

The Rich get Richer: The Enabling Hypothesis

The enabling hypothesis also postulates that knowledge and strategy interact, but not in a compensatory manner. Rather it assumes that a knowledgeable writer has much more to gain by using a strategy than a non-knowledgeable writer (see Figure 4). Developmental studies in reading (Brown, 1980) and memory (Chi, 1985) show that children who lack sufficient knowledge do not use strategies effectively. Employing a strategy may fail in the absence of a strong knowledge base that serves to prime or enablize the use of a strategy. Only when a writer has a strong knowledge base on which to draw in developing the ideas in an outline will the strategy be beneficial. Thus, the rich get richer hypothesis holds that knowledge or content is primary, but that strategy use can further enhance the intelligence of those already highly knowledgeable. From a practical standpoint one must first teach knowledge and then add strategies.

Insert Figure 4 about here

Method and Results

Before describing the outcome of the study a brief word about methodology is in order. The median percentile score on the ACT English test (n = 117) or the SAT Verbal test (n = 32) was used to assign college students to knowledge conditions. Those who scored equal to or less than the 71st percentile were considered low and those greater were regarded as high in linguistic knowledge. The students were randomly assigned to one of the three prewriting conditions, which resulted in approximately an equal number of subjects in each of the six conditions of the experiment. Two writing tasks were used with about half of the subjects in each condition receiving one or the other. Both writing problems were adapted from the Law School Admissions Test (Bobrow, 1979) and called for analytic thinking and informative writing. Shown in Figure 5 is one of the problems used.

Insert Figure 5 about here

Two paid judges rated the documents for (1) content quality, which included idea development, organization, effectiveness of communication, and (2) for style quality, which included word choice, sentence structure, spelling, and grammar. They also rated the quality of the ideas included

in the prewriting plans generated in the cluster and outline conditions. All ratings were made on 7-point scales, with 1 equal to poor and 7 equal to excellent. The number of words included in the essay was counted and words composed per minute (WPM) was computed by dividing this number by 30 minutes, the total time allowed for composing. The quantity of ideas included in prewriting plans was also examined.

Data from the anti-greed and school sports writing tasks were combined in all analyses reported here. As expected from previous research, reliablity coefficients showed a moderate but significant degree of inter-judge agreement for the ratings of prewriting ideas, document content and style. The mean rating of the two judges was used in all analyses presented here.

Insert Table 1 about here

Table 2 presents the mean ratings for content and style, as well as other data, for the six groups of the experiment. An analysis of variance (ANOVA) on the content ratings revealed a significant main effect of prewriting strategy, $F(2, 143) = 3.12$, $p < .05$, and a marginally significant main effect of verbal knowledge, $F(1,143) = 3.35$, $p < .07$, $MSe = 1.05$, for both effects. Subjects in the outline conditions ($M = 5.5$) wrote higher quality essays in terms of the ideas expressed, the organization, and other content matters than those in the both the cluster ($M = 4.9$)

and control conditions ($\underline{M}$ = 5.0). The high verbal subjects ($\underline{M}$ = 5.2) tended to achieve higher content ratings than low verbal subjects ($\underline{M}$ = 4.9). In contrast, an ANOVA on the style ratings revealed significant main effects for both prewriting strategy, $\underline{F}(2,143) = 6.97$, $\underline{p} < .001$, and verbal knowledge, $\underline{F}(1,143) = 7.11$, $\underline{MSe} = 0.99$ for both effects. The outline strategy ($\underline{M}$ = 5.4) again proved more effective than either the cluster ($\underline{M}$ = 4.7) or no strategy control ($\underline{M}$ = 4.7), which were equal. The high verbal subjects ($\underline{M}$ = 5.1) showed better style ratings than did the low verbal subject ($\underline{M}$ = 4.7). Note that there were no significant interactions for either the content or the style ratings.

Insert Table 2 about here

Summing the style and content ratings provides an overall measure of document quality and these data are presented in Figure 6. An ANOVA revealed a sigificant main effect of prewriting strategy, $\underline{F}(2,143)$ 7.78, $\underline{p} < .001$, and of verbal knowledge, $\underline{F}(1,143) = 4.43$, $\underline{p} < .05$, $\underline{MSe} = 3.20$ for both effects. The interaction of prewriting strategy and verbal knowledge was nonsignificant. To summarize the quality ratings, prewriting strategy and verbal knowledge produced independent effects as predicted by the more is better hypothesis. The rich did not get richer and all roads did not lead to Rome in these analyses. Also, outlining proved to be the only effective strategy investigated.

Insert Figure 6 about here

The number of words added and deleted as the document progressed to the final draft were analyzed but no statistically significant effects were obtained (see Table 2). The total number of words in the finished essay are also shown in Table 2. An ANOVA revealed only a significant main effect of prewriting strategy, $F(2,143) = 12.19$, $p < .001$, $MSe = 8212.19$, with the outline subjects turning in longer essays ($M = 412.7$) than cluster ($M = 332.4$) and control ($M = 330.6$) conditions. Because writing time was constant at 30 minutes, this result indicates that outlining improved the efficiency of the drafting process.

Figure 7 shows this drafting efficiency effect in terms of WPM of writing time. Although outlining appeared to affect drafting efficiency as well as quality, note that verbal knowledge had no signficant impact on efficiency. The two factors also failed to interact; the tendency for low and high verbal subjects to differ chiefly in the control condition was nonsignificant. Before concluding that outlining helps writers to finish the task faster it must be remembered that writing time does not include the 10 minutes of prewriting time used by those in the outline and cluster conditions. Figure 8 plots WPM based on total time, writing plus prewriting. Viewed this way the control and outline conditions were about equally efficient overall and were both

superior to the cluster condition. An ANOVA and follow-up tests (Tukey's a) bore out this pattern, $F(2,143) = 13.67$, $p < .001$, $MSe = 6.52$.

Insert Figures 7 and 8 about here

In summary, outlining hastens the drafting process but is no more efficient overall compared to no prewriting strategy. Clustering, on the other hand, is actually less efficient overall than not engaging in a prewriting strategy. With regard to overall efficiency, then, none of the three hypotheses were supported.

The prewriting plans were analyzed for quantity and quality of ideas. Any circled item in a cluster and any main or subpoint in an outline was tallied as one idea, regardless of the number of words used to express it. Table 2 presents the means for the cluster and outline conditions. An ANOVA indicated that the subjects who clustered ($M = 18.4$) produced more ideas in their prewriting plans than those who outlined ($M = 15.3$), $F(1.96) = 6.97$, $p < .01$. Verbal knowledge had no effect and knowledge and strategy failed to interact. The ratings of quality of ideas expressed showed no differences among conditions. Thus, the only benefit associated with clustering is that a greater number of ideas were generated during prewriting.

Discussion

Allow me to summarize the main results. High verbal college students wrote better essays than low verbal

students, with the difference appearing primarily in the style of writing, such as word choice, sentence structure, spelling, and mechanics, rather than in the ideational content of the document. Outlining but not clustering proved to an effective prewriting strategy that enhanced both the style and content of the documents. Verbal knowledge had no impact on the writer's efficiency as measured by words produced per minute of writing time. The subjects who outlined appeared most efficient at drafting. However, after adding in the prewriting time required by outlining and clustering, the no outline and outline conditions were about equally efficient overall and both were superior to the cluster condition.

There are three conclusions that I wish to draw from these findings. First, the results best conform to the more is better or independence hypothesis. Document quality was independently affected by knowledge and strategy. The absence of independent effects for writing efficiency suggest that more is not always better--it depends on the aspect of thinking performance that is being measured. Nevertheless, the general notion that intelligence represents a sum of knowledge and strategy finds support in the present study. No measure of writing performance yielded a significant interaction of knowledge and strategy.

The results were not encouraging for the compensation and enabling hypotheses, but they should not be taken as definitive evidence that all roads do not lead to Rome or

that the rich do not get richer. Manipulations of other types of knowledge, such as knowledge of the writing topic, and other types of strategies, such as composing a rough versus a polished first draft, may or may not support the independence hypothesis. Other intellectual tasks such as puzzle solving, game playing, or decision making may prove more favorable to the notion that knowledge and strategy interact.

Nevertheless, if further research broadens support for the hypothesis that knowledge and strategies independently influence thinking performance, then the implications for cognitive process instruction seem clear. Teaching low knowledge students strategies as compensation would not put them on equal footing with high knowledge students. In contrast, teaching strategies only to students who have been enabled by a high degree of knowledge to use them effectively would also be inappropriate. Both high and low knowledge students can be expected to gain equally from instruction in strategy usage.

The second conclusion to be drawn is that outlining but not clustering is an effective prewriting strategy. Rico (1983) has argued that the reliance on visual network representations and the emphasis on brainstorming in the clustering strategy should lead to enhanced creativity in writing. My results showed that clustering did enhance ideational fluency during prewriting but carried no other benefits. In contrast outlining improved the quality of written documents, and enhanced the fluency of language

production during drafting.

The outlining effect runs counter to the recent theoretical emphasis on writing as a recursive, nonlinear process (Flower & Hayes, 1980; Elbow, 1981, Horton, 1982). Although collecting, planning, translating, and reviewing often do interweave, the outlining effect shows that it can be beneficial to concentrate on developing a hierarchical writing plan during prewriting. Other research of mine in press indicates that the benefits of outlining are due to the writer being able to focus processing time predominately on translating ideas into text during drafting. The need to juggle several processes during drafting is lessened when a writer outlines during prewriting and this benefits writing quality (Kellogg, in press).

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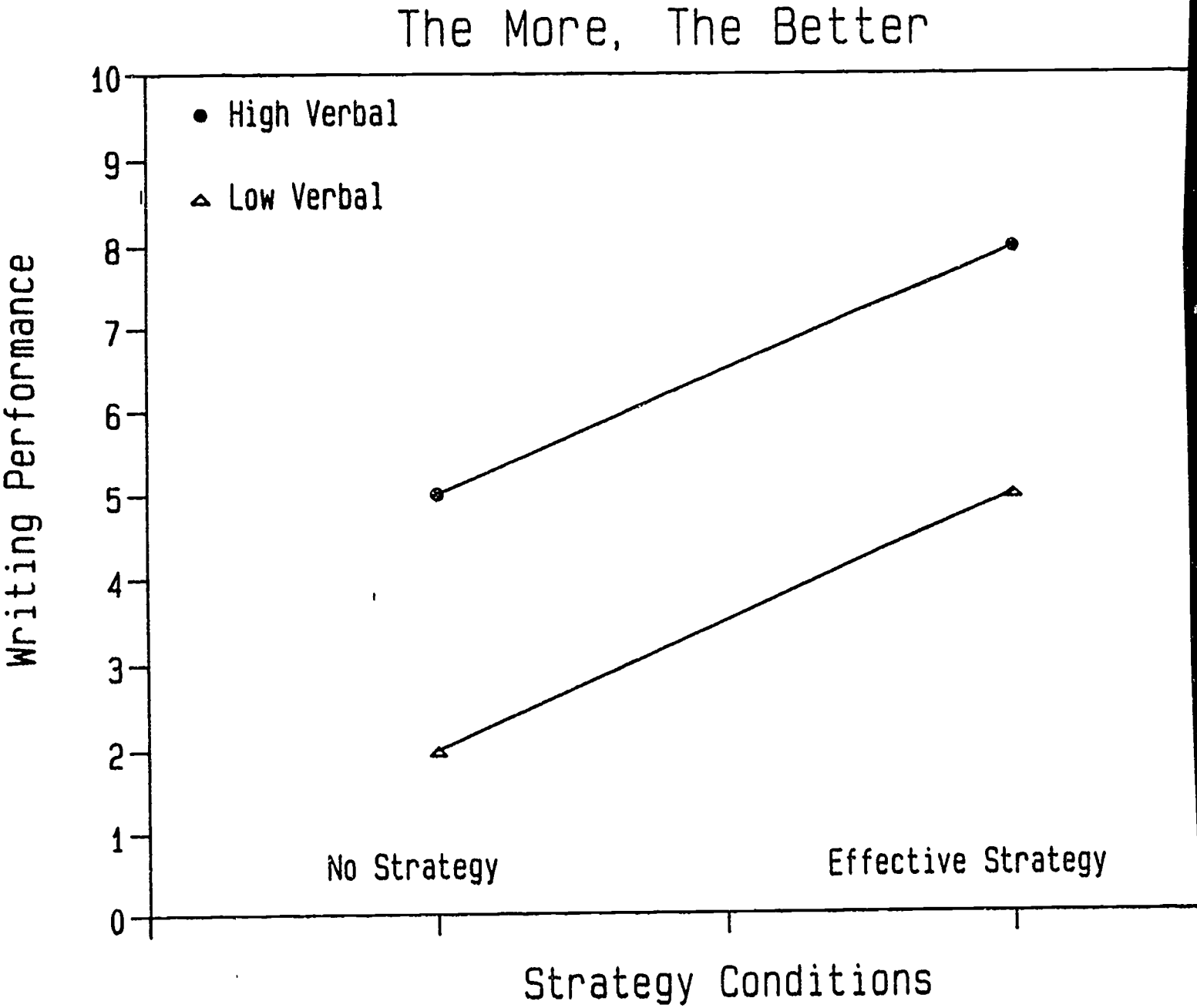
Collecting - reading, listening, searching bibliographic sources
Planning - creating, organizing, setting goals
Translating - actual language production
Reviewing - reading, evaluating, editing errors


The More, The Better
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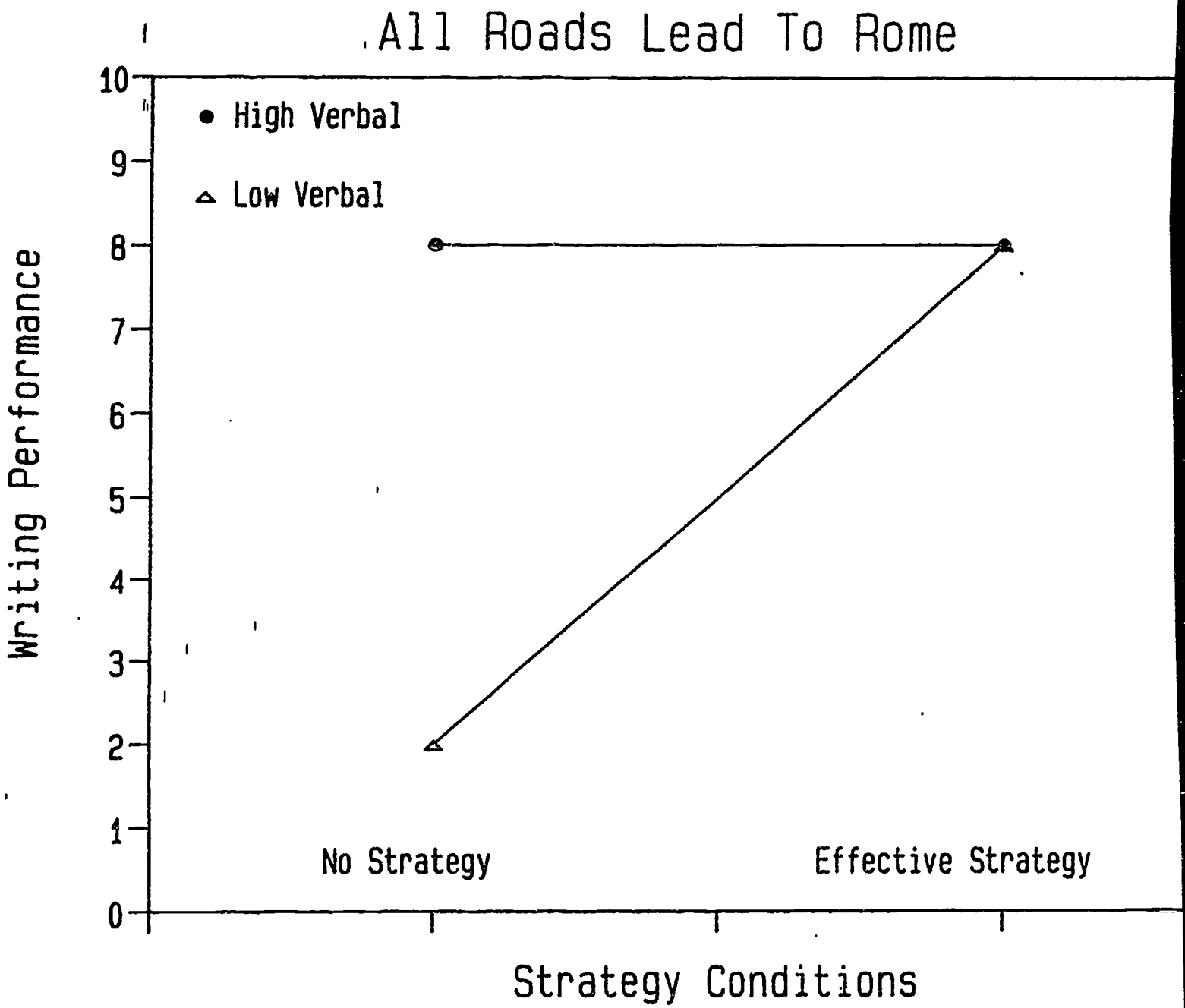
High Verbal
Low Verbal
Writing Performance
No Strategy
Effective Strategy
Strategy Conditions


All Roads Lead To Rome
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High Verbal
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Writing Performance
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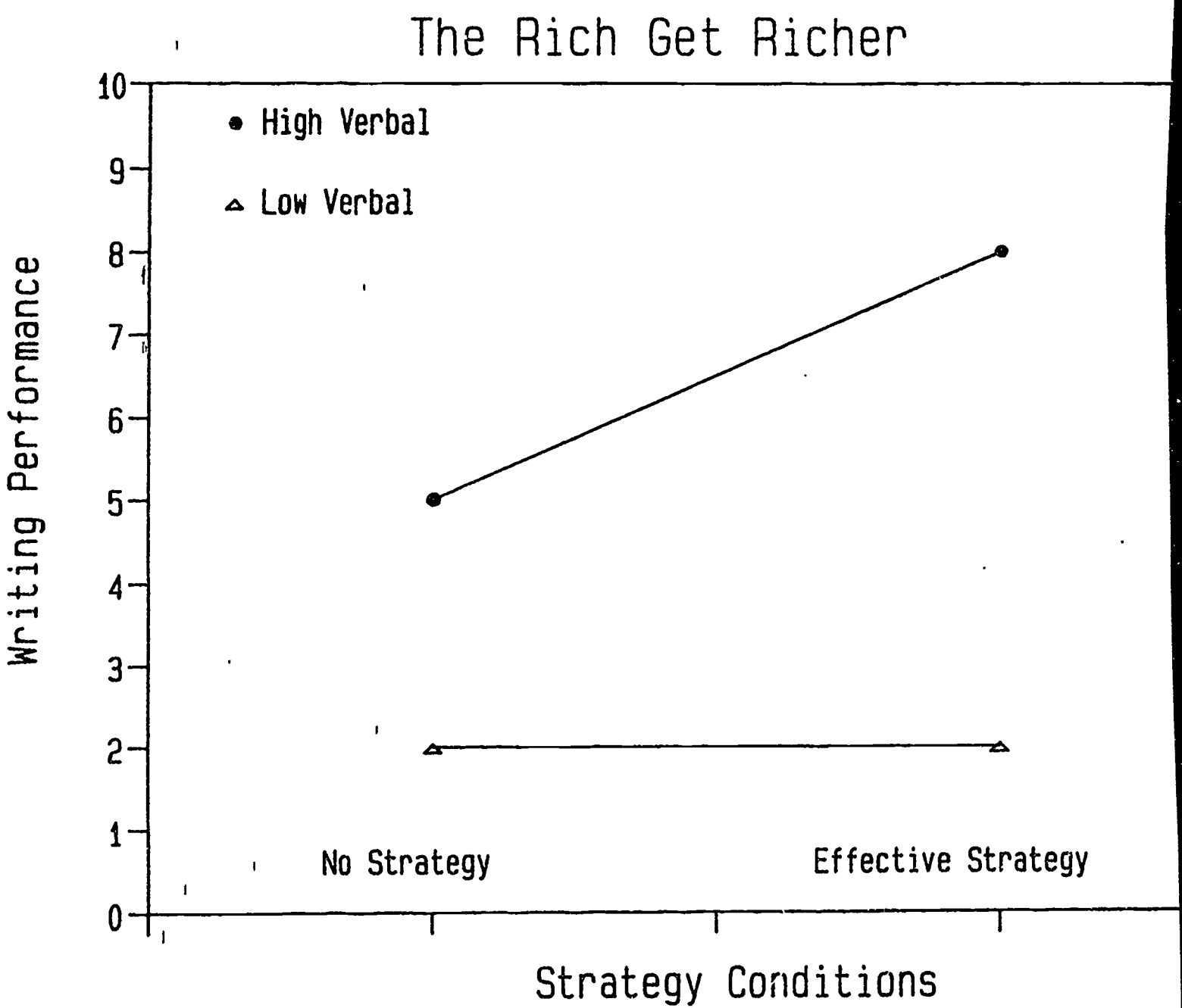
Effective Strategy
Strategy Conditions


The Rich Get Richer
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High Verbal
Low Verbal
Writing Performance
No Strategy
Effective Strategy
Strategy Conditions

Figure 5

WRITING TASK:

Faced with budget cuts, your local high school is considering the elimination of competitive sports from its curriculum. The school officials argue that competitive sports foster unhealthy aggression in team members. To help the school board make this decision in a rational fashion, write a paper presenting both the positives and negatives of competitive sports in school. Try to present both sides of the issue as fully and as fairly as you can, regardless of the position you personally would take.

Table 1.

Inter-judge Reliability Coefficients for Quality

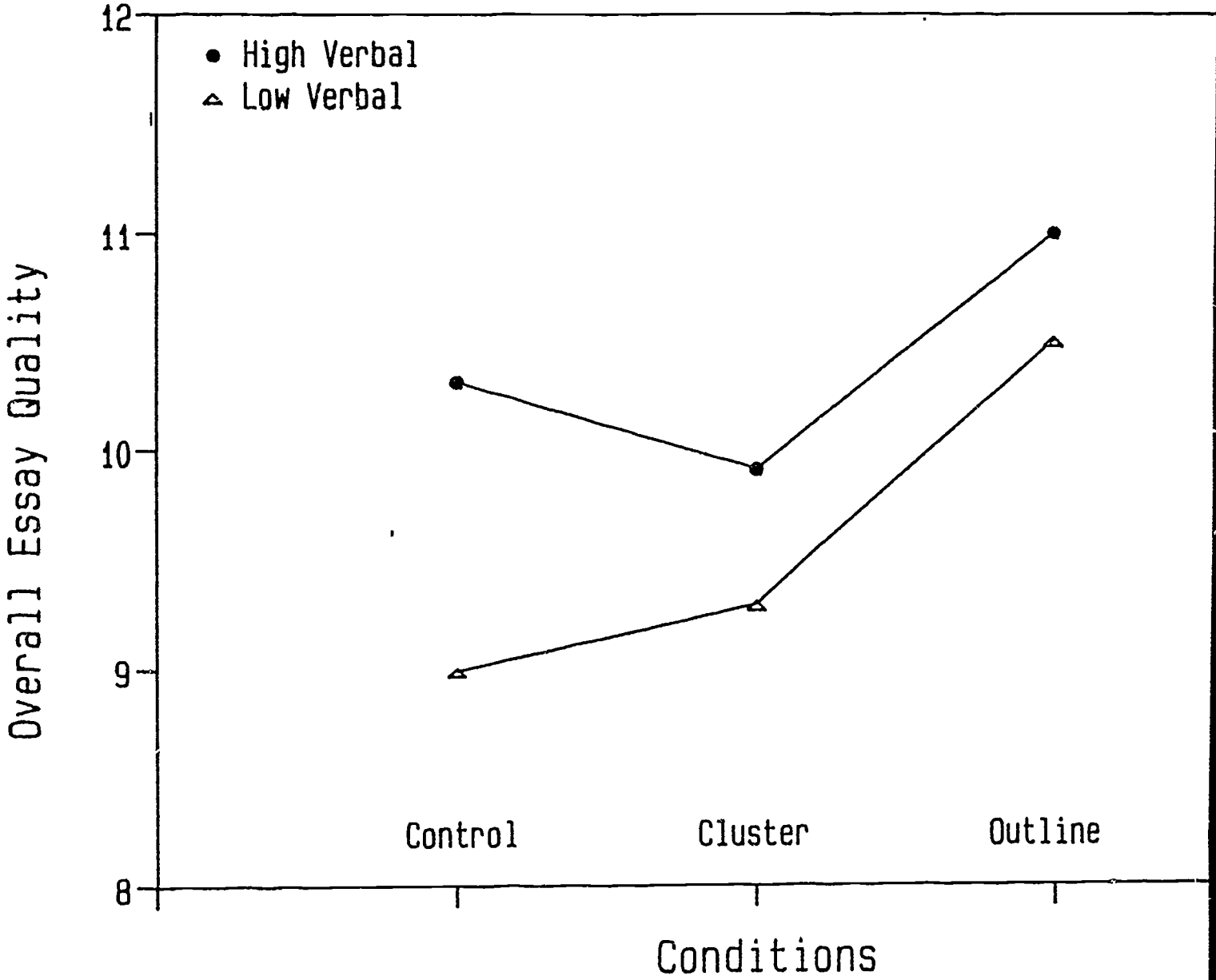
Measure	Pearson's r
Prewriting Ideas	.67
Document Content	.45
Document Style	.51

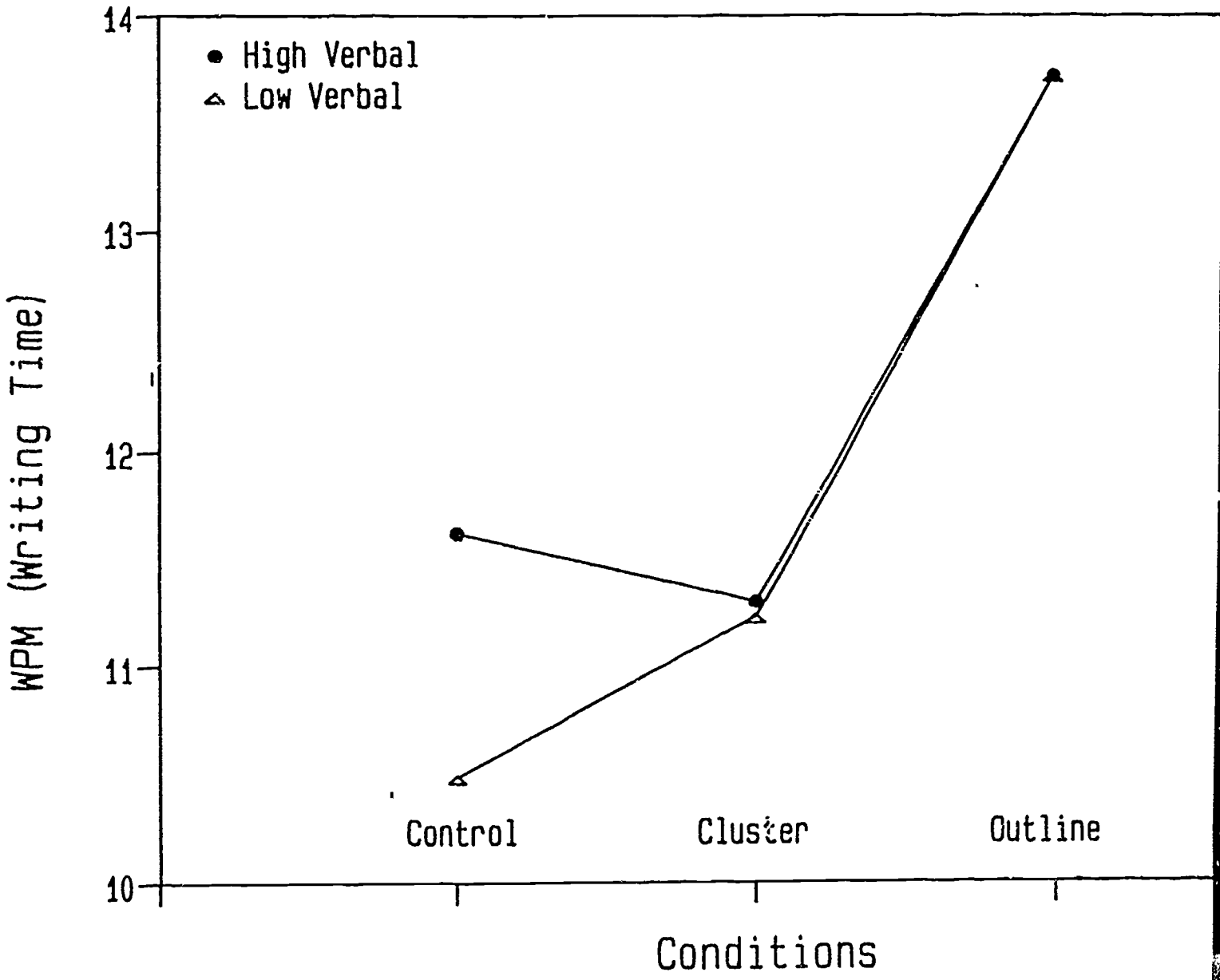
Note. All coefficients are significant, $p < .001$, $df = 147$.

Table 2

Means Scores on Measures of Writing Performance

Condition	Measure						
	Content Quality	Style Quality	Words Added	Words Deleted	Total Words	Prewriting Ideas	Prewriting Quality
High Verbal							
Control	5.3	5.0	2.0	11.4	350.0	---	---
Cluster	5.0	4.9	3.8	10.5	336.9	17.5	4.3
Outline	5.5	5.5	2.2	10.1	411.5	14.9	4.2
Low Verbal							
Control	4.6	4.4	1.6	9.9	314.7	---	---
Cluster	4.8	4.5	5.6	10.5	339.3	19.2	3.7
Outline	5.3	5.2	3.4	10.9	413.9	15.7	4.2


12
11
10
9
8
High Verbal
Low Verbal
Overall Essay Quality
Control
Cluster
Outline
Conditions


14
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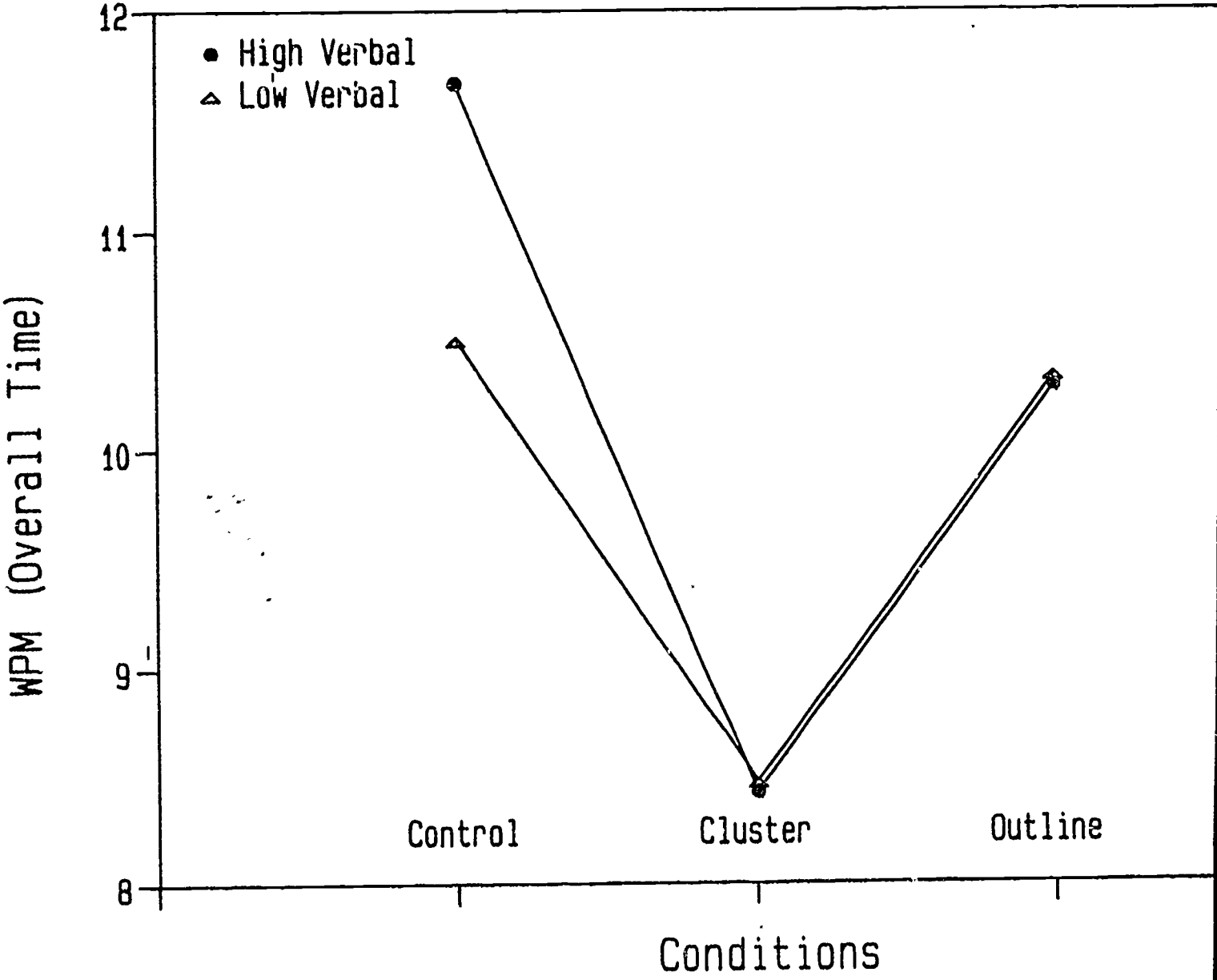
High Verbal
Low Verbal
WPM (Writing Time)
Control
Cluster
Outline
Conditions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High Verbal
Low Verbal
WPM (Overall Time)
Control
Cluster
Outline
Conditions