



### **Typographic Cues as an Aid To Learning from Textbooks**

The design of this article responds to its content, demonstrating the computer's effectiveness as a tool for design rather than as a source of creativity. The one typeface used in this design begins to set up a transparency which lets the author's message come through clearly.

# TYPOGRAPHIC CUES AS AN AID TO LEARNING FROM TEXTBOOKS

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## ABSTRACT

Writers, editors, designers, and teachers all play important roles in developing students' abilities to comprehend, learn, and retain information. From primary grades through college, students are faced with increasing amounts of information in text books. As the information increases in quantity and complexity, the organization of the information plays a more important role in the student's ability to find and comprehend the important concepts.

This investigation proposes a method to identify important categories of information within a particular subject area and to rank these categories by importance creating a hierarchy of information. From this, a hierarchy of typographic cues is developed and matched to the hierarchy. The degree of typographic emphasis indicates position in the hierarchy.

Tests show that typographic cues assigned to each rank aid the learning process, provided the number of cues is less than three. Understanding these principles and their potential applications will aid publishers and designers of textbooks to more effectively organize information.

## INTRODUCTION

An integral part of the educational process is to structure learning situations in ways that provide the greatest understanding and maximum retention of information found in textbooks. Comprehension is the ultimate goal of reading textbooks and is dependent upon mental operations that occur while reading. Levels of comprehension are inferred from the way readers respond to what they have read.

Organization of written information is an important factor relating to reader comprehension. As Conant, in Gage and Berliner (1984) points out, it is important to keep written material logically organized, otherwise, the reader's comprehension of the material will suffer. Gage and Berliner (1984) note that, "the use of structure is something that when pointed out to the students, makes their learning more efficient, better remembered and more useful." It is important for "students to see a framework of facts, concepts and rules that they are being asked to learn."

How do we specify ways in which information is to be structured so that it can be grasped by the learner? One way of presenting information is at the conceptual level. Wadsworth, in Piaget's theory of cognitive development (1979), observed that children are ready to develop a particular concept when and only when they have acquired the schemata that are necessary prerequisites. Educators prefer students to have a conceptual understanding of a subject rather than learning disjointed facts.

This study proposes that written information may be structured according to a defined set of common attributes. This structure will enable the reader to discriminate between various levels of information and make generalizations about the information contained in each level. The proposed vehicle by which the reader is made aware of the structure is the typographic cue.

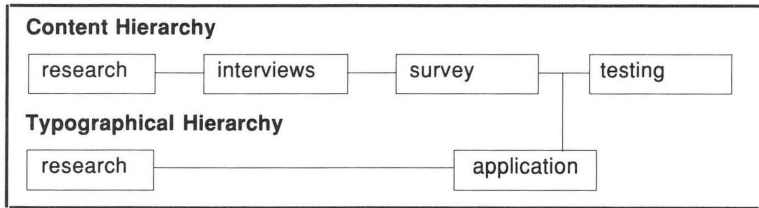
Stimulus properties applied to structural information differentiates between elements in the structure. The ability (of the student) to perceive the varied stimuli results in a heightened response level. Hershberger and Terry (1965) found that typographic cuing helps the reader identify and distinguish various categories of information thereby allowing a student to adjust his style of reading to levels of importance. In turn, the reader will learn proportionally more of what he reads.

In preparing instructional materials, textbook designers can manipulate stimulus properties, such as typographic cues, to improve the learning response, particularly when these stimulus characteristics serve to identify information that is important for the student to remember. Cues help to differentiate several categories of information differing in importance. Drawing on the aforementioned research as a foundation, this study proposes a method for the assignment of typographic cues as stimuli to structure information, within a textbook environment, which will enhance the learning and information retention capabilities of the respondent.

Design of this system follows: first, identify important types of information within a particular subject area; second, develop a hierarchy of typographic cues; third, match the hierarchy of categories of information with the hierarchy of typographic cues. Thus, the reader will be able to identify the commonality or differences of the categories of information through the similarities or differences of typographic cues.

The results of this investigation act as a suggested approach for the effective organization of information intended to enhance the comprehension of and retention of textual material. Figure 1 explains the development of materials to support this study.

**Figure 1** Development of materials to support study



## RESEARCH METHODS

### **Phase One:** Identifying a Hierarchy of Information

The first problem was to identify a hierarchy of information. Five professors from Chicago universities were interviewed. They were identified by calling colleges in the Chicago area and asking to speak to their specialists in American History. These professors were asked which kinds of American History information were important for students to remember. A list of six major categories of information was defined: Cause-effect Relationships, Localized Geography, Physical/Cultural Geography, Major Trends and Developments, Dates, and People.

In order to establish a hierarchy of importance for these various topics, a self-report survey was constructed. This survey listed the six categories of information with instructions to indicate the importance of each category on a 4-point scale (where 4 = very important and 1 = not important). This survey was mailed to fifteen professors who specialized in American History.

## DISCUSSION

Results indicated that these professors felt that the Cause-effect Relationships were the most important category of information. Major Trends and Developments were the second most important. Localized Geography was the third. Physical/Cultural Geography ranked fourth. People were the least important. Thus any American History textbook should highlight these categories.

**Table 1** Mean results of a hierarchy of information from fifteen American History Professors

Cause- Effect Relationships	Major Trends & Developments	Local Geography	Physical/ Cultural Geography	Dates	People
3.86	3.73	3.30	2.20	2.20	2.16

**Phase Two: Testing Importance of Typographic Cues**

The second problem was to test the importance of typographic cues. This hierarchy was based on research conducted by Herbert Spencer, Linda Reynolds, and Brian Coe (1973b) on a "Comparison of the Effectiveness of Selected Typographic Variations." To quote Spencer, Reynolds, and Coe (1973b), the aim of their study was "to compare the effectiveness of certain typographic variations which might be used to make distinctions between the logical elements comprising a piece of text." Materials that have clearly defined logical structures should be presented with sub-units clearly distinguishable from one another. From their study, a hierarchy of four typographic variations or cues were subjectively selected for this study. These cues included: Univers 75 (Most Important), Univers 65 (Somewhat Important), Univers 55 (Slightly Important), and Goudy Old Style (Not Important).

An attitude questionnaire was given to eighty students at the Illinois Institute of Technology. These students were asked to rate the level of importance of these four typographic cues. This was to validate the results of Spencer, Reynolds, and Coe (1973b).

## RESULTS

The eighty students tested responded in the following way:

**Table 2** Perceived Importance of Different Typefaces  
(percent of 80 cases)

importance	typefaces			
	univers 75	univers 65	univers 55	goudy old style
very	72.5%	28.7%	01.2%	03.7%
somewhat	10.0	57.5	18.8	11.2
slightly	10.0	07.5	63.7	16.2
not	03.7	02.5	11.2	65.0
no answer	03.7	03.7	05.0	03.7
	100.0	100.0	100.0	100.0

The results of the ranking of these typefaces by importance was consistent with the previous test of Spencer, Reynolds, and Coe (1973b). The results also validated the subjective cue values that were chosen.

**Table 3** Paired Typographic Cue Hierarchies  
and Categories of Information

<b>Univers 75</b>	Cause-effect relationships
<b>Univers 65</b>	Major trends and developments
Univers 55	Localized Geography
Goudy Old Style	All information not included in above categories

### Construction of the Independent Measure

The hierarchy of categories of information were paired with the hierarchy of typographic cues.

In order to protect the student from sensory overload, only three categories of information and three typographic cues were chosen. An American History textbook was selected based on the fact that this text contained no images, diagrams, photos, and only one typeface used throughout. At issue was whether this text could be divided into the three categories. Eight pages were randomly selected from this textbook (See figure 2). Information on these pages were divided into the above three categories.

**Figure 2** The following two pages represent a sample of the original American History text.

From *The Growth of the American Republic: Volume Two, Seventh Edition*, by Samuel Eliot Morison, Henry Steele Commager, and William E. Leuchtenburg. Copyright 1930, 1937, 1942, 1950, 1962, 1969, & 1980 by Oxford University Press, Inc; renewed 1958, 1968, 1970, 1978 by Samuel Eliot Morison and/or Henry Steele Commager. Reprinted by permission of the publisher.

with unprecedented rapidity until by 1890 it was almost complete and the frontier had disappeared.

The Plains region had long been known as 'the Great American Desert'; it was not, of course, a desert, but the designation had some justification. For over 200 years the American pioneer had moved westward from one woodland frontier to another, and in all that time it had never been necessary for him to make any radical readjustment to forest and prairie and stream. But when the pioneer came to the edge of the Great Plains he found an environment fundamentally different from that to which he was accustomed. Here was an immense grassland, sparsely wooded, with few navigable streams, and with a rainfall seldom sufficient for farming as practiced in the East. When the pioneer farmer tried to apply here the experience he had gained and the tools he had developed in the wooded East, he failed. 'The attempt,' as Walter P. Webb has said, 'of a migrating people to cross this line of the 96th or 98th meridian resulted in social chaos and economic ruin which continued until, through invention and much experiment, new weapons were adopted, new implements invented, new methods devised for getting water, making fences, and farming, until new institutions were evolved or old ones modified to meet the needs of a country that was level, devoid of timber, and deficient in rainfall; until a plainscraft took the place of woodcraft.'

Not until the 1870's did the industrial revolution, science, and invention come to the aid of the farmer and enable him successfully to invade the High Plains. Before he could establish himself permanently on the Plains four things were necessary: the elimination of the Indian; new methods of farming to cope with inadequate rainfall; a substitute for traditional wooden fencing; and transportation to take the crops to market. The army and the destruction of the buffalo took care of the Indian; barbed wire solved the fencing problem; the windmill, dry farming, and irrigation went far to overcome the effect of insufficient rainfall and intermittent droughts; and the railroad furnished transportation.

In the course of this long and arduous struggle with the Plains environment, the miner, the cattleman, and the farmer evolved institutions that differed markedly from those which had obtained in the woodlands of the East. The Plains environment necessitated a modification not only of the tools and methods of farming, but of social attitudes, economic concepts, political and legal institutions as well. 'The physical conditions

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which exist in that land,' Major John Wesley Powell said, . . . are such that the industries of the West are necessarily unlike those of the East and their institutions must be adapted to their industrial wants. It is thus that a new phase of Aryan civilization is being developed in the western half of America.'

## 2. THE INDIAN BARRIER

The first step in the conquest of the last West was the solution of the Indian question. The Indians of the Great Plains and the Rocky Mountain regions, perhaps 225,000 in number, presented a formidable obstacle to white settlement. The strongest and most warlike of the tribes that the whites encountered were the Sioux, Blackfeet, Crow, Cheyenne, and Arapahoe in the north; the Comanche, Kiowa, Ute, Southern Cheyenne, Apache, and Southern Arapahoe in the south. Mounted on swift horses, admirably armed for Plains warfare, and living on the millions of buffalo that roamed the open range, these tribes for generations had maintained a stubborn and successful resistance to white penetration of their hunting grounds.

The first serious invasion came with the great migrations of the 1840's. The fate of the California Indians after the gold rush was prophetic of what was to happen elsewhere in the West. There were approximately 100,000 Indians in California in 1850; ten years later the number had been reduced to 35,000, and the Commissioner of Indian Affairs could write that 'despoiled by irresistible forces of the land of their fathers; with no country on earth to which they can migrate; in the midst of a people with whom they cannot assimilate; they have no recognized claims upon the government and are compelled to become vagabonds — to steal or to starve.' The advance of the miners into the mountains, the building of the transcontinental railroads, and the invasion of the grasslands by cattlemen, threatened the other Indian tribes of the West with the same fate. Most serious was the wanton destruction of the buffalo, indispensable not only for food but for hides, bowstrings, lariats, fuel, and a score of other purposes. Scarcely less ruinous were two other developments: the perfection of the Colt repeating revolver, fearfully efficient in Plains warfare, and the spread of smallpox, cholera, and venereal diseases among the Indians.

The story of Indian relations in the period from 1860 to 1887, the year

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### **Construction of Reading Materials for Testing**

Once the information was divided, the paired hierarchy of categories of information/hierarchy of typographic cues was applied. A total of eight letter-size pages were constructed. Of these eight pages, two pages used three typographic cues paired to categories of information. Univers 75 (Cause-Effect Relationships), Univers 65 (Major Trends and Developments), Univers 55 (Localized Geography), and Goudy Old Style (for all information not included in these categories). (See table 3 for a review of categories/cues). Two pages used two typographic cues Univers 75 (Cause-Effect Relationships) and Univers 65 (Major Trends and Developments), and Goudy Old Style (for all information not included in these categories). Two pages used one typographic cue, Univers 65 (Major Trends and Developments) and Goudy Old Style (for all information not included in this category). Two pages had no typographic cues. Only Goudy Old Style was used. (See figure 3a-3d).

### **Construction of the Dependent Measure**

The effectiveness of using different typefaces was assessed by having the students read the material and then answer multiple choice questions testing their recall of the material read. The percent correct for information presented in the different typefaces was compared as the dependent measure.

Eighty students taking entry level courses at the Illinois Institute of Technology were subjects for the study.

### **Data Collection Procedure**

Students completed the questions during regular class sessions. Before the materials were distributed, students were given a brief description of the study. Once the materials were distributed, students were instructed to read the introduction and instructions, and then the paired eight pages of reading materials from the American History textbook.

The roaring vitality, the cascading energy of the American people in the postwar years, is nowhere better illustrated than in the history of the West. **The generation after the Civil War witnessed the most extensive movement of population in our history; a doubling of the settled area; the rapid development of this population from primitive society to contemporary standards of civilization; the final disappearance of the wild Indian; the rise and fall of the mineral empire and of the economic life articulated to the geography and climate of the High Plains and the Rocky Mountains; and the organization of a dozen new states with a taste for social and political experiment.**

The most notable of these achievements was the conquest of the Great Plains - that region extending roughly from longitude 98 to the Rocky Mountains, and from Texas to the Canadian Border. This vast area, comprising roughly one-fifth of the United States, had long interposed a formidable barrier to settlement. **In the decade of the 'forties the westward frontier had reached the edge of the Plains. Then, instead of moving progressively westward as it had always heretofore done, the frontier leaped 1500 miles to the Pacific coast. For 30 years the intervening territory was practically uninhabited except by Indians and Mormons; not until the decade of the 'seventies did permanent settlers begin to close in on the Plains and Mountain regions; then the process went on with unprecedented rapidity until by 1890 it was almost complete and the frontier had disappeared.**

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The story of Indian relations in the period from 1860 to 1887, the year of the Dawes Act, is a melancholy tale of intermittent and barbarous warfare, broken pacts and broken promises, greed and selfishness,

corruption and maladministration, of alternating aggression and vacillation on the part of the whites, of courageous defense, despair, blind savagery, and inevitable defeat for the Indians. President Hayes observed in his annual message of 1877, 'Many, if not most, of our Indian wars have had their origin in broken promises and acts of injustice on our part.'

**Until 1861 the Indians of the Plains had been relatively peaceful, but in that year the invasion of their hunting grounds by thousands of frantic and ruthless miners, and the advance of white settlers along the upper Mississippi and Missouri frontier, together with dissatisfaction at their treatment by the government and the breakdown of the reservation system, resulted in numerous minor conflicts. In 1862 the Sioux of the Dakota region went on the warpath, devastated the Minnesota frontier, and massacred and imprisoned almost a thousand white men, women, and children. Retribution was swift and terrible and fell indiscriminately upon the innocent and the guilty.** For the next 25 years Indian warfare was constant, each new influx of settlers driving the redskins to acts of desperation which brought on renewed outrage and punishment. In 1864 the Cheyenne, banished from their hunting grounds to the wastes of southeastern Colorado, attacked Ben Halliday's stages and harried the mining settlements to the north; they were persuaded to abandon their depredations and concentrate at Indian posts, and at one of these posts **Colonel Chivington ordered a savage slaughter of the Indian men, women, and children which sent a thrill of horror through the nation.** General Nelson Miles called the Sand Creek Massacre the 'foulest and most unjustified crime in the annals of America,' but Denver hailed Chivington, a former Methodist minister, who exhibited his collection of a hundred scalps at a local theater. **Two years later a small force under Colonel Fetterman was in turn massacred by the embittered Sioux.** All through the following decade the Sioux fought desparately for their hunting grounds. **The climax came in 1875 when prospectors discovered gold in the Sioux reservation in the Black Hills. That summer General Sheridan was able to hold back the importunate gold-seekers, but the next spring they broke through**

The vast territory between the Missouri and the Pacific, first explored by the traders of the American and the Rocky Mountain fur companies, had been crossed and recrossed by emigrants along the great trails, but it was the miners who first revealed to the nation the possibilities of this country. The first frontier of the last West was the miners' frontier. In 1849 the lure of gold had drawn to California a turbulent, heterogeneous throng of miners who later formed the nucleus of a large permanent population and who developed the varied agricultural resources of the state. This process was to be repeated time and again in the decade of the 'sixties: in Colorado, Nevada, Arizona, Idaho, Montana, and Wyoming. In each case precious metals were the magnet that attracted the first settlers and advertised the resources of the territory; then, as the big pay dirt was exhausted, the mining population receded, and its place was taken by ranchers and farmers who established, with the aid of the railroads and the government, the permanent foundation of the territory.

**In 1859 the discovery of gold in the foothills of the Rockies, near Pike's Peak, drew thousands of eager prospectors from the border settlements and from California, bent on repeating here the fabulous story of California gold.** Within a few months the roads from Council Bluffs and Independence to western Kansas were crowded with wagons bearing the slogan 'Pike's Peak or Bust' scrawled on their canvas. Soon brash little mining camps dotted the hills all along Cherry Creek, a branch of the South Fork of the Platte. Denver City, Golden, Boulder, and Colorado City arose almost overnight, the Territory of Jefferson—changed later to Colorado—was organized, and the census of 1860 recorded a population of some 35,000. The mining boom soon spent itself, and the development of Colorado was somewhat retarded by the Civil War and Indian uprisings as well as by inadequate transportation and a failure to appreciate the agricultural and grazing resources of the country. During the ensuing decade population barely held its own; not until the silver strikes of the 1870's, the advent of the railroads, the influx of farmers, and the readjustment of the region to a new economic basis were the foundations for a sounder development laid. Colorado's silver output soared from 600,000 a year in 1870 to more than \$3 million in 1874, and in 1877 silver smelters at

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Leadville also began to turn out large quantities of lead. By 1880 Leadville, already the second city of Colorado, had 13 schools, 5 churches, and 28 miles of streets; its annual silver production soon outdistanced that of any foreign country save Mexico.

**In the same year that gold was discovered in Colorado came the announcement of a rich strike of silver on the eastern slopes of the Sierra Nevada, near Lake Tahoe.** Here was located the Comstock Lode, one of the Richest veins in the world. Within a year the roaring towns of Virginia City, Aurora, and Gold Hill sprang up in the desert waste, the Territory of Nevada was carved out of Utah, and 10,000 men were digging frantically in the bowels of the earth for the precious silver stuff.

Nevada furnishes the most extreme example of a mining community; nowhere else in history do we find a society so completely and continuously dependent upon minerals. And the history of this mining commonwealth for the first decade of its existence is largely that of the Comstock Lode. Within 20 years the lode yielded no less than \$306 million. Very little of these enormous riches, however, remained in Nevada, most of it going to California mining companies or to speculators in the East. The Comstock Lode is notable not only as the foundation of the mineral wealth of Nevada, but as the location of one of the greatest engineering enterprises of the nineteenth century—the Sutro Tunnel. This tunnel, built by Adolph Sutro over a period of eight years and penetrating into the heart of the mountain to the depth of three miles, was a technical marvel; unhappily, it was finished just as the mines were failing.

The application of engineering skill, machinery, and capital to the Comstock illustrates a process that was universal in the history of the mining kingdom. **Panning and placer mining as practiced in the diggings of early California and Colorado were wasteful, and the change from placer mining to quartz mining required the purchase of expensive machinery, the hiring of engineering skill, and the organization of mining as a big business. So outside capital came in and took over the mining industry; the miners became day laborers working for wages, and the profits went to stockholders scattered throughout the United States and Europe.**

One of the most dramatic shifts in the screen-picture of the West was the replacement of millions of Buffalo that had roamed the Great Plains by cattle, and of the Indian by the cowboy and the cattle king. The territory between the Missouri and the Rockies, from the Red river of the South to Saskatchewan-an area comprising approximately one-fourth of the United States-was the cattle kingdom, the last and most picturesque American frontier. Here millions of Cattle -Texas longhorns, full-blooded Herefords, Wyoming and Montana steers-fatted on the long luscious grasses of the public lands. The cowboys and their liege lords, the cattle barons who ruled this vast domain, developed therein a unique culture, folklore, and society.

The development of the cattle industry on a large scale was due to a peculiar combination of factors: the opening up of the public domain after the Civil War, the elimination of the Indian danger and the annihilation of the buffalo, the extension of the railroads into the High Plains, the decline in the number of cattle raised in the Middle West and the East, the increases consumption of meat here and abroad, the invention of the refrigerator car, and the growth of great packing centers and of world markets.

Since the days when the American Southwest belonged to Spain, the sturdy Texas longhorn, descendant of Spanish toros from the plains of Andalusia, had grazed on the limitless prairie grasses north of the Rio Grande. It was not until 1846 that the first herd, valued only for their hides, was driven northward to Ohio, though long before that many had found their way to California. In 1856 a drove of Texas cattle reached Chicago, but not until the middle 'sixties did the 'long drive' to the region of rich grasses and good prices cease to be an experiment. In 1867 the Kansas Pacific began to reach out in the Plains, and in the same year J.G.McCoy established the first of the cow towns, Abilene, Kansas, from which live cattle were shipped to slaughter houses in Chicago. The refrigerator car, in common use by 1875, delivered the western dressed beef to the great eastern centers of population.

On the first of the organized long drive, 35,000 longhorns pounded up clouds of dust all along the famous Chisholm Trail, across the Red and Arkansas rivers and into the land of the Five Nations, to Abilene, Kansas.

Two years later no less than 350,000 longhorned kine made their way along the Chisholm and Goodnight trails to fatten on the long northern grasses and find a market at one of the several roaring cattle towns on the Kansas and Pacific Railroad: Abilene, Dodge City, or Newton. Later the 'long drive' extended north to the Union Pacific and even to the Northern Pacific.

"In after years (writes the historian of the cattle kingdom) the drive of the Texas men became little short of an American saga. To all who saw that long line of Texas cattle come up over a rise in the prairie, nostrils wide for the smell of water, dust-caked and gaunt, so ready to break from the nervous control of the riders strung out along the flanks of the herd, there came a feeling that in this spectacle there was something elemental, something resistless, something perfectly in keeping with the unconquerable land about them."<sup>2</sup>

Altogether some 6 million cattle were driven up from Texas to winter on the High Plains of Colorado, Wyoming, and even Montana, between 1866 and 1888. It was this new industry of fattening cattle on the Great Plains that produced the last phase of the Wild West and the highest and most picturesque development of the ancient art of cattle droving. The experience of cattlemen along the Oregon and California trails in the decade of the 'forties had long proved the practicability of wintering cattle in the northern ranges. Now Easterners and Englishmen of a sporting or speculating turn put their money into cattle, establishing their headquarters anywhere from the Rio Grande to the Canadian border, and in the absence of law managed their affairs through some de facto commonwealth such as the Wyoming Stock Growers' Association. Texas borders who learned their horsemanship and 'cowpunching' from the Mexican vaqueros were the first and the best bucaroos or cowboys. Every spring they rounded up the herds in designated areas, all the way from Texas to Wyoming and the Dakotas, identified their owners' cattle by the brands, and branded the calves, dividing up pro rata the strays or 'mavericks'. The breeding cattle were then set free for another year while the likely three- and four-year-olds were conducted on the 'long drive' to the nearest cow town on a railway. Each 'outfit' of cowboys attended its owner's herd on the drive, protecting it from wolves and cattle rustlers, sending scouts ahead to locate water and the best grazing. The long drive seems romanitic in retrospect, but to the cowboys it was hard and often hazardous work. Andy Adams, later one of the cattle barons of Texas, describes a dry drive along the Old Western Trail:

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Immediately after reading eight pages, students were asked to answer twelve multiple choice questions (three questions per two pages were chosen). Students were not allowed to look back at the eight pages. The paired eight pages were given to the students in different sequences. (See table 4).

**Table 4** Four Cue Sequences Used Out of Possible 24

<b>Sequence</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Number of cues</b>	3	2	1	0
	2	1	0	3
	1	0	3	2

Students were given as much time as needed to read all paired eight pages and answer all twelve questions. The study took between twenty and thirty minutes for each student to complete.

Results: the data were analyzed with respect to recall as measured by the number of questions answered correctly on the multiple choice test. Table 5 summarizes recall by page design.

The mean recall score for 0 cues = 1.53, 1 cue = 1.79, 2 cues = 2.10, 3 cues = 1.36. The mean number of questions answered correctly increased as the number of cues increased from zero cue to two cues. However, when three cues were added, the mean number of correct responses dropped below the number of correct responses for zero cues. The standard deviations for zero, one, two and three cues were 0.81, 0.80, 0.88, 0.93 respectively. The similar standard deviations for means of the four conditions made it possible to perform parametric statistics to examine the data for the four groups. Figure 4 graphically illustrates the relationship between the number of cues and level of recall.

**Table 5** Results of Recall by Page Design

Number of Correctly Recalled Items	Number of Cues			
	0	1	2	3
Mean	1.52500	1.78750	2.06250	1.36250
Standard	0.81092	0.80652	0.87652	0.93109

**Figure 4** Mean Correct Recall Scores and Standard Deviations

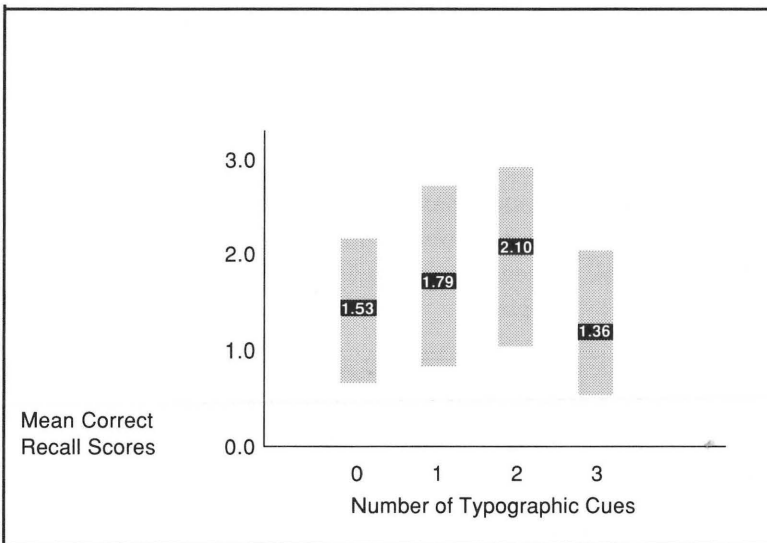


Table 6 shows the results of randomized block analysis of variance with kinds of cues as the independent variable. The randomized block analysis of variance was chosen because each subject experienced all of the cues. The analysis of variance produced an F-ratio of 316.15 ( $df = 4.316$ ). This F-ratio was statistically significant at well beyond the .01 probability level. Thus, the hypothesis that mean correct response differed for the groups was confirmed.

### Attitude Questionnaire

An attitude questionnaire was given to the eighty students after they answered the multiple choice questions to determine if the design of these pages were helpful. Seventy percent found the design helpful. Ten percent felt the pages were not helpful. Twenty percent had no response.

**Table 6** F-Test for Significance of Canonical Correlations Coefficient

	SS	DF	MS	F
Hypothesis	930.49	4	232.62	316.15
Error	232.51	316	.74	

### SUMMARY

The results of this study suggests that each successive added typographic cue resulted in increased learning until the third typographic cue was added. Under the 3 cue condition, the mean recall dropped below recall with 0 cues. Much was highlighted under the 3-cue condition indicating too much for a student to remember. Too many cues (three or more) are distracting, thus decrease learning. Typographic cues do affect learning as predicted.

The results support the hypothesis that: 1) categories of information can be identified within a particular subject area; 2) hierarchy of typographic cues can be developed; and 3) hierarchies of categories of information can be matched to hierarchies of typographic cues.

Thus, information which has a logical structure may be enhanced by the addition of typographic distinctions which are assigned to concept areas. The transfer of information may be increased if the reader is able to

perceive that an information structure exists. Visual typographic cues can aid the reader by highlighting this structure and differentiating between important and unimportant information, and thus enhance the learning process.

## DISCUSSION

There are two factors which determine a reader's response to a textbook. The first factor is the reader's attained knowledge. A student's familiarity with language structures, the breadth of their vocabulary, and their past experience are likely to have a profound effect on reading performance. The second factor is the reader's relationship to the text itself. Legibility of print, illustration and color, vocabulary, conceptual difficulty, syntax and organization of information also have an effect on reading performance. (This investigation has addressed only the organization of information.) A high level of comprehension can be achieved through a high level of reading performance and the effective organization of information in a text can raise this performance level. This concept could have significant implications for textbook designers. Currently, there is no formal visual language to govern the structure of information within textbooks. Designers wishing to produce more comprehensible texts could develop a visual structure through the definition of categories of information, organization of the categories and the assignment of typographic cues to the categories to aid in comprehension.

Though the tools of formal education have evolved to include such devices as computers and video, the textbook retains its position as the primary source of information in the classroom.

## FURTHER IMPLICATIONS OF THE RESEARCH

Publishing companies seek innovative design solutions that aid the learning process, and at the same time control development and production costs. Often the cost of an innovative design solution to an information communication problem is prohibitively high. Technological innovations, such as desktop publishing, have brought down the cost of publishing. What is needed now are cost efficient methods for the structuring of content which can be easily integrated with this technology.

This study is only a suggestion for textbook designers and publishers for the effective organization of information. The results of this investigation may be applicable to other tools of formal education, such as interactive video displays, television, and film. Structuring and cuing devices may be beneficial to students with low motivation or reduced learning skills.

Informal learning situations may also benefit from a clearly structured approach to information presentation. For example, organization and cuing may help museum visitors comprehend an exhibit. Museum visitors are heterogeneous with diverse interests, attitudes, expectations, and backgrounds.

Interpretive information that is carefully organized and cued can stimulate and aid reception. This approach might extend to other informal situations such as complex instruction manuals or instructional steps found on some consumer packaging.

Research into the development of methods to improve formal learning situations is not new. This study has proposed the use of certain visual cues to enhance the transfer of information from print to thought. Further studies can be made which expand upon the conclusions drawn in this one. For example, how might a chromatic

cue system work? The use of cue systems for nonprint media, such as interactive computer systems or informal learning environments, such as exhibits and museums could be studied. How might a mixed cuing system such as spatial cues with temporal cues work?

This study demonstrates that information can be organized and typographically cued to make learning more efficient and better remembered. It is important to help students see a framework of facts, concepts and rules that they are being asked to learn. These principles and their potential applications to diverse information communication contexts can enhance meaning and remembrance.

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