

# The Scientific Principles of Textbook Design and Illustration<sup>1</sup>

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THE PRESSURE OF MODERN SOCIAL EVOLUTION with its exploding demands for more knowledge and more education has created a great upsurge of interest today in all things educational—the teacher, the student, the schools, educational methods, visual aids, television teaching, and even mechanical devices to substitute for teaching. Only one major aspect of the educational process has not been put through lengthy reappraisal, the books used in teaching. A scientific appraisal of the principles of the artistic design and illustration of textbooks is the object of this study.

What is the science of book design? How can more effective textbooks be developed? Can we chart a new program of book design? Can we develop a scientific theory to guide us in designing books that will also give us insight into the fundamental nature of reading and writing? Or, are books on the way out as teaching devices, to be replaced by mechanical gadgets, tape recorders, and television sets? These are the beginning questions of the science of book design which we can attempt to deal with in the future.

The theory of book design is a part of the theory of verbal learning. Today in psychology, a special point of view called “reinforce-

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ment theory" dominates thinking about verbal learning. Reinforcement theory reduces the problem of acquisition of meaning to the strengthening of the specific verbal response by feedback to the individual of some rewarding outcome in the use of the word. The general point of view presented here denies, on the one hand, the arithmetic nature of this reinforcement process in reading and emphasizes, on the other hand, the role of perceptual or artistic reinforcement.

We relate the functional or organic theory of reading to be discussed here to the historical facts about the origins of writing and reading. From the outset, in the calendrical picture writing and in ownership seals of ancient Egypt, reading and writing have been related to picture art. The hieroglyphic symbol, or sacred writing, represents the highest point of picture writing, after which the written symbol came to be related to the sounds of speech. The abstract lines of thought in Greece and the influence of later religions on thinking separated writing and books from picture art. It is this abstract tradition in book design that we inherit. With the modern explosive expansion of technical knowledge, the two forms of manual expression—picture making and symbol writing—have been joined together again, not only in the form of concrete representation of things, but also through the use of abstract line designs and graphs which describe the interaction between events. Our purpose here is to interpret this history of writing and artistic illustration in relation to scientific concepts and principles of book design.

The general ideas here are not only theoretical in nature. Most of them have been applied in the design of an artistically illustrated textbook (Smith and Smith, 1958)<sup>2</sup> and an artistically illustrated workbook in psychology (Smith, Smith, and Hansche, 1958). Samples will be taken from these books to illustrate the use of artistic drawings in directing, strengthening, and motivating the individual to read and of the design of books to improve reading.

### *Principles of Illustration*

The general idea pursued here is an organic or functional theory of textbook design. When we use the term organic we mean that the design of the book and its illustrations must emerge from several inte-

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<sup>2</sup> The overall design and illustration layouts for this book were prepared by Donald M. Anderson, who was assisted in the execution of the finished art work by Bill H. Armstrong, Bob Burkert, Nancy Ekholm Burkert, Donald Grover, Burke Martin, and Dorothy Zupancich.

grated sources—the materials and machines of printing, the specific requirements of subject matter, and above all, from the natural processes of behavior and communication—both verbal and non-verbal—that go into reading and study. The view proposed and applied here is that these natural processes of communication in textbooks demand the use of various forms of impressionistic, representative, and abstract illustration in order to bring effective organization to textbooks and to create books which not only meet the perceptual and artistic needs of the student, but also refine his understanding of what is read, improve his retention of material, and stimulate the development of creative thought.

Creative art in books serves three main functions. First, it serves to *perceptually motivate* the reader—to attract him to pick up the book, to explore it, and above all to develop a high feeling of expectancy in turning each page. Second, artistic illustration *perceptually reinforces* what is read, so that the situations, events, and relationships described in words are made more meaningful and thus are better retained. Finally, correlated art *symbolically enhances* and deepens the meaning of the verbal material and thus serves to advance organization of the verbal materials to promote creative thinking.

This organic theory of reading puts stock in some of the most favored features of books, as compared to mechanized, controlled instruction by mechanical or electronic means. Books confer a freedom on the student that these controlled means of instruction do not. The reader can flip pages at will, seeking expression of his own interests and needs, probing deeply into difficult subjects, and passing over what is well known. The general theory under discussion suggests that these salient features in books can be enhanced through creative art, that the reader's probings can be deepened by better vision, and that his motivation can be increased by artistic programming of subject matter.

*Perceptual motivation and art in reading.* Reading is always in part a perceptually motivated activity. It may involve other motives, such as the pressure to study or to cope with examinations, but it also consists of activity directed and sustained by observing visual patterns (words) and by the perceptual relations, actions, and situations created in the experience of the reader by the words.

Artistic illustration can strengthen perceptual motivation in reading by giving immediate perceptual organization to the environment

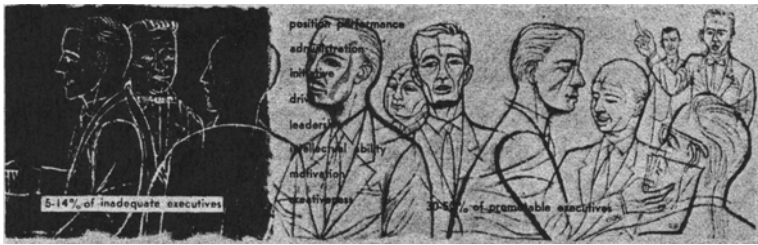
created by the printed matter and the situations and actions described. If a book is not illustrated, the reader perceptually reconstructs and projects himself into the events and situations of the book through the process of verbal symbolism. Art quickens this organization, and gives to words an immediate meaning which the reader, through his limited experience, may not be able to develop.

This artistic enrichment of a book creates what we call the "perceptual space" or "environment" of the book. In order to create a rich perceptual human environment in the book on behavior, a great variety of illustrations of people were used, as shown in Figure I. People of different ethnic origins and of different ages, size, form, and manner were shown. For example, Figure Ib describes a panel of personalities which was employed to symbolize the field of individual differences. The belief is that the well-organized perceptual environment provided by such illustrations gives the reader a continued feeling of familiarity with his surroundings, and one that is seemingly animated with human life.

Art can increase perceptual organization during reading in a second way, which we might call *artistic segregation* and *programming* of the reading material. By these terms we mean the highlighting of main concepts, events, and situations in the reading by illustrations in a progressive and systematic way.

Some of the possible techniques of artistic programming which have been used are shown in Figure II. At the beginning of each chapter of a book a theme drawing, usually of an abstract nature, is used to set the stage for the main characteristics of behavior to be described in the chapter. For example IIa is meant to suggest the almost infinite detail of human perception, as well as its characteristic object and space properties. Descriptive sequential and classificatory drawings, such as the illustration of the perceptual motivation of a child for his blanket (Fig. IIb), are used in introducing a subject in order to establish familiar ground plans before the later introduction of detail. To illustrate such detail, highly representative drawings, sometimes combined with line or bar graphs, are used.

There are still other techniques of artistic programming of subject matter. The initial subject drawings in a chapter are made easier to understand and more general in their meaning than those illustrating more detailed subjects. Later drawings in the same chapter describe detail and interactions. Other drawings spell out complex sequences

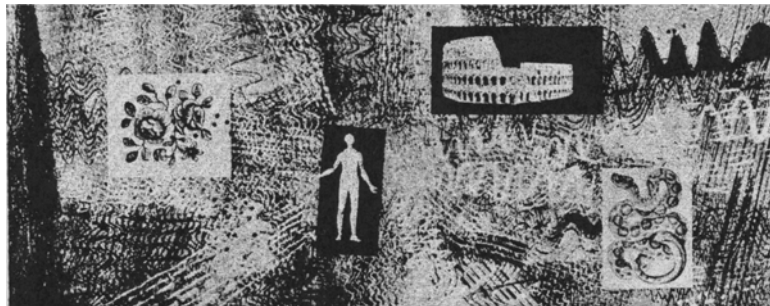


*a*

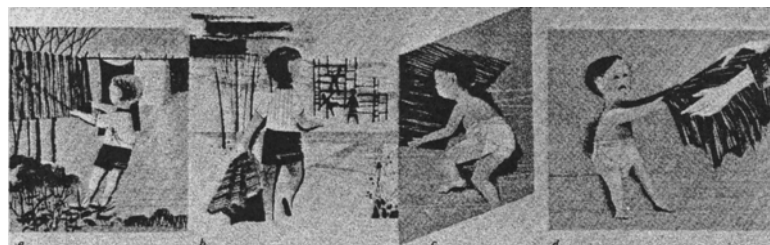


*b*

**FIGURE I.** *The creation of an integrated perceptual environment within a book by means of sustained artistic illustration.*



*a*



*b*

**FIGURE II.** *The techniques of artistic programming.*

*(a) Abstract and expressionistic designs set the stage and define artistically the theme of a chapter. The design shown here illustrates the infinite detail and object qualities of human perception, along with the physical forces governing it. (b) Sequential drawings classify parts, stages, or sequences of events within a topic. The four drawings illustrate four stages in the perceptual motivation of the child for his blanket.*

and classify events in many different ways. Still others illustrate theoretical ideas and relationships.

A third function of creative art in reading motivation is to promote the natural curiosity of people to explore, to seek new things, while still holding securely to things they already know. The importance of such exploratory, or general perceptual motivation has been recognized by psychologists for years as a primary form of both human and animal motivation.

Exploratory perceptual motivation is promoted by artistic illustration in two ways—by what we call the exploratory drawing and by use of unusual and varied art forms.

Figure III identifies a type of exploratory drawing. This drawing combines a series of fairly familiar things in an unusual relationship. There is a picture of a familiar face (Max Planck), a section from Lincoln's second inaugural address, a chord from Bach, a monk, a

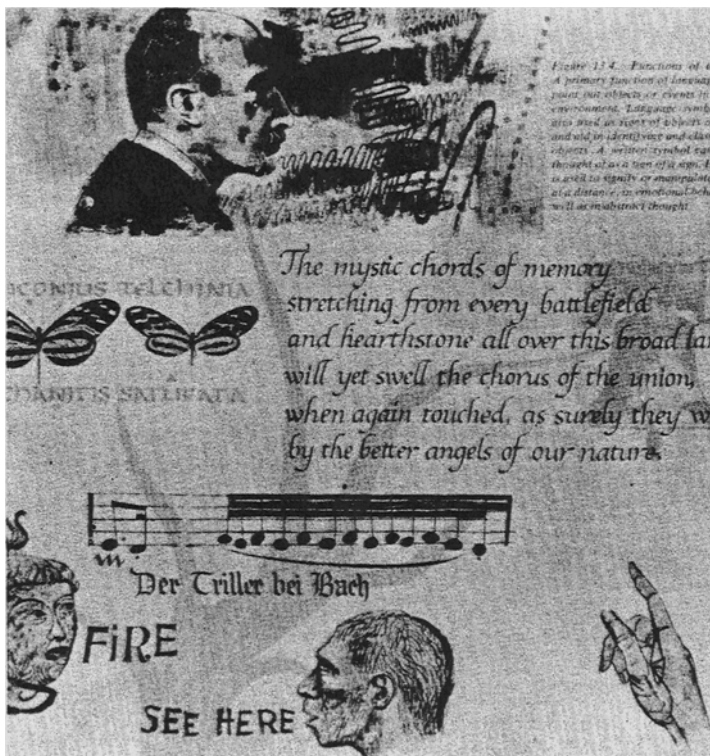


FIGURE III. Artistic enhancement of symbolism and thought in reading. The exploratory drawing is used to promote investigation and curiosity about relationships discussed only in part in the text.

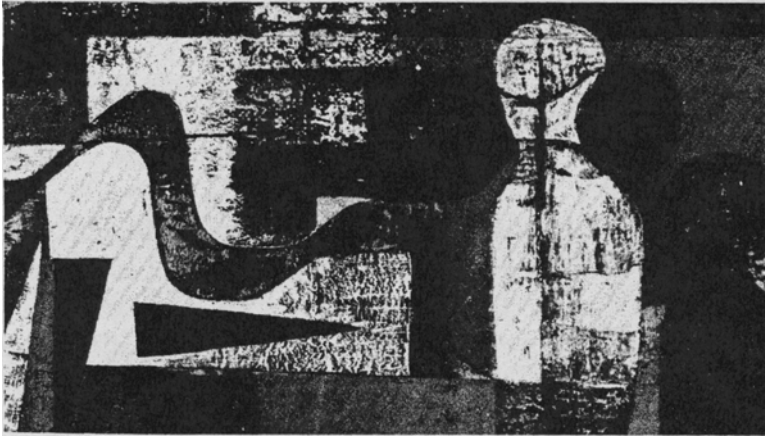
Neanderthal man, and a pointing hand. All of these symbols are indicated in the text as representing the pointing, signaling, symbolizing, motivating, and abstracting functions of language. The drawing is given a caption, but the specific meaning of each figure is not described. The student must explore with some help from the text.

Figure IV describes some unusual artistic techniques which have been tried in order to create theme drawings of an abstract or expressionistic nature which are employed to introduce different chapters in a book. Figure IVa is an expressionistic design of the dynamic relationships in human adjustment. Figure IVb is a special photographic study of human hands, combined in unusual relationships in order to illustrate emotion. Figure IVc is an oil emulsion effect produced on clear film by combining oil and India ink. The design was used to introduce a chapter on the organic or bodily mechanisms of human behavior.

*Artistic reinforcement of verbal symbolism in reading.* We identify a second function of art in book design. The view is that artistic illustration strengthens the learning process by providing additional experiences which confirm and extend the verbal responses. We call this artistic or perceptual reinforcement of reading. It involves information feedback from the artistic displays which serves to strengthen the symbolic responses of the reader. Such feedback is comparable to goal reinforcement in general learning where it consists of achievement of some reward or goal through reaction of the individual. The behavioral goal achieved reinforces or strengthens the response that led to it, and causes this response pattern to be retained better in memory than one which is not reinforced.

The goals of reading activity are primarily perceptual in nature, as suggested by the symbolism of words and sentences. To reinforce the acts of reading, we make these goals clear and definite by illustrative art. We use the artistic drawing to feed back information to the reader which confirms and strengthens the symbolism of the reading material.

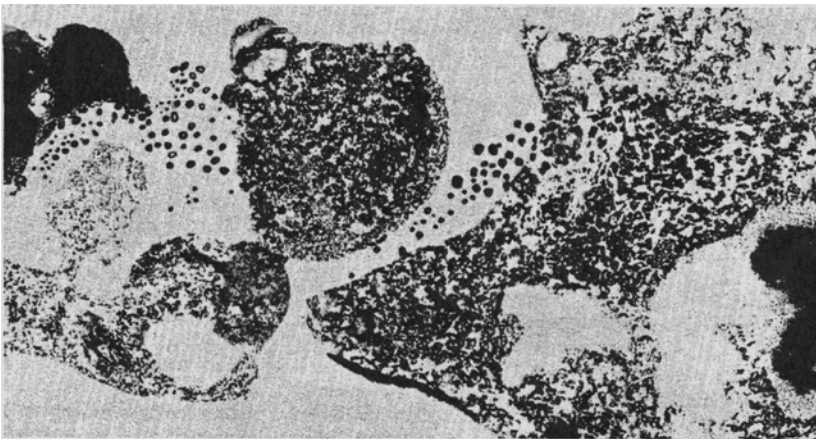
The theory under discussion specifies a number of principles, one of which is to align subject matter and related art as closely as possible on the page. To achieve this alignment, the page of the book must be designed to accept the art. We have introduced the art column in a book, a half column that can be used for both illustrations and captions. When necessary, this space can be combined with



*a*



*b*



*c*

*FIGURE IV. Techniques of artistic programming in reading. (a) An abstract design is used to define environmental and individual interaction in adjustment. (b) A photographic montage of hands illustrates the behavioral expression of emotion. (c) An oil-emulsion design on plastic provides the essential impression or organic detail.*



column space for larger illustrations. The flexibility of this page design permits very close alignment of subject matter and art in most cases.

A second principle of perceptual reinforcement which we have developed is the close coordination of verbal, graphic, and artistic descriptions. Interlocking text with drawings and graphs is especially effective in describing experiments, as shown in Figure V. A drawing of the whole situation sets up the initial description of what goes on. A second stage drawing illustrates a critical detail also described verbally. Finally a graph presents the quantitative results of the observations. In this way, each stage of a sequential drawing reinforces the verbal symbolism as well as the prior stages of the drawing. The drawing in Figure V illustrates the stages of an experiment on perceptual motivation in the monkey. The monkey is trained to discriminate between a white and black door by rewarding him for a correct choice. (If he chooses correctly he is allowed to look out of his box.) The graph shows the learning of this discrimination habit.

A third principle of perceptual reinforcement in reading is to sharpen the verbal presentation by artistic means. We use bizarre drawings to characterize bizarre subjects, such as dreams. We use sequence and stage drawings to coordinate with descriptions of inter-related sequences and stages of experiments and other behavior. Many full-color paintings and photographs illustrate color phenomena of visual perception.

One technique used to sharpen and thus reinforce descriptions of social behavior is to portray groups of people as if observed from a vantage point high above them (Fig. VI). Such drawings create the illusion of actual observation of social events. These drawings also make possible diagrammatic representation of groupings and inter-relationships among individuals and groups.

Another method of artistic sharpening which has been tried involves matching the design and execution of a drawing with the time and nature of the particular topic with which it dealt. An example of this matching in Figure VII shows a panel of primitive figures designed to illustrate the primitive origins of language.

There are still other ways to correlate subject content and artistic illustration. One is to utilize the special artistic talents of different contributing artists and their feeling for certain subjects in the execution of particular drawings. In this way, techniques of execution are

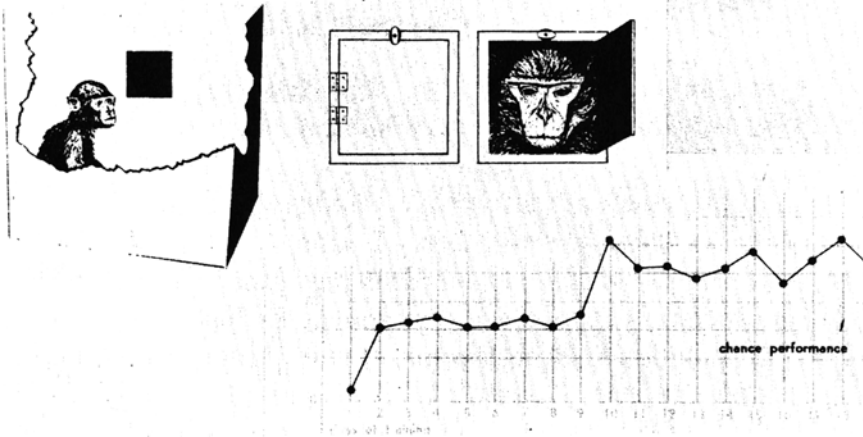


FIGURE V. One technique of perceptual reinforcement in reading. Integration of artistic and graphic descriptions of behavior, which are described in the text in sequence.

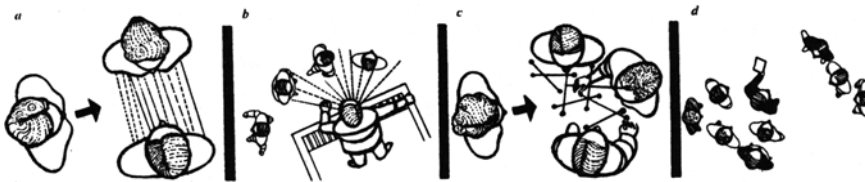


FIGURE VI. Techniques of perceptual reinforcement. Drawings of social behavior reveal the impression of observation of such behavior at a distance or other vantage points.

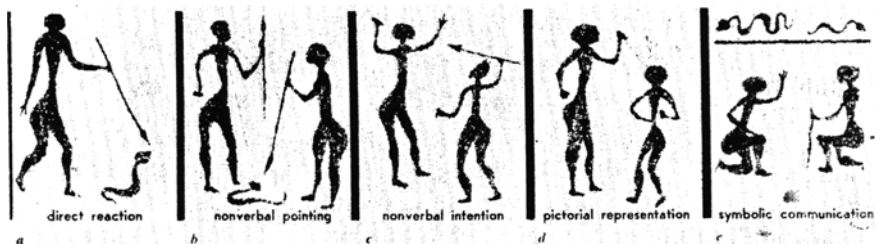


FIGURE VII. Techniques of perceptual reinforcement. The execution of a drawing is made to correspond to subject matter. In this case a primitive type of artistic execution is made to depict the primitive origins of language symbolism.

fitted to the particular subject. As a result, drawings of different subjects—animals, children, males, females—are differentiated by artistic techniques as well as by the topics with which they deal.

*Artistic enhancement of creative thought in reading.* To appreciate the functions of artistic illustration in promoting creative thought, the difference between verbal and non-verbal communication and their complementary relationships need to be recognized. The effectiveness of spoken language depends not only upon verbal communication, but also upon non-verbal patterns, including gesture, emotional expression, tone of voice, inflection, and posture or body language. Written language ordinarily lacks the context of non-verbal communication characteristic of oral speech. Unadorned writing substitutes for this non-verbal base various techniques of individuality in writing or literary style. However, artistic illustration can be used to give a foundation of non-verbal communication to written language, thereby promoting originality and creativity in the reader's symbolic responses.

The artistic enhancement of creative thought in reading involves principally the matching and interplay of different forms of art—representative, abstract, and impressionistic—with the demands for concrete description, clarification of abstract relations, and expression of emotional tones and values in the writing. We have tried out various forms of artistic illustration matched with different types of abstract, evaluative, and concrete subjects.

Some artistic impressions of human events related to mental illness are shown in Figure VIII. From our point of view, these drawings accomplish what no series of photographs or even actual observations of mental hospital patients could do. They give a symbolic interpretation of individuals in difficulty within the strange environment of mental illness, and they do this with a persisting compassion for the people and a consideration of human values. They invest the word meanings of the text with the immediate potent non-verbal impressions and meanings of artistic symbolism. The interaction within the reader between these two forms of symbolism, one verbal and the other non-verbal, may very well be the key to a whole new line of creative thought on the part of the reader.

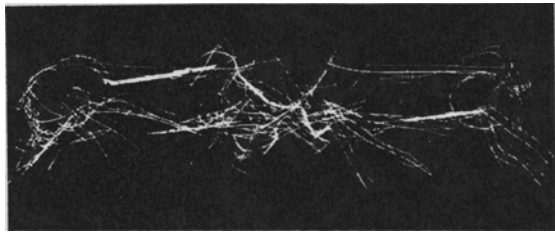
We use abstract art as a form of non-verbal communication correlated with abstract concepts defined in the text. As examples, abstract designs illustrate dynamic phenomena of force, energy, motivation



Figure 17.7. Forms of schizophrenia. a. The simple schizophrenic often makes a borderline adjustment to the world. b. The hebephrenic shows regressive forms of behavior. c. Rigid, stereotyped behavior marks the catatonic. d. The paranoid schizophrenic has delusions, and is usually extremely suspicious and apprehensive.

FIGURE VIII. Artistic enhancement of symbolism in reading. A drawing of behavior in mental illness enhances the human values of behavior disorder.

a



b

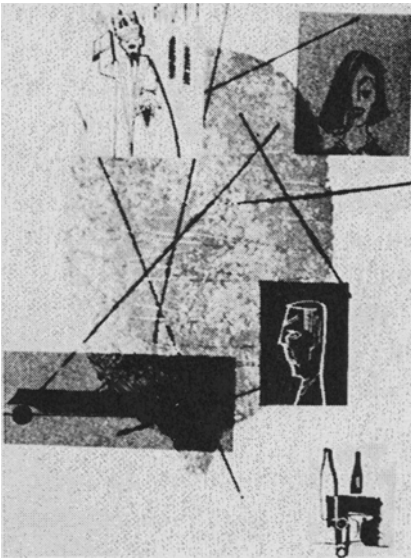


FIGURE IX. Artistic enhancement symbolism in reading. Abstract drawings are used to enhance concepts of force in motion and motivation (a) and interaction in conflict (b).

(Fig. IXa), interaction of events and conflict (Fig. IXb). Such dynamic phenomena can never be described adequately by words alone. Abstract art, along with such visual representations as the quantitative graph and the mathematical formula, can be used to give non-verbal meaning to descriptions of dynamic relations and interaction of events.

Another type of drawing used to promote creativity in thought through non-verbal communication is the *exploratory drawing*, which is captioned but not specifically labelled, as already discussed. We believe that the exploratory activity generated by such drawings is in itself a process of creative thought not far removed from research.

### *Application of Principles*

The workbook is the original "teaching machine." It too can be designed in terms of specific principles of artistic illustration in order to promote perceptual motivation, learning, and creative thought in reading and study. Several new ideas of visual design have been tried out in preparing a general workbook for a psychology textbook.

The general theory of workbook design is that visual art provides the essential perceptual materials with which the student can work in answering general questions, solving problems, answering self quizzes, or doing projects contained in the workbook. If there are no rich sources of materials to guide the work, as there are in the social sciences, most students find a workbook unrealistic, too abstract, non-challenging, and unrewarding as a task. Correlated visual art in a workbook, extracted and modified from the related textbook, provides the means of promoting and aiding transfer of learning from the textbook to the actual work efforts by the individual student.

Our notions of the design of workbooks follow in general the principles already discussed. We demand a lot of illustrations to keep a varied environment for the student. The workbook itself is divided into chapters headed by an abstract drawing or photographic montage which is related to an introductory paragraph giving a general discussion of the subject. On this first page of each chapter, space is provided in which the student must write out some eight to ten definitions of general concepts dealt with in the related chapter in the book. Such an introductory page can be varied artistically in many ways. The montage can be made to illustrate specific concepts or high points which must be defined. Or any essay question can be required covering the subject illustrated in the theme drawing.

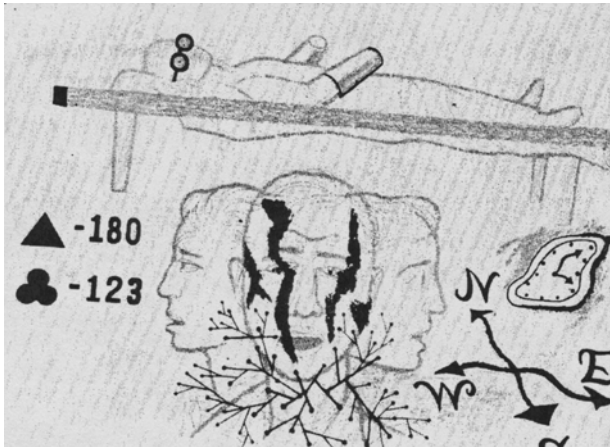


FIGURE X. Techniques of perceptual reinforcement in workbook design. The workbook drawing (b) is a modified reproduction of the original textbook drawing (a) used to motivate and partially reinforce attempts to write an essay on the subject of the drawing.

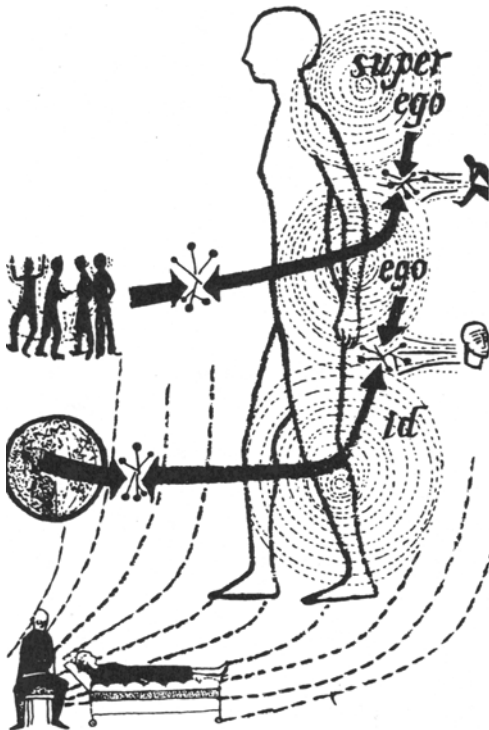


FIGURE XI. A drawing illustration of psychoanalytic conceptions from the book is altered slightly for inclusion in the workbook and used as a visual reinforcer for answering a series of completion questions.

Figure X illustrates how artistic illustrations are used to perceptually motivate the student and to reinforce his own efforts in answering essay and completion questions. An illustration used in the book is modified in some ways and reproduced in the workbook. Captions are eliminated and significant legends, used in the original illustration, are omitted. The student is then asked to write a short essay covering the subject related to the illustration. Or a series of completion questions on the subject may be prepared.

The diagram in Figure Xb, for example, is a modification of an illustration of an experiment on perceptual restriction. Legends and other details are missing, as compared to the illustration in the textbook (Fig. Xa). The student is asked to write a short essay on the experiment illustrated in the drawing. The drawing in Figure XI gives an example of relatively complete artistic support for the student in answering a series of completion questions. This drawing illustrates the interactions of personality indicated by the Freudian theory of psychoanalysis. The drawing is almost identical to the equivalent drawing in the textbook, except for some reduction in size and elimination of the caption. The related completion questions require the identification of the founder of psychoanalytic theory, the elements of motivation of behavior in this theory, the levels of personality, the dynamics of personality development, and the nature and effects of conflict between different levels of personality.

In the workbook, abstract drawings are sometimes substituted for representative drawings, or specific concrete illustrations are given of ideas illustrated by general drawings in the textbook. Sequential drawings in the textbook are put in different order in the workbook, and questions presented about the experiments or ideas are thus rearranged. Original workbook drawings or modified drawings from the textbook are used to set up matching questions and individual projects.

The general ideas followed in the design of workbooks are thus an extension of the scientific and artistic principles of textbook design. Textbook art is much more than just pictures or comic-book technique. It is a complex tool of non-verbal communication which can be applied in many ways to motivate and reinforce learning, and to promote transfer of learning from a reading context to the individualized work situation in study. Moreover, correlated art in textbooks is an indispensable instrument in advancing creative individual thinking in study and in reading. Impressionistic art deepens the processes

of creative thought in relation to human values, feelings, emotional tone, ideals, morals, and cultural factors. Representative drawing is the tool of classification, of demonstration, and of depicting processes, operations, and concrete examples. Abstract art, of which the bar and line graphs are functional derivatives, has all kinds of indispensable applications in textbook design—to give life to illustration and symbolism of all phenomena of interaction and dynamics, to create curiosity about unknown relationships, to demonstrate relativity of events, and to generalize at the perceptual level.

### *Procedures of Artistic Illustration*

Many original ideas are being developed today about the procedures of improving books visually and artistically. Hogben (1959) has spoken of a “New Look” which can be achieved by the use of professional illustrators in the publishing business. Here the illustrator serves both author and publisher in producing illustrations suggested or laid out by the author.

We have ideas about the procedures of book illustration which differ from the above arrangement. In our opinion, the integrated artistic illustration of textbooks cannot be achieved by arranging commercially executed illustrations in relation to the printed galley. The book must be written from the outset around illustrations, and the demands of the visual art must be met in the revision and editing of the final manuscript. Just as an illustrated lecture demands timing and interplay of speech and vision, the visions and symbols of an illustrated book must interact in their effects to produce a uniform flow of verbal and non-verbal artistic communication.

Here are the steps in a program worked out in relation to this general theory of book design. The first draft of the book is written around illustrations prepared by the author. In making his preliminary illustrations, the author works with two ends in view—to get illustrations that will serve the artistic functions of the book and to achieve drawings that will communicate with the artist.

A basic secret of interaction of author and artist is the fact that their communication must be carried out largely at the non-verbal level, through the use of the author’s drawings. The author must learn the varied uses of representative and abstract drawings and must know how to exploit the value of simple abstract designs in conveying the needs of artistic meaning to the artist. Thus from the first draft, the



manuscript is prepared to incorporate the illustrations as an integral or natural part of the communicative process of the book.

The initial plan for overall design of the book must take into consideration the number and variety of illustrations. After a plan is drawn up for the format, size, type, color, and special arrangements, and an agreement reached with the publisher, the artist-designer and the author can then proceed to finish the preparation of the book.

The artist-designer is given a copy of edited manuscript, along with the author's preliminary drawings for each chapter. Tentative artistic layouts specifying exact proportions are prepared from this material. Author and artist then discuss the desired illustrative effects for their layouts.

In order to achieve true artistic expression, the artist is left free at all times to execute layouts and finished drawings according to his own lights, as long as the general purposes of an illustration are not violated. The author can criticize a drawing as to accuracy or content, but not as to artistic effect, which is the domain of the artist. In this way, the artist can make a truly original contribution to the book and bring out novel illustrative approaches to subjects. He cannot make this contribution if he works according to specific directions.

After preliminary layouts are completed, they are checked for accuracy by the author. If the artist is doing an original job, his contributions will lead to revisions in the manuscript. The final manuscript will thus combine the verbal and visual conceptions of the author, the suggested changes by the editors, and the artistic additions by the artist.

The final drawings are prepared by the artist-designer or by contributing artists. When these drawings are done, the last stage of the work in page design is executed. The original design of the book, if effective, will expedite this process. As noted earlier, we developed the concept of the art column in the textbook, a marginal half-column that can be used to adjust both illustrations and captions to fit a given drawing to the text of the page.

The final page designing can be done from galley proof supplied by the publisher, or from typed manuscript. We have tried the latter procedure with some success, but also with some difficulties in keeping the page plan exact. The artist-designer uses a carefully-prepared manuscript which is typed so that the line length of the manuscript will correspond with the line length of the column of the book. He

sets up the page design and dummies from his own layouts and by computing the number of words per page from the typed manuscript. When the page dummies are finally prepared by the publisher, minor changes can be made in the manuscript to keep the text "in step" with the illustrations.

Figure XII illustrates some of the stages of evolution in the author's preliminary drawing, through the artist-designer's layout, to a final illustration of symbolism in dreams. Figure XIIa gives some idea of how the author attempted to achieve illustrative effects which could promote rapid effective communication with the artist-designer, but still not commit him to a specific concrete mode of execution of the subject. The abstract drawing gives the artist leeway to execute his own layout in terms of many different illustrative effects.

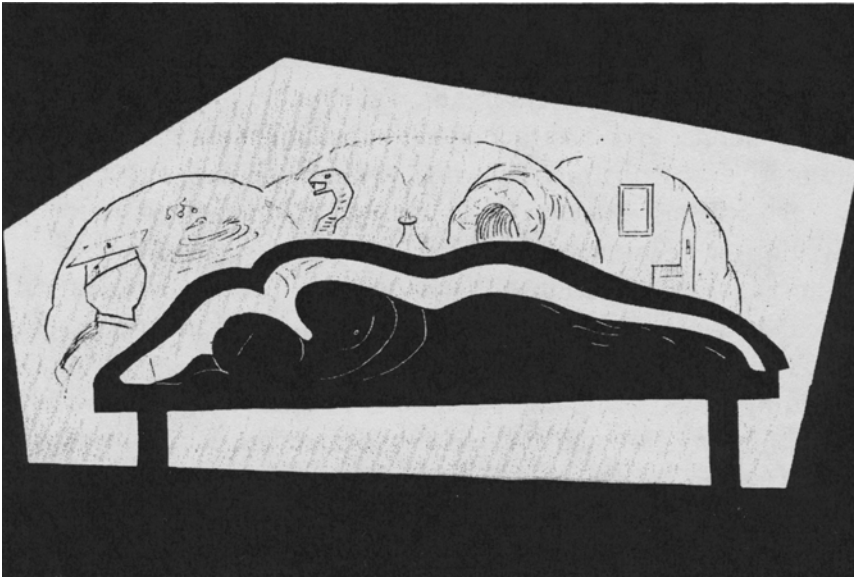
The layout of the artist in Figure XIIb is much more concrete and detailed than the original drawing of the author. The essential form of this drawing is followed by the contributing artist, whose production (Fig. XIIc) is a bizarre integration of pen drawing and the use of old engravings to achieve a special artistic effect.

The general conclusion from our experience covering the preparation of several hundred drawings by many artists, is that the essence of communication between author and artist is non-verbal. The disappointments which authors experience in trying to communicate with artists by verbal direction may be predicted from our theory that artistic communication is by nature not subject to verbal expression. Our experience is that the use of the author's drawings, prepared in both abstract and representative form, eliminates most of the problems of author-artist communication. The author's sketch is not enough. Poor art from the author probably means poor art in the book.

### *Theory of Textbook Design and Illustration*

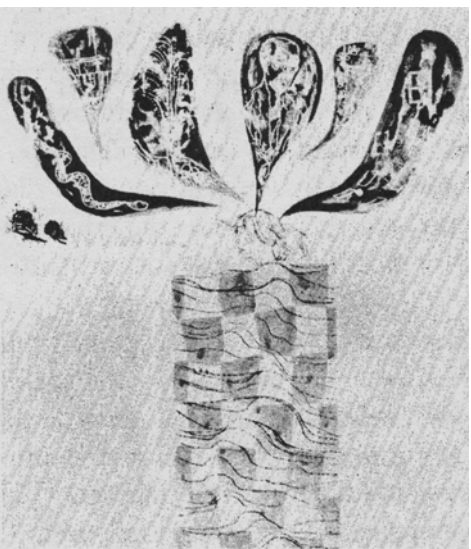
The systematic principles of textbook preparation just discussed constitute in effect a theory of textbook design. We have been interested in this theory, not only to guide us in preparing specific books, but to advance the scientific study of textbook design. Such study, aside from some observations to be reported here, has yet to be conducted in a systematic way.

Our general point of view was stated earlier. Books must be prepared according to principles of organic design. They must reflect and provide for various levels of natural behavior, symbolism and



a

b



c



(c) Final drawing by a contributing artist.

FIGURE XII. Variation in artistic conception of a subject (dream symbolism). (a) Author's preliminary drawing. (b) Layout artist's drawing.

Figure 24. In the preliminary sketch, the number of actual content of a dream symbolizes the basic content. All of the dreamer's wishes that are not acceptable to his conscience will be "repressed" into the unconscious where they can create symbolically in dreams. Each object or situation in a dream has a latent meaning. According to Freudian interpretation, most dreams symbolize actual drives.

The Nature of Dreams. Of all the voluntary reactions described above, dreaming is perhaps the most widely recognized and least understood. Throughout man's history the dream has often been regarded as having supernatural or mystical properties. The problem of interpreting dreams was a serious business in times when they were thought to govern the future.

Interpretation of dreams in modern-day psychoanalysis is not a matter of looking into the future, but of peering into the dreamer's past. Freud considered the dream a significant expression of the wishes and desires that he believes the level of consciousness. In his wish-fulfillment theory all of the ability or unpleasant associations related to any conflict are "repressed," or forced into the unconscious. In the dream they are released in symbolic form. The actual objects and events of a dream, in

communication, both verbal and non-verbal. To achieve such an integral confirmation of inner organic or emotional communication, as well as concrete and abstract symbolism, impressionistic as well as representative and abstract drawings are used to give substance to the verbal symbolism. According to this view, the coordination of art and writing is a natural expression of symbolism in thinking.

The organic interrelation of verbal and artistic communication is of historical origin. Art is ageless in its impact on the observer. Historically, writing was derived from artistic symbols—pictorial images representing objects and their relations in space. In the evolution of creative thinking, art and writing complemented each other and contributed to their mutual progress. Even in modern times, word symbols are learned first through their relations with objects and pictures. The reader can gain meaning from written words only in so far as these words create for him actual perceptual experiences or associations. Even the most advanced scientist depends on this connection between perception and verbal symbolism, and consistently uses visual illustration to support his use of words.

A primary principle of our theory is that artistic illustration helps define the general character of a book. The effectiveness of a book, textbook or otherwise, depends to a great extent on the reader's recognition of its unique individuality. Dictionaries and encyclopedias have their place, but most good books are not just collections of facts. They are organized symbolic systems, which reflect the significant relationships of events in nature. Visual art can sharpen the reader's awareness of a book's character by emphasizing vital meanings, pointing up certain values, and in general reflecting the author's attitudes toward his subject.

We have said that the motivation to read is in part perceptual motivation to explore, add to, and organize more completely the social and physical environment. The same motivation underlies artistic appreciation and artistic creation. Millions of people roam the museums of the world and intellectually roam through books for the same general purpose, to promote a more complete perceptual organization of the world at large and of their own needs and place in it.

Because of this common functional pattern of perceptual motivation in artistic appreciation and reading, verbal and artistic symbolism can interact in attracting, directing, and sustaining interest in the events and ideas of a book. According to our point of view, artistic

illustrations have no substitute in providing the essential conditions for sustained perceptual motivation in reading books. They direct attention to main events, segregate important observations, program the course of thought from the general to the specific or from the simple to the complex, and produce the environmental variations needed to hold the reader's interest over long periods of time. They provide, as it were, a natural, deep, organic, non-verbal base for verbal symbolism in writing.

Our theory also assumes a reinforcing effect of the artistic display on symbolic learning. The visual art can be used to confirm tentative ideas and perceptions derived from the reading material. This reinforcing effect serves to enhance understanding of the verbal symbols, and to improve retention of what is read. The artistic illustration acts as a goal in relation to the correlated passages in the text, and selectively increases the strength of the particular verbal ideas illustrated. The perceptual variety and richness provided by illustrations also promote learning at the symbolic level.

We have many decided notions about the way in which visual art can facilitate learning in reading. We believe there would be much better understanding of science, mathematics, and social human values if creative artistic illustration were systematically applied to books and teaching in these fields. We also feel that there would be a much wider understanding of foreign languages if all language books were illustrated by creative artistic displays. The widespread use of art in language training will promote understanding among different cultures. Art is not only ageless, it is also a universal form of language.

Our perceptual organization theory of reading finally proposes that artistic symbolism stimulates and implements creative thinking in the reader. Artistic illustrations provide a non-verbal base of communication which enriches insight into the meaning of written words, much as gesture and emotional expression add to understanding of spoken language. This interaction of the verbal and non-verbal material in books is based upon the correlation between equivalent forms of symbolism in art and in verbal expression. Specifically, representative, abstract, and impressionistic symbolism in artistic expression can be used most effectively with concrete, abstract, and emotional or motivational patterns of literary expression. This correlation enhances the reader's insight into the subjects thus illustrated, and increases the probability of his developing new relationships and ideas in thought.

Artistic illustrations can be created to interact effectively with any form or level of verbal symbolism.

The theory of learning underlying the principles of book design outlined here is in contrast to doctrines of specific-response reinforcement and conditioning, which have become so prominent in modern psychology. The main notion here is that man learns some few things through specific-response reinforcement, but that generally, and especially in reading, he has risen above this level of motivation and organization. We do not depreciate reinforcement as a factor in learning. We say that, in man, reinforcement is organized on a broader base and in terms of many more dimensions than the base and dimensions of the specific reflex response. We say that the primary dimensions of reinforcement in human learning, and especially in verbal and symbol learning, are related to perceptually organized motion, to perceptually structured emotion and need, and to the general activities of motivation in aural or visual recognition, discrimination, classification, and artistic representation. The phenomena of the picture book, of music, radio, motion picture, television, the various forms of human art, and of the development of language itself all define the significance of this point of view. Artistic visual design is tied in with reading on both the side of motivation and reinforcement, as we have shown. Artistic representation is the basic transitional process between manipulation and knowledge of objects and the verbal symbolization of these objects. Art is a primitive age-old indispensable means of human communication, which may be degraded by picture-books and poor television, but which will always have a vital role in human learning and education. The full significance of artistic design is yet to be discovered in modern education.

The theory of textbook design presented here, and the materials of the textbook and workbook evolved from this theory, may be employed as the basis of research on the nature and effectiveness of textbooks in teaching.

One of the main predictions of our theory is that students will react to an artistically illustrated textbook as being better organized than a book based largely on verbal dialectic and logical discussion. A systematic comparison has been made of an artistically illustrated book and an equivalent scientific textbook on human behavior consisting of a rigorous logical approach to the subject. Over 80 percent of 150 students in a beginning class in psychology in one of the out-

standing educational institutions of the country reacted to the illustrated textbook as a well organized book. The same reaction to the other one as a well organized book was considerably less.

We do not predict from the theory stated here that verbal memory and comprehension are increased on a short-term basis by artistic illustration. Experimental tests have shown that immediate verbal comprehension with and without illustrations is not significantly different. The prediction is made, however, that perceptual memory of the contents of a book is enhanced by artistic illustrations. We are at present developing electronic teaching machines to test some of these predictions about the relative comprehension and memory value of illustrated and purely written material.

The theory of artistic visualization of books described here may be extended to other educational media, such as the design of advertisements, industrial training books, and teaching devices. We apply the specific principles described here to the design and development of automated lecturing devices, made up from tape recorders and tape-recorder controlled filmstrip and slide projection devices. We have termed them "Audiovisumatic Teaching Devices." Besides presenting material to be learned, these training machines also ask the student questions in aural or visual form, which must be answered by punching an answer sheet. The correct response to the answer sheet controls further questions presented by the machine.

The audiovisumatic teaching methods represent a "new dimension" of visualization of lecturing and tutoring. These machines achieve for lecturing what artistic illustration achieves for book design, that is, controlled integrated visualization that may be varied in artistic function. They also open up a new approach to study and the development of aural-visual "workbooks" for the student's individual use. The integrated artistic visualization of material with both written and oral speech in teaching is now within the reach of every teacher.

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