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ABSTRACT

In 1964 World Book wanted to be able to say that more than 1,000 maps being made for the encyclopedia were designed to be appropriate and useful for children between the ages of nine and fourteen. However, there was virtually no research on which such a program could be based. This paper briefly reviews research projects in this area started in 1964 by Field Enterprises Educational Corporation and continued through 1967. In summary, this work has provided two major things: 1) it has shown the inadequacy of existing research relating to children and their characteristics as map users, and of the theoretical framework in which the research has been done; and, 2) it has provided an approach to map design that consists essentially of matching an intellectual array of map use tasks to a visual array of graphic elements. (SBE)

Designing Maps for Children

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Designing Maps for Children

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Anyone who claims to be designing maps specifically for children implies that he has some knowledge about the characteristics of children as map users. When I came to World Book in 1964, I found that they wanted to be able to say that the more than 1,000 maps being made for the encyclopedia were designed to be appropriate and maximally useful for children between the ages of nine and fourteen. But at that time there were virtually no research data on which such a program could be based, and I had very little idea what such a program would eventually entail and what the maps that might result from it would be like. Therefore the first research project I conducted was very wide-ranging, and from that project as a base we were able to focus later on more efficient and useful approaches.[1] Over a period of three years, I interviewed about 1,000 children, one at a time, for periods of from ten minutes to half an hour[2]. During the test period, the child and I had a map of some sort in front of us, and I then asked a series of open-ended questions that were to provide us with specific information on which to base design decisions. These were ultimately to do far more than that in providing us with insight into the perceptual and cognitive processes involved in map use.

And now what can we say? We can most assuredly say that the

phrase, "characteristics of children as map users" as the focus of this presentation is meaningless until it is enormously qualified. The kinds of qualifications we have learned to make are as important a finding for us as any specific data. First, the word, "characteristics." Taking the topic of color, what characteristics would be relevant? Those having to do with hue discrimination thresholds? Or those having to do with color labeling abilities? Or hue memory capacities? Or comprehension of color as a visual symbol, or the affective value of color. Or what? Are we to be most concerned with a data-bank kind of knowledge assessment at a particular age, or is it more important to focus on organismic capacities for physical discrimination? What kinds of characteristics, in short, must be taken into account?

Clearly, there are many kinds. While research on the global topic of "color" sounds useful, much of what exists is virtually worthless in the real choices that must be made as maps are produced. There is need for careful qualification of the word "characteristics." Isolating and defining the characteristics of children that are relevant to their map use is an area in great need of intellectual and empirical labor.

Second, the word, "children". I will not belabor the obvious point that there is very little resemblance among the six year old who approaches the map, the nine year old, and the thirteen year old. All that children share as a category of map users is that they do not behave exactly like adults. Within the category there is

sufficient variation to make it rather useless as an indicator of any functional homogeneity. If common sense is insufficient to demonstrate this point, there is always Piaget's definitive work on the development of cognition during the years from birth to adolescence. While The Child's Conception of Space[3] is an enormously valuable elaboration of the stages of development in children, it is too general to be directly applied to the specific mapping problems we face. At the practical level, as makers of maps for children's reference books, we find also that we can't be very involved with children's conceptions of space, because there may be very little connection between those conceptions and the maps that children are expected to be able to decode in conventional ways. For example, we need to know if they can easily use our maps to report that Town A is east of Town B, because, in fact, our responsibility ends there. Whether they have any idea of what "direction" is, or what "east" means cannot be of direct concern to us. We have found that their conceptions of things like "east" are generally very limited ones, and are not easily transferred to new, more generalized problems or to new stimulus situations. For example, most sixth grade children could use a map to tell you that one town is east of another on that same map. But if they are given two maps with clearly labeled grid lines, and asked to tell which country is east of the other, their responses would not be nearly as satisfactory.

Even given the fairly restricted age range in which we have conducted research (nine- to fourteen-year-olds), there can be very

great differences over this range, in performance, experience, and cognitive capabilities. For example, when the children were asked the direct question, "How far is it from A to B?" on a map with a graphic scale, only 40% of the nine-year-olds could respond correctly, but this proportion had increased to 90% by age thirteen. There are a few things that we can assume to be true for nine- and thirteen-year-olds alike. As a result, we tend to design for the least capable map-using child, knowing that if he can understand something, the more capable child will also understand. There is, of course, a rock-bottom level below which we are unable to go in reference books with severe space limitations. We can make the most conspicuous legend, with the simplest words and most explicit graphic choices possible... but we are unable to help the child who does not know that this thing is a map and that it represents a part of the earth's surface, and that the ink marks tell you things about the earth and that the legend tells you how the ink marks and the real earth things are related. We can simplify our vocabulary as much as possible, but we cannot teach the child a new language.

In the phrase, "characteristics of children as map users," I find the most troublesome words of all to be the last two--"map users." The possible diversity of maps that children might encounter is obvious. What is not so obvious is the variation inherent in the conception of "use". What <u>does</u> one do with a map? Saying that maps are "read" tells us nothing, and in some ways is worse than no word at all because it

implies that there is some unitary task involving a bounded set of perceptual-cognitive skills, and that all the evaluator or researcher has to do is find out how well children "read" maps. Understanding and defining the nature of the multitude of tasks that can enter into any situation of map use is the activity that has taken more of my time and intellectual energy than any other in the years at World Book.

In order to evaluate children's performance in using maps, you must ask them to do something, since you can't just say, "Read that map." Any findings, then, will be intimately related to the task they are given, and the results will be task- and situation-specific more often than not. There is simply no way in the world to unambiguously answer the question, "Can a ten-year-old child use a map scale?" What was he asked to do? What did the map look like? In what form did the scale appear? How big was it? What were the scale units? How was it subdivided? How was it labeled? How close to the map was it? Did you ask the child how far it was from one town to another, or did you ask, "What city is 800 miles from Town A?", or did the question take some other form? Did you expect an exactly correct response, or was something within 25% of correct an adequate answer? Did you want a mechanical measurement, or some evidence of comprehension of the idea, "to scale"? Every single one of these things will modify the answer that might have been given to the original question. A child might well be able to use a map scale with one map and not with another, and might be able to give an accurate response with one form of scale and not

with another. The naivete of the original question is apparent.

Continuing on the topic of "to scale" and "the scale", there are findings that further underscore the complexity of research in the area of map use. Since I have done all of my work on the basis of individual interviews, I have been able to observe a great many things that would have been unobservable in a group paper-and-pencil test situation. For example, knowing the reason that children give wrong or inadequate answers to questions is frequently more valuable to us in map-making than is simply knowing that X% of the children gave an accurate response to a particular question. In the matter of scale use, I observed an interesting five-stage sequence in the development of children's abilities to use a graphic scale. This does not mean that each child went through the five stages; it simply means that at the time of testing, I found each child to be in a stage, or at one level of development, on the way from complete ignorance to complete comprehension.

The stages were:

Stage One: The child had no idea that you could measure a distance between two places on the map. He had no idea that, a. distance could be symbolically represented, or b. that it could be measured in some way.

Stage Two: The subject would gaze at the map for a bit, and then comment that "this thing" (meaning the graphic scale, to which he would point) had something to do with the question, but that he didn't know what.

Stage Three: Throughout the testing procedure, a 12-inch ruler lay right next to the maps. It was never pointed out to the subjects, but they were free to use it. In the third stage, the child would reach for the ruler, or use two fingers, and hold it along the edge of the scale, thus marking off one unit equal to the total scale length. Then he would apply this unit of measure to the distance in question on the map, and when they didn't match exactly, he would give up in bewilderment. This stage rather surprised me--the child seemed to be so close to using the correct technique, and yet was intellectually almost as far from it as a child would be in Stage One.

Stage Four: The child used the correct measuring technique, applying the units of the scale to the distance in question, but he did it very crudely, by using his eye, two fingers, or the ruler. The answers given in this stage were crude, but usually correct $\pm$ 50%. In this stage, there were no attempts to estimate parts or interpolate between scale units.

Stage Five: The child produced an immediate, correct measurement, indicating comprehension of the idea of scale and the appropriate technique for measuring it.

So if a child cannot use a map to report the distance between two places, he could be failing to do so for one or more reasons, and the map maker must know why many children fail. Any of the following could be specific reasons for failure--

A. He doesn't realize that a map is a depiction of reality which is

smaller than reality, but can be measured in a way that will provide the measurements which exist in reality.

B. He realizes these notions, dimly, but doesn't know how to go about extracting distances from the map.

C. He realizes A, and he knows something about scale bars, but the distance in question is a fraction or a multiple of the total scale bar, and he cannot compute it.

D. He realizes A, but applies some other scale "rule" he has learned (such as, "one inch equals 100 miles"), not realizing that maps can be <u>any</u> scale.

E. He realizes A, finds a scale bar or statement, but since the design is different from any that he has encountered before, he is uncertain about its use.

Clearly, there is a complex group of basic ideas that must be understood <u>before</u> any particular map scale is used. The use of the map scale is a final achievement, based on a number of preceeding achievements, not a simple mechanical manipulation. The same thing can be said of every commonly stated map use "skill".

Another area in which we have done some relatively extensive research is that of map typography.[4] Here again our original question was to prove impossibly naive: What about type on maps for children? And here again I had to ask children to <u>do</u> something. What do you do with map type? There seemed little point in just asking them to pick up a map and begin to call out the names. I could think of nothing for

them to do that would allow me to directly compare the findings for map type with the findings that existed in the general type legibility literature, that is, I could not think how to measure speed-of-reading or degree-of-comprehension per unit time. Instead I asked the children to search maps, and controlled the type variation and the appearance of the list of names from which the searching was done, and was able to establish that there are certain kinds of type variation on maps that will affect the amount of time it takes to find place names, using a random search technique. Of course there are many other things I could have asked the children to do with names on the map -- I could have asked them to look at a map, then look away and try to write down all the names they could remember seeing. I have, in fact, done something similar to this.[5] Children had looked at several political reference maps of Illinois as they answered a variety of questions. Then, unexpectedly for them, I turned the map over and asked them to tell me as much as they could about the map they had just seen. A great many responses included something about the names; often the children reported seeing Rockford, Peoria, Springfield, Chicago, and St. Louis because the names had been set in rather bold type. This is not a particularly sensitive way of finding out about type variation effects, but it did tell us that we had a hierarchical arrangement of type, with the cities just mentioned falling into one category of memorability, and all the rest of the place names falling into another.

In general, the particular findings about specific tasks, subjects,

and map designs have been less important to us than have been the development of systematic approaches to the analysis of map design for a designated group of map users. Two things have been of especially great importance in our approach to map-making. First, there is the explicit recognition of the need to describe our purposes or intents in making each and every map. We force ourselves to ask what tasks we would like children to be able to perform using our maps, and what tasks they might reasonably expect to perform. We are concerned with anticipated impressions as well as with specific tasks; choice of an equal-area projection for a world wall map, for example, would demonstrate our concern with the impression of relative country size, even though the children might never specifically be asked how they thought countries compared in size. The tasks we consider in map use are not general tasks; I think we have shown how un-useful it is to say, "the type should be readable," or that "the children should know about climatic variation," or that "clarity is a desirable goal in map-making,"--when the real question is, "clarity of what?" or "clarity for what?". Given the notion of figure-ground contrast, it is obvious that clarity of the figure is gained by reducing the conspicuousness of the ground. Clarity for one aspect of the map is usually gained at the expense of some quantity of information or at the expense of the quality of some other information. Further, we know that performance of a map user with a map will depend on the nature of the task for which the map is used. Virtually all of our findings have been task-specific, so that

the selection of tasks for which the map is intended is critical. Since there is normally more than one task that is to be performed, the tasks must be arrayed in a hierarchy of importance, for it is impossible for one map to be equally useful for ten tasks. The hierarchy is to be preferred to a simple listing, for it will often be true that two tasks may make demands on the map design which are mutually exclusive or contradictory, and a choice must be made on the basis of judged relative importance. For example, the type that makes one name stand out may have to be so large that other names must be omitted. So the map becomes more useful for that one name, and useless for the omitted names. Most place-name reference maps become something of a compromise between a high-impact billboard and a high-information telephone directory.

Defining and arraying specific task requirements is the most difficult task in map design. Once this is done, the selection and arrangement of graphic elements becomes relatively easy.

But not too easy. The visual hierarchy must then be organized to match the task or intellectual hierarchy. Things that are intellectually most important for the map must look most important. Major intellectual differences must appear as major visual differences. Young map users in particular are susceptible to visual impressions because they lack other information which will enable them to compensate for misleading or inadequate visual information. If one country is shown on a political map, for example, in a very bright and visually outstanding color, the children will often assume that this country is somehow more important.

If one city has its name set in bolder type than the cities around it, they assume it is a more important city. If two countries occupy the same page space in an atlas, they will assume they are the same size on earth, and so on.

In summary, our research has provided us with two major things. First, it has shown how inadequate is existing research relating to children and their characteristics as map users, and how inadequate is the theoretical framework in which most of this work has been done. Second, we have devised an approach to map design that consists essentially of matching an intellectual array of map use tasks to a visual array of graphic elements. It seems obvious that in arriving at this approach we have an approach to map design that goes beyond designing maps for children.

Footnotes

1. Bartz, Barbara S., Map Design for Children (Chicago: Field Enterprises Educational Corporation, 1965).

2. The following reports summarize much of the research conducted at Field Enterprises Educational Corporation from 1964 to 1967, and can be made available (in microfilm) upon request to the author.

   a. Map Design for Children (1965), 224 pp.
   b. Map Type: Form and Function (1966), 145 pp.
   c. What About Illinois? or Children and A Reference Map (1967), 71 pp.
   d. Medium Article Political Maps Research (1967), 43 pp.

3. Piaget, Jean, and Barbel Inhelder, The Child's conception of Space (New York, W.W. Norton and Company, 1967).

4. Some of this research is described in a series of articles which appeared in 1969 and 1970 in The Journal of Typographic Research:

   a. Bartz, Barbara S., "Type Variation and the Problem of Cartographic Type Legibility," in Volume III, No. 2, April, 1969, pp. 127-144.
   b. Bartz, Barbara S., "Search: An Approach to Cartographic Type Legibility," in Volume III, No. 4, October, 1969, pp. 387-397.
   c. Bartz, Barbara S., "Experimental Use of the Search Task in an Analysis of Type Legibility in Cartography," in Volume IV, No. 2

5. See 2.c. above.