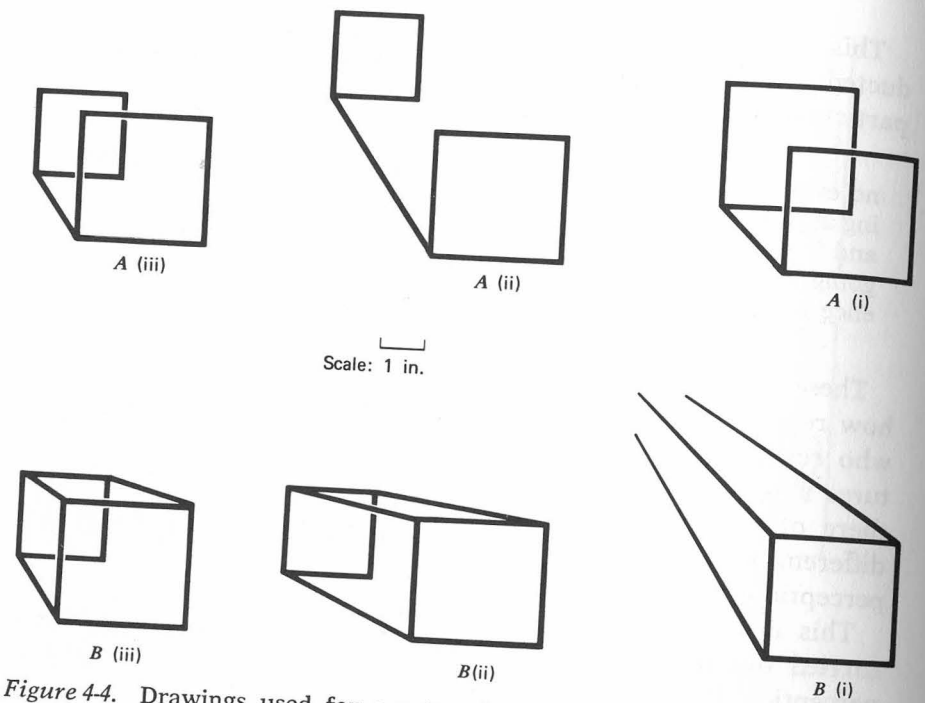


Figure 4-4. Drawings used for construction models in depth perception test.

Deregowski's pictures! The models were not always perfect, but they clearly reflected information about depth. Deregowski summarizes these results in the following manner:

> The frequency with which subjects who were 2D on Hudson's test made 3D responses to the construction test suggests that it is probably illegitimate to extrapolate from Hudson's findings to all types of pictorial material. A subject, it appears, cannot be classified as a 2D perceiver of all pictorial material merely because he is a 2D perceiver as far as Hudson's test is concerned. This does not invalidate Hudson's remarks about the difficulties which might arise owing to the cross-cultural differences in pictorial perception (Hudson, 1960, 1962a, b). It *does*, however, limit their applicability by excluding, at least in part, the type of pictorial material used in the construction test (Deregowski, 1968b, p. 203).

This work clearly demonstrates that we cannot talk glibly about 2-D and 3-D perceivers as if they were different people. But it is not clear what gets a person to respond three-dimensionally under some circumstances and two-dimensionally under others.

Deregowski emphasizes that the content of the picture is important. But we also ought to consider the influence of what kind of response subjects are asked to make. It might well be that what someone is asked to do with a picture influences his attention to particular cues; the request to make a stick model certainly is not the same as asking questions about a hunter's target. What would have happened, for example, if subjects had been shown a three-dimensional board-model of the contents of Hudson's pictures and asked to place the hunter and the antelope (or the hunter, the antelope, and the elephant) in their correct positions? If this construction task influences the expression of three-dimensional responses, a new dimension would be added to the study of pictorial depth perception. If it does not, we would confidently narrow our study of factors influencing three-dimensional pictorial perception to the questions of picture *content*, emphasized by Deregowski.

Several other experimental observations point strongly to the influence of culturally patterned conventions on the perception of pictorial material. Hudson reports several studies in which various pictorial conventions taken for granted by Europeans were absent in tribal Africans. Among these was the use of foreshortening to indicate perspective: a picture of a man ascending stairs was seen appropriately by literate European children, but nonliterate African children saw the man as maimed, one leg being shorter than the other. African students asked to draw a cow in profile showed all four cloven hooves, two horns, and two ears, much as if the pupils were making a combination of profile and frontal views, while European students drew a profile. Hudson concludes that the European child draws what he sees, literally, even though he knows it may be conceptually inaccurate, while the African draws what he knows to be there—a cow is not a cow without four cloven hooves.

Perception of Orientation

Another convention that we take for granted, but which is almost certainly learned, is the orientation and positioning of a figure on a sheet of paper. In Western art, objects are normally positioned with reference to the base of the page and its sides: African children studied by Hudson drew all over their pages and the orientation of each figure was, to all intents and purposes, random.

This latter finding raises an interesting question: Do nonliterate people experience actual difficulty in *perceiving* the orientation of objects in pictures, or do they simply ignore our conventions when asked to reproduce a picture?

Deregowski (1968c) posed the question as follows: In perceiving the orientation of one depicted object relative to another, does difficulty arise from the angle at which the picture was taken (he used photographs) or from the subject's position when he is asked to reconstruct a pictorial arrangement? He also wanted to determine whether subjects would be influenced by the contents of the depicted scene.

In a study of 11-year-old schoolchildren in Lusaka, Zambia, he used the apparatus shown in Figure 4–5. This figure is a schematic drawing of a board with a toy Land Rover in the center. In the first of two studies, the Land Rover was alone on the board. In

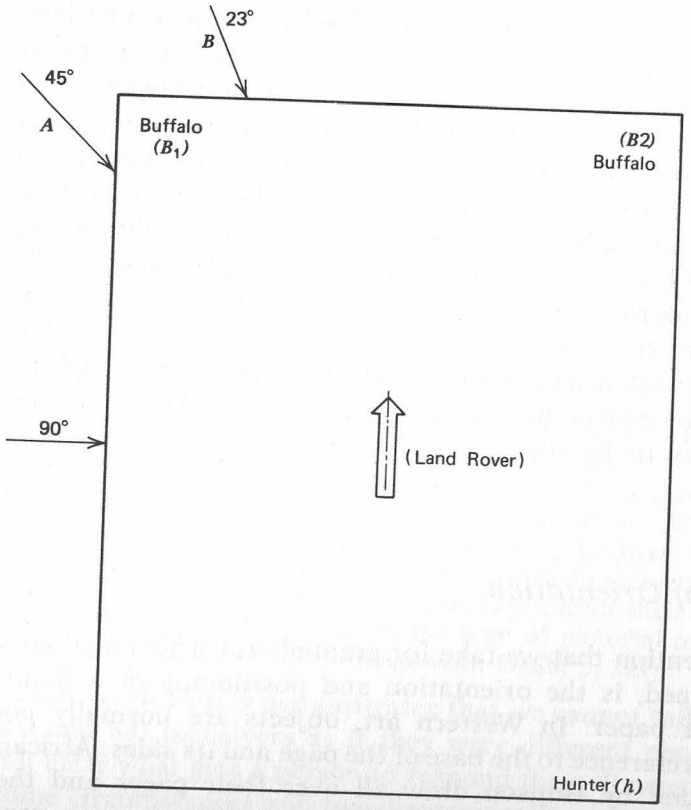


Figure 4-5. Arrangement of objects in Zambian study of pictorial orientation.

the second there were toy buffalos at C1 and C2 as well as a hunter at H. The hunter was pointing his gun at buffalo number 2.

For Experiment 1 there were three photographs of the Land Rover taken from just above ground level. The photographs were taken from the angles indicated by the arrows at 23°, 45°, and 90°, and from such a distance that the truck was seen to be in the middle of the board.

For the reproduction trials, in which the subject had to position the truck to accord with its location in a photograph, the Land Rover was mounted on a freely rotating disc in the center of the board, and the board was placed on the floor. Each subject was shown a picture taken from one of the three angles and asked to place the truck just as it appeared in the picture. Different groups of subjects stood at different angles to the truck (23°, 45°, or 90°).

The main question was to determine whether subjects misjudged orientation, and how.

Deregowski's results show that his subjects certainly did make errors in their judgment of orientation of the Land Rover: if the camera angle and the subjects's viewing angle coincided, placement was more or less accurate. But when camera and subject viewing angles did *not* coincide, gross errors occurred. Deregowski summarizes the pattern of responses as reflecting a process whereby the subjects assume that the camera occupied the position that they, at the moment, occupy and hence make adjustments in which the car is at approximately the same angle to themselves as it is to the camera (1968c, pp. 152–153).

In Experiment 2, Deregowski sought to determine whether the content of the photographs would influence the subjects' perceptions of orientation.

For this purpose, he used the two toy buffalos and the hunter, but removed the Land Rover. He then photographed three arrangements of buffalo and hunter. In the first picture, both buffalos were present; in the second, only buffalo 1 was present; in the third, only buffalo 2 was present. The hunter always aimed at the spot where buffalo 2 was supposed to be placed, *even when that buffalo was absent.*

The question then became, would subjects who are asked to place the toy hunter in the same position as the photographed hunter reorient him to make the scene realistic? That is, would they make the hunter point at buffalo 1 if buffalo 2 were absent? Subjects did change their responses to the different displays in

the way predicted if they were trying to make the reproduction sensible. Moreover, when Deregowski compared the results for different camera angles in Experiment 2 with the size of errors he had obtained in Experiment 1, he found that the subjects seemed to be more influenced by their desire to render a meaningful reproduction than by camera angle.

Although other research along the same general lines could be cited, it is clear that pictorial representation and the interpretation of pictorial material have a large experiential component to them, which involves the mastery of conventionalized forms of representation and conventionalized definitions of the task (such as making a distinction between what one "sees" and what one "knows," for example).

An important question that remains to be clarified is to what extent such perceptual habits acquired early in life are reversible later. Even college-educated Africans often interpreted Hudson's pictures two-dimensionally, and so did most of the schoolboys in Deregowski's study. But Dawson (1967) reported that three-dimensional interpretations can be taught rather easily.

He selected 24 young Temne mine apprentices who in an earlier study had given two-dimensional responses when shown drawings using depth cues. From this population, he set up two groups matched in education (all were in secondary school), in intelligence test scores, and in other characteristics in which he was interested. The training group received 8 hours of instruction in drawing pictures with depth cues; the others acted as controls. Both groups were retested three months later to see whether training effects, if present, would endure over time. The training group showed significant improvement in the use of 3-D cues, as compared with the control group when retested on the original material as well as on new material. These results suggest that specific instruction in the conventions of pictorial representation rather than general exposure to pictorial material may be the critical learning experience for 3-D responses, but one training study confined to one population is inadequate evidence; this is clearly an important question for future research.

Visual Illusions

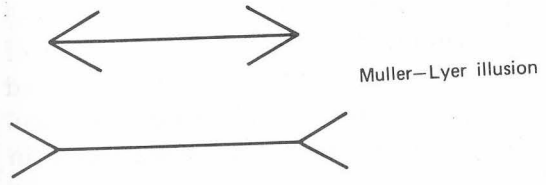
One way to study the influence of past experiences on perception is to set up an experimental situation where the normally useful

cues are misleading. Therefore, the study of visual illusions has provided interesting evidence of the relation between culture and perception.

Segall, Campbell, and Herskovits (1966) conducted the first systematic study of perceptual illusions across cultures. They also provide a lucid and comprehensive discussion of the rationale and methods needed to make such studies successful. Although their particular theory can no longer be considered adequate, their method of approach is a good starting point for a discussion of this problem.

They worked with two well-known visual illusions, the Muller-Lyer illusion and the horizontal-vertical illusion (see Figure 4–6), asking members of many different cultural groups to respond to these two perceptual stimuli. They reasoned that if different groups of people raised in different environments had different inferential habits when it came to using such cues as distance and length, these groups ought to respond differently to illusory stimuli.

In particular, Segall and his associates hypothesized that people growing up in Western environments, which they characterize as *carpentered* (with regular rectangular objects, straight lines, and



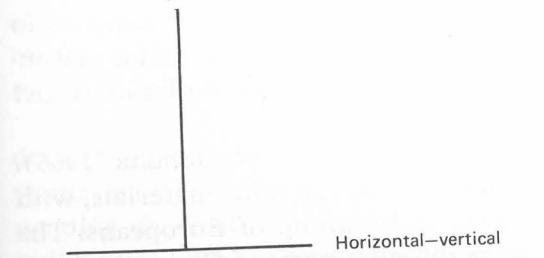


Figure 4-6. Visual illusions used in Segall, Campbell, and Herskovits cross-cultural study.

so forth), would tend to be more subject to the Muller-Lyer illusion than people who have not been exposed to such regular geometric relationships; similarly, the horizontal-vertical illusion would be weaker in people whose environments provide little opportunity to view the horizon or to see great distances (such as jungle dwellers) and stronger in people whose environments required them to make many such distance perceptions.

The researchers took many precautions to make sure that their subjects understood the task and that the experimental procedures were the same from sample to sample. The subject had only to indicate which of two lines was longer each time he was shown a stimulus pair. Many different examples of each of the illusory stimuli, as well as stimuli that did not produce any illusion, were presented to each subject. When the data had been collected, it was possible to get a score for each subject, indicating the extent of his susceptibility to the illusion.

This experiment was conducted with almost 2000 people from 14 non-European locations and the United States. The results showed that American subjects were more susceptible to the Muller-Lyer illusion and that many, but not all, of the non-European groups were more susceptible to the horizontal-vertical illusion. Segall and associates concluded that response to these illusions varies with the conditions of an individual's (or group's) environment: carpentered environments lead to misperception of the Muller-Lyer figures and experience with long, uninterrupted views enhances susceptibility to the horizontal-vertical illusion. (Note, however, that illusion-supported responses were found in all the cultures studied; that is, the illusions *were*, to a lesser or greater extent, illusions.)

The story of research on cultural-environmental effects and susceptibility to illusions does not stop here. As so often happens in scientific research, a particular fact may have more than one interpretation, and this is very much the case with the findings just reported.

One alternative explanation is provided by Gustav Jahoda (1966). He conducted the same experiment, using the same materials, with two groups of Ghanaian subjects and a group of Europeans. The two Ghanaian groups were from different parts of Ghana, and one of the groups had adopted more Westernized, "carpentered" technology. This would lead us to predict, on the basis of the *carpentered world hypothesis* that the Westernized Ghanaian group and the European group would respond alike, but differently from the non-westernized Ghanaian group. However, the two Ghanaian groups responded alike and were less susceptible to the Muller-Lyer illusion than the European group. Jahoda concluded that some factor other than carpenteredness of the environment must account for the data. He suggested that the explanation might lie in the difficulty all Ghanaian subjects have in interpreting pictorial material.

More recent attempts to account for variations in susceptibility to the Muller-Lyer illusion across different human groups implicate physiological as well as cultural and ecological factors. This work stems from Pollack's discovery (Pollack, 1970; Pollack and Silvar, 1967) of a strong relation between a specific property of the visual system—retinal pigmentation—and susceptibility to this illusion: the more dense the pigmentation, the less the illusion susceptibility. Since it is generally known that retinal pigmentation is more dense among dark-skinned people, Pollack compared the susceptibility to the illusion of dark- and light-skinned children in the United States and found, as expected, that the dark-skinned children were less susceptible.

Could this relationship account for the cross-cultural results? Berry (1971a), who has studied the Muller-Lyer illusion in a variety of cultures, originally thought that he had supported the carpentered world hypothesis when he had found a significant correlation between this ecological factor and extent of illusion. But when he reanalyzed his data, he found that degree of pigmentation was more highly correlated with susceptibility to the illusion than was carpenteredness. However, Jahoda (1971) questions the *ad hoc* ranking of skin color for Scottish, African, Eskimo, Australian aboriginal, and New Guinea Melanesian communities; the "actual values of the correlations should be regarded with some reservation," he says (p. 200).

In a carefully designed study, Jahoda tested other hypotheses derived from Pollack, suggesting that for individuals with dense retinal pigmentation susceptibility to the illusion should vary, depending on whether a figure is drawn in red or in blue, whereas individuals with less dense pigmentation should do about the same with either color. With populations of African and Scottish students, Jahoda did, indeed, find that the African, but not the Scot-

tish, students performed differently on the red and blue stimulus figures. While this confirmed certain aspects of Pollack's theory, an interesting feature of the results was that overall illusion susceptibility was somewhat higher among the Africans—a reversal of the original findings by Segall's group, which set off the theorizing in the first place! Jahoda concludes, "it seems likely from these and other studies that no single factor can adequately account for the observed variations in M-L illusion susceptibility" (p. 206).

Bornstein (1973) used the pigmentation hypothesis to make predictions about how cultures in the original study made by Segall's group would rank on Muller-Lyer illusion susceptibility. The rank ordering predicted by pigmentation data fit Segall's obtained results quite nicely. In an interesting extension of this line of reasoning, Bornstein went on to develop the notion that differences in pigmentation associated with differences in sensitivity to certain colors (especially those in the blue-green range of the color spectrum) might account for cultural differences in primary color names. A survey of color names in 126 societies showed a regular geographic patterning of color naming that did indeed parallel the distribution of eye pigmentation. These data have fascinating implications for two of the most controversial issues in cross-cultural research. For one thing, they raise the possibility that people in different cultures may, in fact, *see* color differently. Secondly, they suggest that the relation between perceptual and linguistic phenomena in the color domain may be the very reverse of that posited by Whorf—color *vocabulary* may be determined by color *vision.*

Bornstein's careful work relates the physiological characteristic of yellow ocular pigmentation to environmental variations (differences in exposure to ultraviolet rays, which vary with altitude and proximity to the equator) and differences in diet. Thus, environmental differences operating through *physiological* mechanisms might contribute substantially to the two classical cognitive phenomena (color naming and susceptibility to visual illusions) for which evidence of differences among people is strongest. Discussing the deficiencies of earlier single-factor explanations of these phenomena, Bornstein says that his psychophysiological approach is not offered as the sole explanation of cultural differences. "Most probably," he points out, "the interactional complexity of environment, culture, and organism will disallow any monistic view" (p. 43).

This line of work is an important reminder that specific physiological characteristics of receptor systems need to be taken into account in perceptual research, and that when physiological and cultural factors co-vary, it is folly to pursue one without taking account of the other.

Another example of differential responses to illusions comes from a study of the Zulu of Natal made by Allport and Pettigrew (1957). Their experiment made use of the rotating trapezoidal window illusion (see Figure 4–7). The window is so proportioned that when it rotates, the length of the longer edge is always longer on the retina than the shorter edge. The perception normally reported is that the window appears to be swaying back and forth instead of rotating. The explanation given by the inventor of the illusion (Ames, 1951) is that the observer, familiar with *rectangular* windows, assumes that this window, too, is rectangular. From long practice in viewing objects of all types the subject interprets the window as oscillating rather than rotating.

Allport and Pettigrew studied Zulu responses to the trapezoi-

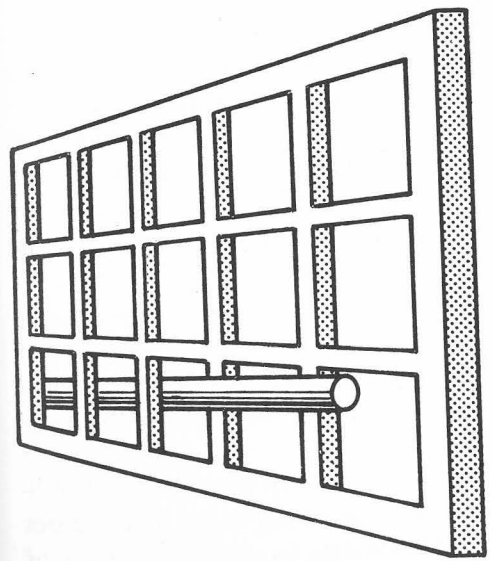


Figure 4-7. Apparatus for studying trapezoidal window illusion (adapted from British Psychological Society).

dal windows because they hypothesized that traditional Zulu culture "is probably the most spherical or circular of all Bantu cultures, possibly the most spherical of all native African cultures." Round rather than angular style is the aesthetic ideal; huts, corrals, fields, doorways, and many other aspects of the Zulu cultural environment are round where Europeans would expect to find angular shapes prevailing. The Zulu language has a word for round, but none for square.

The experiment was conducted with four groups: rural African boys from two different areas, a group of urban African boys, and a group of urban European boys. Testing for the illusion was carried out under four conditions, varying from easy to difficult.

Previous research in the United States had shown that the *more difficult* the viewing conditions, the *more likely* it was that subjects would be fooled by the illusion. In South Africa, Allport and Pettigrew found also that all groups reported the illusion under difficult viewing conditions. But under the easiest viewing conditions, the Westernized groups reported more illusory responses than the traditional groups. The authors conclude that *both* an effect of culture on perception *and* evidence for general-human perceptual processes are suggested by the pattern of results: the general-human process is manifested under difficult viewing conditions, the cultural influence under easy viewing conditions. Under the easy viewing conditions the fact that Westerners and Westerized Zulus live in a carpentered environment, with many examples of right angles and rectangular windows, leads them to make the wrong inferences even under conditions where the traditional Zulus stop being influenced by the illusion and report correctly on the motion of the window.

Perception and Attention: The Problem of Selection

Thus far we have emphasized the way in which a person's experience, or lack of experience, with certain phenomena may affect the way he organizes stimulus information (as in perception of pictorial representations and illusions). In this section, we will inquire about cultural influences on the *selective* aspects of perception. We are constantly bombarded by a barrage of stimuli, but at any one time we attend to only a small set of this available stimulation. Does cultural experience affect perception by guiding the selection process?

Binocular Rivalry

One way to approach the problem of selection is to take advantage of the phenomenon of binocular rivalry: When two different objects are shown to a subject, and each object is seen with a different eye, subjects usually report that they see one object first and then the other. Sometimes, if the objects are similar, the pictures "fuse" and the subject reports seeing a single object combining features of the two.

Berry (1969) used this technique to determine whether familiarity, in the sense of cultural relevance, would influence what subjects tend to see first. As part of a larger study of the relation between culture and perception, he tested Eskimos and subjects from Sierra Leone, West Africa (Temne), using photographs of five pairs of objects. One member of each pair was an object familiar to the Temne, the other a corresponding object familiar to the Eskimo. The object-pairs (for example, man-man or house-house) were shown twice to each subject so that each picture could be shown to each eye. Berry also made sure to check each person's vision. The results were consistent with the idea that culture would influence what a person saw when conflicting pictures were presented to his two eyes: a greater number of the culturally familiar pictures were seen first.

Many questions come to mind concerning these interesting findings. For example, did the subjects really "see" the more familiar item sooner, or did they just report it first? Could cultural relevance and frequency be separated as factors influencing the results? For example, would Eskimos see a Temne man more quickly than some rare, but relevant, feature of Eskimo society? These questions notwithstanding, Berry's work clearly indicates that subjects are predisposed to attend to and report things with which they are familiar, and the questions we raise are certainly answerable through further research.

Perceptual-Cognitive Styles

Berry's work on culture and selective perception was carried out within a general framework that Witkin (1967) calls a *cogni-*

tive style theory. The term *cognitive style* refers to modes of functioning that characterize an individual's perceptual and intellectual activities. Extensive research by Witkin and his associates shows that people tend to be consistent in the way they approach tasks requiring cognitive skills, just as they are likely to be consistent in the attitudes and emotions they bring to situations. Although there is a wide diversity of individual styles, Witkin found they could be ordered along a dimension he calls *global–articulated.* A person with an *articulated* cognitive style is one who is skilled at differentiating and organizing features of the environment and at distinguishing between phenomena that are internal to his self and those external to it. A *global* style is the opposite.

Although Witkin applies his theory very widely, most cross-cultural research has concentrated on differences in *perceptual* style. In the area of perception, the terms *field-dependence* and *field-independence* are used to designate the two major cognitive styles, global and articulated, respectively. An intuitive idea of what is meant by these terms can be grasped by an examination of Figure 4–8. This is an example of an item in the *embedded figure test,* which is widely used to diagnose perceptual styles. The subject is first shown a picture of the small triangle on the left and is then shown the complex geometric figure on the right. The question is: Will he be able to break up or analyze the complex figure to find the simple one, and how long will it take him to do it? The person who performs accurately and quickly on this test is considered to be field-independent.

Witkin's theory is relevant to the study of culture and perception because he believes that there is a normal course of cognitive development from the global end of the spectrum to the articulated end (compare Werner, 1961). The young child does not clearly differentiate himself from his environment, but as he grows he becomes aware of the boundaries of his body and personality and gains a sense of separate identity. This process of psychological differentiation is reflected in his cognitive and perceptual styles.

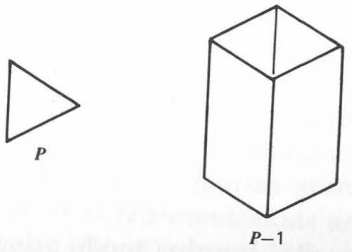


Figure 4-8. Type of stimulus material used to study perception of embedded figures.

According to Witkin both sociocultural and environmental factors influence the course of psychological differentiation. The two sociocultural influences he discusses are (1) the opportunity given the child to achieve separation, or independence, particularly in his family situation and principally by his mother, and (2) the way in which adults treat the child's expression of impulse: differentiation is fostered when the child is permitted to form his own standards of behavior and has to deal with his own impulses. The most important environmental factor is the degree to which the environment is variegated and contains a lot of what Witkin calls "structure," as contrasted with one that is homogeneous and gives very few structural cues.

Examples of the way these ideas have been applied to the question of cultural differences in perception come from the work of Dawson (1967) and Berry (1966; 1971b).

Dawson worked with two tribal groups, the Temne and the Mende in Sierra Leone, West Africa. These groups were said to contrast sharply with respect to "tribal values, severity of child-rearing practices, and other socialization practices" (p. 122).

> Temne tribal values are much more aggressive than the western-type values of the Mende. The Temne mother is extremely dominating whilst discipline in the Temne home is very strict. . . . [T]he Mende people have much less severe socialization processes, the Mende mother is not as dominating, and individual initiative is encouraged to a greater extent than occurs with the Temne (p. 122).

In view of what has been said about Witkin's theory, these differences in child-rearing practices lead to the prediction that the Temne will be less articulated, more field-dependent, than the Mende because Mende early experiences have been such as to foster differentiation, while Temne experiences do not. As measured by a specially prepared version of the embedded figures test, this hypothesis received support in Dawson's study; the Mende showed significantly higher scores for articulated functioning on this test.

Berry (1966) extended this analysis to include differences in the nature of the physical environment as well as differences in sociocultural factors having to do with early childhood. One of the cultures studied was Temne (already described in connection with Dawson's work); the comparison culture was a Canadian Eskimo culture. Both traditional and transitional groups were drawn from each culture. A group was called transitional if its members had become involved in Western-style economic enterprises and lived in Western-style housing. Berry reports that the Eskimos treat their children with great kindness and rarely punish them. Considerable freedom is given the children, who are expected to develop independent skills. Berry's description of the Temne is very much like Dawson's. He adds that there is a strong ethic to conform in Temne society, fostered by secret societies and very harsh discipline after the child reaches the age of two and a half years. These factors would lead us to expect more field-dependence and less articulation in the Temne than in the Eskimos.

In addition to the contrast in their child-rearing practices, the Temne and Eskimo obviously can be contrasted with respect to the visual aspects of their environments. The Temne landscape is covered with tropical vegetation; varieties of color and contour in the rich green jungle growth, in the abundant flowers, in streams and rivers. The Eskimo environment appears barren to us at any time of the year. In winter, virtually all is white. In the summer, which lasts only a few weeks, moss and lichen cover the rocky landscape giving the area a grey-brown tone. Berry considers the Eskimo landscape to represent a homogenous, unstructured environment and the Temne landscape a variegated, structured one. By comparison with the Temne, whose livelihood depends mostly on farming, the Eskimo hunter must be skilled at picking out seemingly minor variations in his homogeneous view, and he must be able to navigate freely in a relatively featureless environment in search of game. Thus, environmental as well as cultural factors predict greater differentiation and less field-dependence among the Eskimo.

Consistent with this analysis and Witkin's theory, Berry finds that in contrast to the Temne, the Eskimo are very field-independent (differentiated) as measured by the embedded figures and other tests. Their performance is similar to a comparison group of Scottish subjects. The Temne were considerably more field-dependent than either the Eskimo or Scottish groups. Other results also fit with Berry's analysis of the difference between Eskimo and Temne environments. For instance, in a task of reproducing pictures that contained figures with slight discontinuities in them (geometric figures with a small gap at some point) the Eskimos were more sensitive to the gap than the Temne. Also significant is the fact that the more Westernized groups among both the Temne and the Eskimo tested higher than the traditional groups on these perceptual skills. Berry concludes

> that ecological demands and cultural practices are significantly related to the development of perceptual skills. . . . In some sense, cultural and psychological development are congruent; cultural characteristics allow people to develop and maintain those skills which they have to (1967, p. 228).

He makes two other points that are of general relevance to this discussion. (1) In view of minimal differences between the Scottish and Eskimo samples (in contrast with the Temne) and the significant differences between traditional and transitional groups within each culture, explanation of the differences in terms of racial factors is very unconvincing; and (2) The great Temne–Eskimo differences should caution us not to lump all primitive, non-Western peoples together "as if they were cognitively homogeneous."

As important and valid as these two last points are, we must be very cautious in trying to interpret the specific results reported by Berry. The distinction we need to make here will recur often in our later discussion of cultural differences in problem solving and other learning tasks. Berry makes a plausible case for the theoretical account of his cultural-perceptual differences, but as he himself points out, it is not possible to separate sociocultural and environmental effects in these studies because hypothetically both operate in the same direction; on either sociocultural grounds (child-rearing practices) *or* environmental grounds (uniform versus varied perceptual environments) Berry would predict greater differentiation and field-independence for the Eskimo. As matters stand, we can not locate the source of the difference.

Moreover, we might well ask whether the Temne jungle environment is really more structured than the Eskimo arctic environment. Is it any less of an isolating skill to be able to spot a camouflaged

deer hiding in a jungle thicket than to spot a polar bear on an ice floe? Isn't the Temne jungle environment, in fact, more like the example of the embedded figures test given in Figure 4–8? The Temne hunter, too, must be able to find his way around in an environment that is, to the naive observer, "featureless." Presumably, a critical difference, from Berry's point of view, is that the Eskimo *must* hunt to live, while the Temne spend most of their time farming and rarely have to depend on fine perceptual judgments.

The fact that we raise these questions does not mean that we consider Berry's research to be of poor quality. Instead we need to emphasize that the manifestation of every cognitive skill is determined by many factors. In order to pinpoint which factor (or factors) may be at work, several experiments are almost surely required. It will also be necessary to find some adequate way to characterize environments (jungle versus arctic is probably too global a description for detailed research). What is more, the characterizations must be consistent and independent of the test we are interested in; otherwise we may find ourselves making up different descriptions of the same environment to fit any new result that comes along.

Berry was quite aware of these difficulties, and in subsequent work he set out to deal with them. The first requirement was to get away from the two-culture comparison by adding several more cultural samples to his study. This he did by working with four cultures, all of which had subsistence-level economies. Within each culture, two subgroups were chosen; one of the subgroups lived in a style that was as close as could be found to traditional patterns, in rural areas, while the other had a transitional life style and lived in an urban setting.

Berry (1971b) summarized his argument as follows:

> Hunting peoples are expected to possess good visual discrimination and spatial skill, and their cultures are expected to be supportive of the development of these skills through the presence of a high number of "geometrical spatial" concepts, a highly developed and generally shared arts and crafts production, and socialization practices whose content emphasizes independence and self reliance, and whose techniques are supportive and encouraging of separate development. Implicit in this argument is the expectation that as hunting diminishes in importance across samples ranked in terms of this ecology dimension, the discrimination and spatial skills will diminish, as will each of the three cultural aids (1971b, p. 328).

Note that Berry is hypothesizing a link between the ecological demands on a group and socialization practices. To test these ideas, Berry gave four tasks to samples of subjects in each cultural subgroup: a test of ability to make fine discriminations and three "tests of spatial skill," including the embedded figures test. The groups were from several areas of the world: the Temne of Sierra Leone, New Guinea natives, Australian aborigines, and Eskimos.

The results of this large study were generally consistent with Berry's hypothesis, although he found that *education*, as a special institution, had to be taken into consideration.

When his four cultural groups were ranked according to the importance of hunting, he found that improvements in discrimination ability and performance on the three spatial tests paralleled the increase in hunting requirements. A special influence of education was hypothesized because the transitional-urban samples generally performed better than the corresponding traditional-rural groups.

Consistent with his earlier findings on the Temne and Eskimo, Berry found that severity of child-rearing practices and emphasis on conformity decreased as hunting became more important. These results and others led Berry to conclude:

> It is apparent from the data that the visual skills are developed to a degree predictable from an analysis of the ecological demands facing the group, and the cultural aids developed by them. Further it is apparent that there are relationships between the ecological and psychological variables which are more than dichotomized ones; they appear to covary in a systematic way (cf. weak version of ecological-behavioural interaction) and can be demonstrated to be adaptive to the ecological demands placed on the group (cf. moderate version of ecological-behavioural interaction). Finally the psychological underpinnings of technological development, often isolated as spatial ability, are shown to develop in relation to an ecology, which by way of technological change is open to change itself (1971b, p. 335).

We can certainly agree that Berry has identified an orderly relation between cultural-environmental variables on the one hand and psychological skills on the other. Inclusion of degrees of cultural-environmental differences greatly increases the plausibility

of his explanations. Such inclusive studies are all too rare in this area of research.

There are still many remaining questions about the relation between ecology and psychological processes, even those processes studied by Berry. One problem is that Berry's use of the term *ecology* is too broad. Hunting, for example, is an *activity*—what people do in their ecology. It might well be that it is not hunting but some other aspect of these people's lives that accounts for the patterns of performance we have been discussing. For example, we might expect that if hunting experience is of critical importance, we would see a difference in spatial skills between hunters and nonhunters within a society that emphasizes hunting. One way to test this notion is to compare men's and women's performances among the Eskimos and Aborigines, Berry's two hunting samples. Surprisingly, no significant sex differences in test performance occur in these societies, although the women are not hunters in either of them. This raises once again the problem of isolating causal factors when several variables (hunting practices, socialization patterns) co-vary.

A quite different set of problems was raised by Wober (1967) working in Nigeria. Wober gave his subjects two tests of field-dependence, the embedded figures test used by Dawson and Berry, and a rod and frame test, which has also been used in this kind of research in the United States.

In the rod and frame test the subject sits in a dark room and looks at a display consisting of a luminous square frame with a luminous rod mounted in the center of it. Both the rod and the frame can be tilted at any angle relative to the ground. The chair in which the subject sits can also be tilted, and, as a result, a new set of cues, in addition to visual ones, enters the picture. These are *proprioceptive* cues—internal bodily sensations. Since the chair comes equipped with a footrest that tips along with the rest of the chair, the subject cannot make physical contact with the floor. This means that when the chair is tilted, the subject has to use cues that he receives from his own body in response to the force of gravity—cues from his muscles and his inner ear—to tell him where he is. This experiment studies the effects of both visual and proprioceptive cues.

The subject's task is to set the rod to a *vertical position* with respect to the ground. Insofar as he is able to do this, he is said to

be independent of the individual and proprioceptive stimuli that might mislead him.

A situation that might confront a subject in this test is shown in Figure 4–9.

Wober conducted this study with 86 men from southern Nigeria, all of whom worked for a large company and some of whom were educated, to various degrees. The major results are presented in two parts.

First, Wober calculated the errors in rod adjustment when the person was tilted but the frame was not. Errors here would presumably reflect errors in responding to the proprioceptive cues that indicate the amount of body tilt. Under these conditions, American subjects made errors that averaged about 3.5 degrees, while the Nigerian errors averaged only 1.25 degrees. When the frame and body were both tilted, the problem was more difficult. Under these conditions, subjects from both cultures made larger errors, but there were no reliable differences between the Nigerians' scores and those of the Americans. In only one case did the Americans make smaller errors. This occurred when the frame

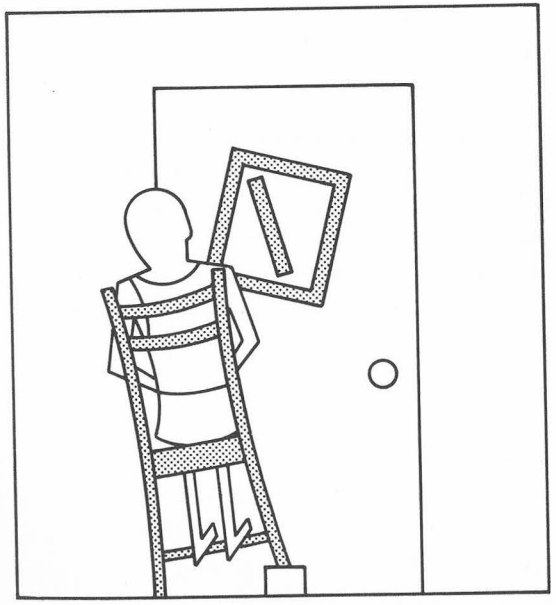


Figure 4-9. Rod-and-frame test (adapted from British Psychological Society).

was tilted but the person was not. In this case the Africans' errors were about as great as when they themselves were tilted, but American errors were only half as large. This is exactly what we would expect if the African subjects found it more difficult to make judgments based on visual cues than on proprioceptive ones.

The other major finding in this study was the absence of a correlation between performance on the rod and frame test and performance on the embedded figures test; the two tests did not seem to reflect a single, underlying psychological process. These results do not in any way contradict Berry and Dawson's findings. Rather, they suggest, as did Deregowski's work on making models from three-dimensional pictures, that findings obtained with one test instrument do not necessarily reflect the workings of a general psychological mechanism.

Wober's conclusions are very much to the point.

> It would appear that "style of cognitive functioning" is not so uniform throughout all fields of an individual's expression as had originally been supposed by Witkin. The finding in America that the [embedded frames test] and similar visual tests indicated a person's level of psychological differentiation was supported in Sierra Leone . . . using visual tests. However, visual tests do not appear to be the sole indicators of psychological differentiation. The evidence here is that such differentiation may occur in sensory fields other than the visual one (p. 37).

Wober goes on to suggest that the expression of differentiation probably depends on early experience that emphasizes the visual or proprioceptive modes. This suggestion would certainly be interesting to test; if Wober had been able to work with Berry's different cultural groups, he would perhaps have found that as hunting activity increases in importance, dancing and other "proprioception skills" decrease!

Attribute Preference: Color, Form, Number, and Size

Another experimental setting used to study how subjects selectively respond to environmental stimuli focuses on preferences for particular stimulus attributes. For example, a sizable literature has grown up around preferences when the materials used as stimuli vary along such dimensions as color, form, size, number, and function. Normal American children exhibit orderly developmental trends in their preferences for certain of these dimensions.

The conventional wisdom about color-or-form preference, which

is supported by a good deal of evidence from European and American children aged 2 to 8 years, is that younger children prefer color to form, but that some time during the fourth year form comes to be preferred. Typical is an experiment by Suchman and Trabasso (1966) in which children aged 3 to 6 years were presented with slides such as those shown in Figure 4–10 and asked to "point to the two that are the same." Children up to 4 years of age chose to match on the basis of color, rather than form; most older children matched on form.

This change from color to form preference is accompanied by

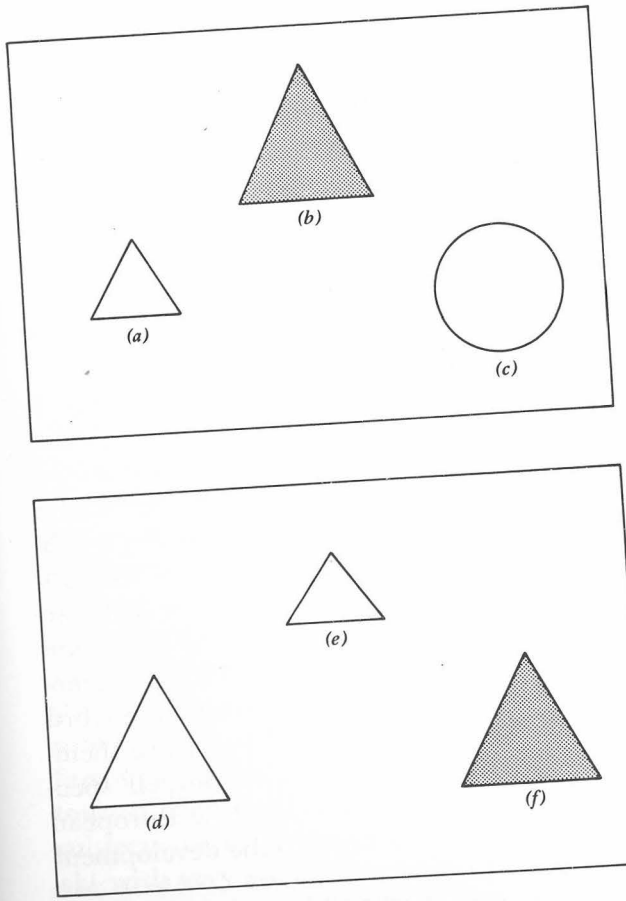


Figure 4-10. (*A*) Card for testing dimensional preference where color, form, and size vary. Items *a* and *b* are the same form; *a* and *c* are the same color; *b* and *c* are the same size.
(*B*) Card for testing dimensional preference where one dimension (form) is excluded. Items *d* and *e* are the same color; Items *d* and *f* are the same size.

changes in other cognitive spheres. Children who prefer form have higher mental test scores, and perform better on a variety of classification and concept-formation tasks than do children who prefer color.

These trends are interesting when considered in cross-cultural perspective because it is found that African tribal children do *not* show the developmental trend characteristic of European children. Suchman (1966) worked with Yoruba children attending a Koranic school in Nigeria. She found that at all of the ages studied (3 to 15), children preferred color to form, with no age trends. Serpell (1969) obtained similar results with Zambian tribal children, but his data go a little further in explaining the factors controlling color–form preferences. He found that children attending certain schools did show an age-related increase in perference for form over color and that university students had a strong perference for form, while illiterate adults preferred color to form. Even very young Zambians showed a form preference if they attended an elite school in Zambia's capital city, but, interestingly, other schoolchildren did not. Serpell accounts for these results (as well as analogous results with American deaf people) by what he calls the *perceptual experience* hypothesis: It is assumed that initially all children prefer color and that the shift to form preference is caused by the guided play that goes on in the typical middle-class European home or in Western schools; for school performance, forms are clearly more important attributes of things than colors (in reading, for instance). Otherwise there is no reason why a subject should choose form on logical grounds. Presumably the failure of certain school situations to produce the shift from color to form preference is a function of the particular kind of education found in that school; Nigerian children in Koranic schools memorize the Koran in Arabic without being able to understand a word of that language. The teachers in many African schools are themselves poorly educated by Western standards, and Serpell speculates that they do not put as much emphasis as their European counterparts on the kind of learning that leads to the development of form preferences.

Before we jump to sweeping conclusions about the significance of various stimulus preferences in these selection experiments, we should ask ourselves how general and consistent the observed preferences are and the extent to which they depend on the particular measure used. All too often very broad generalizations are

made on the basis of a single study using a single method of experimentation.

As an example of some of the problems involved, we shall present data gathered by our own research group in Liberia. The first experiment* used a technique very similar to that employed by Suchman and Trabasso (1966), in which stimuli could be matched on the basis of color or form. There was only a slight preference for color over form among illiterate children aged 6 to 8 and 10 to 14 years (53 percent), with the preference changing to form for matched age mates attending local schools (66 percent). However, if the stimuli permitted three ways of matching—on color, form, or size (large red triangle, large white square, and small white triangle)—there was a preference for *form* instead of color for the illiterate children (77 percent) and an increased preference for form among the schoolchildren (also 77 percent). Ciborowski's results suggest that the preference for one dimension over another is *not* absolute. It depends upon the context of the stimulus choices experienced by the subject.

A second experiment, by Sharp, measured preferences of Liberian children for color, form, and number, using a slightly different technique. Subjects were shown pairs of cards, each of which contained figures that differed in three dimensions. For instance, one card might contain three red triangles, the other two black squares. The subject was asked to choose one of the cards and to describe the picture on it so that the experimenter could pick it out. Subjects' responses were scored according to which attributes were mentioned and whether they mentioned one, two, or three of the attributes of the card they had in mind ("it's the red one"; "it's the one with the two red triangles").

On the basis of this measure of preference (which aspect of the stimuli a subject chooses to talk about when communicating to someone else), these subjects (who were of different ages and different educational levels) would be classed as having a strong bias toward color, with number second, and form weakest. But these subjects are from the same population as that studied by Ciborowski with very similar material (except that his included size as a third dimension while Sharp's included number).

We have to conclude that stimulus preferences are *not* a fixed

*This experiment was conducted by T. Ciborowski (in Cole, Gay, Glick, and Sharp, 1971).

property of the individual studied. They are very sensitive to a number of variables, including age, education, the particular stimulus dimensions present when the choice is made, and the method used to test for preference.

In view of all these complexities, one might well ask whether any significance can be attached to subjects' preferences for one stimulus attribute over another. Certain aspects of this research do seem to be significant. There is the repeated occurrence of a stable preference for color in young European and American children, which is converted into a preference for form at the age of 4 to 5. Evidence from other cultures indicates that form preference does not always occur, or does not occur in so marked a fashion. When color is dominant, it may remain so. Or, in some cases, a color–form shift occurs if children attend European-style schools. This suggests that the developmental trend observed in European and American children is connected in some way with the experiences that result from formal schooling. Many investigators hypothesize that sensitivity to printed words is an important factor in promoting a form preference, although this idea remains a speculation at the present time.

Summary

Referring back to the questions we posed at the beginning of this chapter (p. 64), we can see that many culturally linked variations in perceptual behavior have been demonstrated by cross-cultural research. Once we go beyond this simple generalization, however, a multitude of difficulties sets in. Once again we get enmeshed in the question of what kinds of behavior we want to call "perceptual" and in problems of determining what, exactly, is controlling the behavior we observe.

To begin with, we can be fairly confident that our modes of responding to pictures and diagrams (two-dimensional representations of three-dimensional scenes and objects) are not experience free; they depend in some way upon our past histories of dealing with such materials. Note that we use the term "responding to pictures," not "perceiving pictures." This distinction seems necessary in that the studies demonstrate that our inferences about what a person "saw" depend on what kind of response we ask

him to make; describing a pictorial representation and making a model of it are different tasks and yield different interpretations of underlying perceptual processes. In a way, this may be seen as a parallel problem to that of drawing what we see. When African children draw a profile of a cow with four legs and two eyes, we do not attribute this to x-ray vision, but to habits of representation. The studies reviewed here leave us wondering whether the same cannot be said of two-dimensional responders.

A closely related problem has to do with the conditions that promote two-dimensional responses. Several reports seem to indicate that African children continue to respond two-dimensionally even after years of European-style schooling, while others claim differences after just a little exposure. This issue has not been resolved.

A recent theory of perceptual development put forward by Olson (1970) may offer the possibility of resolving some of the inconsistent findings with respect to perception of pictorial material. In a series of studies of children's perception of diagonality, he found that what the child "saw" in a geometric pattern presented by the experimenter was related to what action he was asked to perform —whether he was to recognize the pattern, to copy it, or to reconstruct it. Olson maintains that various forms of activity require different perceptual information, and that the child elaborates his perceptual world (makes new and different discriminations) as he masters new activities. For example, creeping around a room or walking across a field requires information based primarily on topological cues, whereas building a wooden crate requires information based on geometric features. "You require different cues to catch a ball than to discriminate it from a cup" (Olson, 1970, p. 201). Different activities—such as locomotion, speaking a language, writing a language, drawing, carving—proceed in different media. When a person attempts to perform in a new medium—say, he is learning to draw—he has to attend to and select new cues or information from the perceptual world in order to meet the demands of this specific medium: "Performatory attempts in representational art, geometric drawing, and constructing require, for their guidance, perceptual information that is somewhat unique to that medium. To state this point in the form of an aphorism: 'squares did not have equal sides and equal angles until one attempted to draw them.' " (Olson, 1970, p. 202).

This approach seems to tie in very well with Dawson's training

program in pictorial depth perception. He asked young men to draw scenes requiring representation of depth cues, and he gave them experience in comparing their drawings with the original scene. In Olson's terms, the activity of drawing required selection and attention to particular cues containing distance information in the real-world scene, cues that otherwise may have gone unnoticed.

Olson's position clearly has important implications for cross-cultural research on many issues of perception, in addition to those involved in the restricted domain of picture perception. One of its especially interesting features is that it draws the attention of psychologists to the range of media and technical activities provided by different cultures as a possible source of cognitive differences among the people of different cultures.

This same comment applies to the work on selectivity in perception, an area that has generated a good deal of work, but about which much remains uncertain.

Some of the questions that concern us most are the following:

1. Almost all of the research on selectivity in perception (except for that using the binocular rivalry technique) employs abstract stimuli and makes a "correct answer" dependent on some special attribute (such as color). There have been no studies of responses to embedded figures using locally significant stimulus objects, and only a few studies of attribute preferences have used meaningful objects.

2. Although it has rarely been systematically investigated, we can be fairly confident that the kind of response a subject is asked to make (drawing, speaking, matching figures by pointing) affects the kinds of perceptual processes that we conclude he has. Some hint of this comes from our own work in Liberia, where asking people to sort cards and asking them to describe them seem to lead to different conclusions about stimulus preference. But what about studies involving embedded figures? Might it not also be the case that the way a subject is asked to respond affects what he "sees" in the embedded figure? We think it possible (and in accord with Olson's 1970 findings), but know of no data on the problem.

3. Finally, we are concerned that all but one of the studies reported (that by Wober) rely exclusively on the visual mode to make inferences that are often not mode-dependent. Certainly those who are engaged in work on field-dependence do not think that they are studying the visual field alone. Yet in relying on visual material they are courting difficulties, some of which we have discussed above. When this question of stimulus modality and the question of response requirements are combined, we can see the possibility of some serious problems. For example, Wober found less field-dependence in Africans on a test in which somatosensory information (proprioceptive cues) was available (rod-and-frame test) than on a test presenting visual information only (embedded figures test). But in switching tests, he not only added information in a new sensory modality, he changed the response requirements of the task as well. Instead of being required to outline or name a figure, his subjects had to adjust a rod—a three-dimensional object in the real world. Which component determined the results he reports?

Finally, it is worth emphasizing that all of the research on culture and perception discussed in this chapter leaves open the question of cultural differences in the perception of naturally occurring visual scenes. We know that there is something special about perceiving depth cues in pictures, but is there any evidence of cultural differences in depth perception when the person being studied is observing a natural scene? We know of no systematic data on this point, but anecdotal evidence indicates that there may indeed be cultural (or at least, experiential) influences on perception for natural scenes. For example, Turnbull (1961) in his ethnography of the pygmies of the Iturbi forest relates an incident in which a pygmy accompanies him out of the forest. At one point there is an opportunity to see some cows, grazing in the distance. The pygmy, who knows what cows are, but who has never had the opportunity to see one at a great distance, thinks that he is looking at ants! We have observed a similar phenomenon when a jungle-raised Kpelle child is taken at around age 10 to the capital city of Monrovia, where large tanker ships can be seen far at sea from a tall hotel on a hilltop. The child, who had never seen such a view before and was not familiar with tankers, commented on the bravery of men who would go out to sea in such small boats. These anecdotes suggest, among other things, that it would be interesting and theoretically profitable, to arrange some "natural" perceptual experiments to test out the generality of laboratory-generated phenomena.

It should be clear to the reader, as it is to us, that a great deal of research remains to be done before the kinds of questions about culture and perception that we have asked, as well as questions we have not been astute enough to think of, are answered.

chapter 5 Culture and Conceptual Processes

Discussions of cultural variations in thought processes often emphasize that a major source of group differences is in the "ways of classifying the world" that characterize a given cultural group. "Ways of classifying" is also a useful bridge between the experiments on perceptual processes discussed in the previous chapter, and experiments on conceptual processes, which we will discuss in this chapter.

When we closely examine statements by psychologists about perception and conception, it becomes apparent that the data we previously discussed as a matter of perceptual preference may be viewed just as easily in terms of elementary conceptual groupings or classifications. All of these are pyschological processes* by which we treat as "similar" or "equivalent" phenomena that

*For present purposes, we will not make any distinctions among the terms *classification, concept* or *category*, although it should be understood by the reader that there are many different psychological concepts of a *concept*.

vary in some way among themselves. No two roses are identical, but they are commonly experienced as interchangable members of the class of roses; a rose and a dandelion are physically even more unlike, but are "similar" members of a class of flowers; and together with an oak tree, a frog, and an infant, roses and dandelions are "alike" with respect to their inclusion in a class of living things. As these examples illustrate, there is a whole multiplicity of processes by which we deal with environmental variability, reducing or holding differences constant and establishing similiarity or equivalence as a basis for action and thought. These processes may vary with the attributes of the things in question, the context in which the act of classifying occurs, and the skills and knowledge we possess.

When similarity among things is defined in terms of their physical attributes, the act of classifying may be considered close to perception. For example, when considering neighboring points on the color spectrum, it seems at least possible that true lack of discrimination in some sensory sense is occurring when subjects respond with a single term to two different colors. When a person says "red" to a set of color chips that we know to be discriminably different, it may still be possible to give a perceptual interpretation by arguing that the subject perceives all of the hues to be the same. But why speak of a perceptual process when one is dealing with a set of stimuli consisting of a black triangle, a red triangle, and a red square? Surely the subject can discriminate among these objects. A more appropriate method of characterizing the subject's choices when he says that two of the objects are the same is to consider them ways of classifying objects in the environment.

Bases for Classification

In studies of classification, both in developmental and cross-cultural psychology, a good deal of interest has centered on two aspects of the subject's performance: (1) the particular attribute the subject uses as the criterion of similarity (this is comparable to interest in the stimulus dimension in perceptual preference studies), and (2) whether or not he uses a single attribute consistently as the basis for grouping. Findings with respect to these questions have provided much of the empirical foundation for

theories of cognitive development that stress progression from a kind of thinking that is concrete and context-bound to thinking that is abstract and rule-governed. Results from cross-cultural studies of classification have led several authors to characterize the thinking of nonindustrialized people as concrete and deficient in the abstract attitude. In Chapter 2, we showed how scholars with such contrasting points of view as Claude Levi-Strauss, the structural anthropologist, and Heinz Werner, the developmental psychologist, share a common interest in analyzing the concepts and classifications employed in primitive cultures.

As the examples at the beginning of this chapter indicate, the notion of *class* or *concept* is used very broadly by psychologists to refer to a wide range of grouping operations. Theories that have been developed to explain classificatory behavior have usually been tied in closely to the particular set of operations an investigator has chosen to study. Jerome Bruner's theory of cognitive growth furnishes a useful framework for examining current research in this area. It has generated specific hypotheses about effects of cultural institutions on classification, and these hypotheses have been explored in cross-cultural settings. Conceptual development, according to Bruner, involves a shift in what features of the world the child uses as a basis for defining how things are alike (what we have called the criterial attribute). Very young American children tend to treat items as equivalent on the basis of *perceptual* qualities, such as color, size, shape, or position. With intellectual growth, the child breaks away from this perceptual dominance and bases his classifications on *functional* attributes—what things can do or what a person can do with things. He also increasingly comes to group items together under a common *class name.*

Bruner asserts further that along with the change in favored attribute, there is an orderly progression in the *operations* by which the child combines things. Initially, the child will form loose groupings or "collections"—in which he uses a variety of characteristics and associations among the items. Gradually the child works his way toward "true conceptual groupings based on the rule of the superordinate class"—that is, toward groupings based on some *single common* feature that characterizes all the items included within the group and none of the items excluded from it. To put it still another way, the child operates with a single rule governing admission of an item into the group.

While Bruner does not use the terms *concrete* or *abstract* in his discussion of these different aspects of grouping performance, these terms have classically been used to differentiate the young child's performance from that of the older child. A classification based on a perceptual characteristic is usually considered to be concrete. For some theorists, only a nonperceptual grouping based on a class name or nonphysical property (such as animate, edible, mammal) qualifies as "abstract." The term *abstract* has also been used to refer to the operation by which one common characteristic is singled out (i.e., abstracted) and used to unite the items being worked with. From this point of view, Bruner's superordinate, single-rule grouping indicates a more abstract level of thought than groupings making use of multiple criteria.

With these distinctions in mind, we will turn to consideration of an extensive investigation of the cultural influence on classifying conducted by Patricia Greenfield, a colleague of Bruner's (Bruner, Olver, and Greenfield, 1966). Data were gathered from children of the Wolof tribe in rural Senegal, using a sorting procedure similar to the preference studies described in the previous chapter, but with some important differences. Ten familiar objects were laid on a table in front of the child, who was asked to "pick those that belong together." The set contained four articles of clothing, four round objects, and four red objects (one of which was an article of clothing and one a round object), permitting the child to form groups according to function, form, or color.

If the items that were selected conformed to one of these classes (color, form, or function), the child was credited with applying a consistent classification rule. Figure 5–1 plots the percentage of nonschooled tribal children at each age level who consistently applied any of the possible classification rules. It can be seen from the graph that by the age of 15, virtually every Wolof child is making a systematic classification of the objects. A majority of these children based their classifications on color, and the authors conclude that "the change in grouping structure with age consists primarily, then, in learning to apply the color rule systematically" (p. 286). In terms of *preference,* these results fit in nicely with the findings on color dominance reviewed in the previous section, but the interpretation here is *con*ceptual, not *per*ceptual.

A further study by Greenfield among the Wolof used sets of

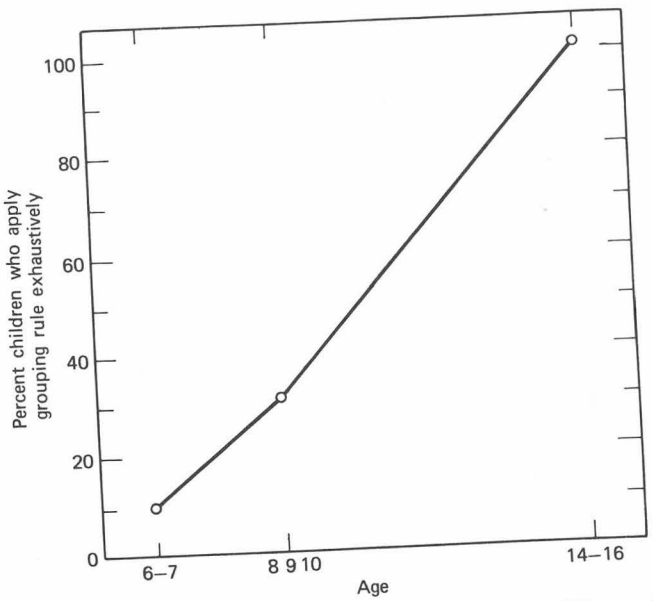


Figure 5-1. Percentage of unschooled Wolof village children who apply grouping rule exhaustively.

pictures mounted on cards. The cards were designed so that within each set it was possible to form pairs based on the color, form, or function of the object pictured on the card (see Figure 5–2). The child was first asked to show the experimenter which of the two pictures in a set were "most alike." He was then asked, "Why are they most alike?" Subjects were selected from three populations: (1) traditional people from the bush who had not attended school —ages 6 to 7, 8 to 9, 11 to 13, and adults; (2) schoolchildren from the same town, and (3) schoolchildren living in Dakar, the capital city of Senegal.

This experiment produced many interesting results. Among the most important for understanding the issue discussed here is that schooling apparently exerted a very strong influence on the way classifications were made and on the kinds of reasons subjects gave for the classes they formed. Children who had attended school, whether from the small bush village or the city, performed very much as American children did; preference for color decreased sharply with grade, while form and function preferences increased. Furthermore, an increasing proportion of the older children justified their classification in terms of a superordinate cate-

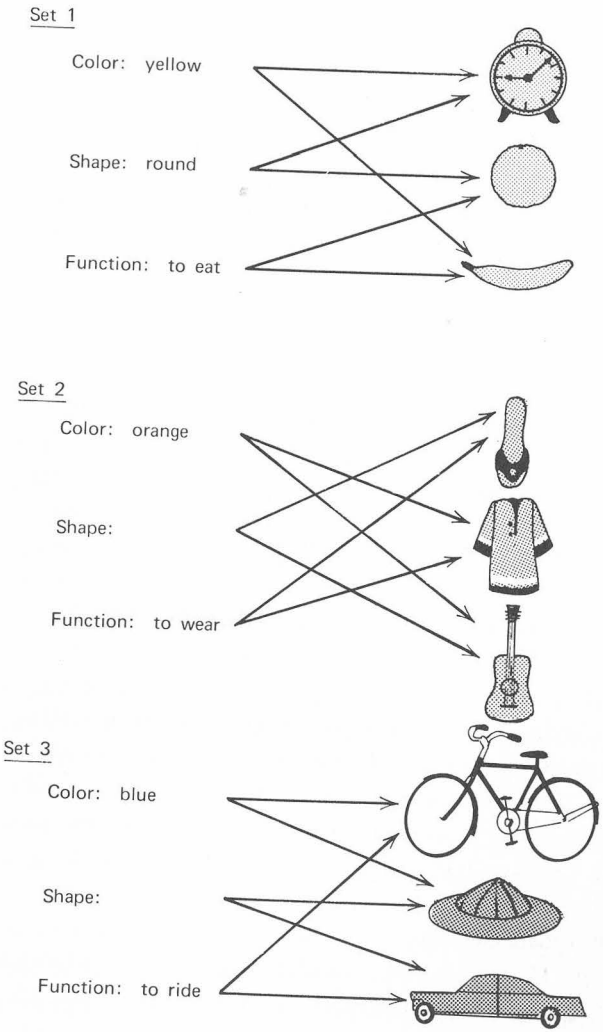


Figure 5-2. Three picture displays in Wolof classification study, with their attributes. *Set 1,* clock, orange, and banana; *Set 2,* sandal, *bubu* (Wolof robe), and guitar; *Set 3,* bicycle, helmet, and car.

gory ("it's the round ones"). The children who had not attended school and lived in the bush responded quite differently. Such children showed *greater* preference for color with increasing age and rarely justified their responses by noting the category to which the pictures belonged. The authors make the following comments about how the course of development of schoolchildren differed from that of children who were not in school:

> This perceptual development is basically a conceptual one. . . . By conceptual we mean that school is teaching European habits of perceptual *analysis*. An analysis into parts is plainly crucial to concepts based on the multi-dimensional attributes of form, whereas unitary global perception could suffice for color grouping (Bruner, Olver, and Greenfield, 1966, p. 316).

Bruner and his colleagues feel that their results are also pertinent to observations made by various anthropologists and psychologists to the effect that the early cognitive development of primitive peoples is quite rapid, but that primitive children's development stops much earlier than that of European children. European children develop more slowly at first, but their development continues through adolescence. In the experiment just presented, the evidence for this idea is that nonschooled children fail to develop a form preference and fail to provide categorial justifications for their choices. Taken together with the fact that children who attend school do show the shift from color to form preference, these findings suggested to Greenfield and Bruner that leveling off of cognitive development occurs because children lack the experiences provided by the school. In this view, African children who have attended school are "European" in their development. Although no one can be sure how schooling exerts its effect, Bruner and his colleagues speculate that the school makes complex demands on the growing child, forcing him to develop new intellectual tools in order to keep up. One of these tools is the kind of perceptual analysis that underlies form classification.

Many questions are raised by this interpretation. One that immediately comes to mind is what significance should be attached to the subject's selection of a particular attribute when he is given only one opportunity to make a choice. If a child chooses color, does this mean that he does not have the capacity to group by form or only that he *prefers* to group by color? We might also ask a prior question. When a set of stimuli allows for several bases of classification, the choice of a classification rule is often arbitrary (color, form, and function are all logically consistent classification schemes). Do people realize this fact? When a person groups a set of cards or objects on, say, the basis of color, is he expressing a preference among a set of alternatives, or is he performing what he considers to be *the* (one and only) correct classification? In short, does he recognize that there are other possible

ways of classifying the items? (An analogy here would be the ways in which members of a family could be grouped: as males and females, as parents and children, or as members of the nuclear family and members of the extended family).

Classification and Reclassification

Sharp and Cole (in an unpublished experiment) attempted to get at these questions. Working in Yucatan, Mexico, where the educational experience of Mayan people is quite variable, they presented to people of various ages and educational backgrounds the set of cards depicted in Figure 5–3. The cards were laid out in a haphazard arrangement on a small table in front of the subject, and he was asked to place them into piles so that the cards in each pile were alike in some way. He was not told what was meant by the term *alike.* No restriction was placed on the number of piles a subject could make, but the stimuli were clearly divisible along the dimensions of color, form, and number. On all but a few occasions, subjects placed the cards in two piles. But it was by no means the case that the two piles were chosen in a manner consistent with one of the three preselected dimensions.

For subjects who did sort the cards into two piles in terms of color, form, or number, the cards were then shuffled and the person was asked to find a different way to form piles that were alike.

The subjects in this experiment were children and young adults living in rural towns. The youngest children were 6 to 8 years old and were enrolled in the first grade. In addition, there was a group of 9- to 10-year-olds (in the third grade), a group of 12- to 13-year-olds (sixth grade), and a group of teenagers (15 to 20 years old) who had attended no more than three years of school.

To begin with, it was found that not everyone was successful in arriving at a partition of the cards according to one of the three specified stimulus dimensions (using a single rule). The percentage of successful initial classifications for the first-, third-, and sixth-graders was 17, 47, and 84 percent, respectively. These data indicate a reliable increase in the likelihood of a dimensional classification as school children grow older. But the results from the teenagers indicated that sorting of these materials was con-

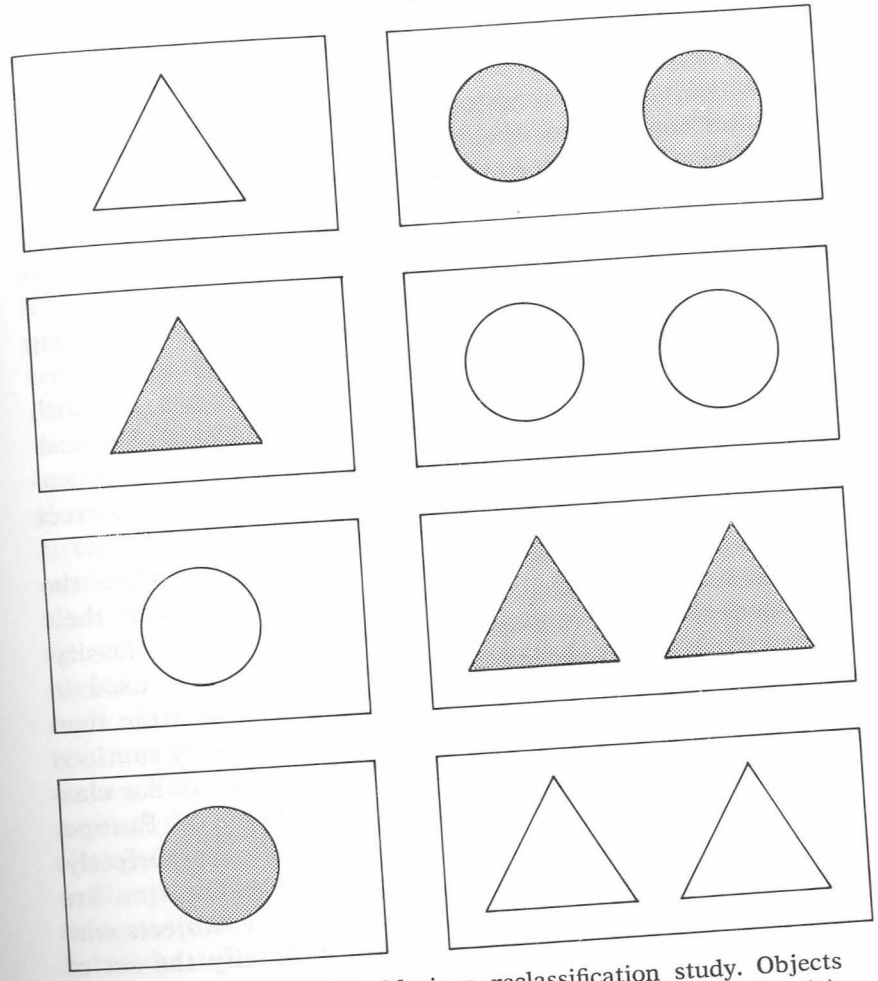


Figure 5-3. Cards used in Mexican reclassification study. Objects portrayed vary in color (black and red), form (circle and triangle), and number (one and two).

ditioned much more by educational experience than by age alone. The teenagers averaged 37 percent correct sorts. This is between the levels for the first- and third-graders, and is consistent with the average educational level of 1.4 years for the teenagers. The relation between education and classification is even more striking when the performance of the teenagers is calculated separately for those who had never attended school or had attended only one year and for those who had attended two or three years. For the relatively uneducated group of teenagers, there were 25 per-

cent correct sorts, while the more educated teenagers sorted correctly 52 percent of the time.

When subjects were asked to classify the cards in a new way, very little reclassification was observed among the first-graders. Only one of the 32 children in this age group successfully re-sorted the cards consistent with a new dimension. Third-graders (44 percent) were more successful in finding a new, consistent sorting scheme, and a majority of the sixth-graders (60 percent) were successful. Again the performance of more poorly educated among the teenagers implicates education in the development of skilled performance in this classification task. Only two teenagers with one year of education or less (8 percent of those tested) reclassified the cards. Those teenagers with two or three years of education responded similarly to the third-graders (28 percent correct re-sorts).

These results from rural Yucatan support and extend the analysis offered by Greenfield and Bruner on the basis of their studies in Senegal. Two points stand out. First, success in classifying arbitrary sets of multi-attribute stimuli like those used in these studies is much more influenced by years of education than chronological age *per se*. This result should make us very cautious about the interpretation of developmental changes in similar classification behaviors observed in the United States or Europe, where age and educational experience co-vary almost perfectly. Secondly, we can see that classification and reclassification are not necessarily the result of the same process—many subjects who could make a single classification could not reclassify the set of cards along another dimension. It seems quite possible that one consequence of educational experience is to instill the notion that any set of objects can be treated (classified) in a varity of ways—there is no "one correct way," regardless of the task at hand. There has been relatively little work done on the problem of reclassification, either intra-culturally or cross-culturally (see, however, Goldstein and Scheerer, 1941).

Generalizing Rules of Classification

The study just described illustrates the problems that arise when uneducated people are asked to change the classification rule that they have been using in sorting a set of material. The study to be described in this section turns the question around and

asks what problems may be involved in carrying over the *same* classification rule from one problem to another. If someone is taught a particular classification rule, will he apply this rule to other problems of the same kind? Does the fact that someone learns to make "correct" classifications imply that he has learned a general rule applying to classification?

To answer some of these questions, Sharp (1971) conducted a study in which he taught Kpelle children to classify material according to attributes the experimenter defined as correct.

Sharp's stimuli were figures on cards which differed in form (triangle, circle, square), color (red, blue, black), number (two, three, four). Subjects were not presented the cards all at once but were shown pairs of cards differing along all three dimensions (for example, two red triangles on one and four black circles on the other). The subject's task was to say which of the cards the experimenter was thinking of, and he was informed after each decision whether or not he was correct. For example, the correct cards for the first problem might be the blue ones, regardless of the forms depicted or the number of figures on the card. Subjects continued responding until they were correct 9 trials in a row or until 40 trials had been presented. Then they were given a second and a third problem, in which the task remained the same but the attribute that defined the correct cards changed for each problem.

Sharp was interested in learning whether children would show improvement on this task as a result of practice: Would they solve the second and third problems faster than the first if the dimension of solution (color in our example) remained unchanged?

Two kinds of practice were studied. (a) Three problems were presented, all involving the dimension of color, but a different color was correct on each. (b) Three problems were presented on which the correct dimension was different each time (color on the first, form on the second, number on the third, for example).

These two kinds of repeated practice allowed Sharp to distinguish between two kinds of improvement—generalized transfer resulting from practice in learning this type of problem, and specific transfer resulting from learning about particular dimensions.

Sharp's children were selected from three groups: a group of 6- to 8-year-olds who did not attend school, a group of 12- to 14-