

### CHAPTER 3 — RESEARCH PRINCIPLES

In an inquiry of this type, which involves many different disciplines, and which attempts to integrate insights drawn from each of them into unified conclusions, it is important to observe strict and careful scientific method. This method must not only be constructed in accordance with general scientific principles, but it must meet the particular demands of each of the subordinate disciplines involved. In this chapter, we will consider scientific method, both in general and in terms of linguistics, anthropology, psychology and education. And then, following the method described, we will outline in the next chapter the specific experiments conducted in this project.

#### a. General Scientific Method

##### (1) Philosophical presuppositions

The first presupposition is that it is possible to begin the inquiry with a descriptive study of the problems and the way the Kpelle people approach these problems. It is hoped that a careful, detailed, and thoroughly objective study of pre-mathematical and pre-logical behavior is possible, apart from any recommendations for amelioration of the teaching situation. It is clear that there are difficulties hindering the objective, descriptive approach, not least of which is the utilitarian motive behind the whole project. We have a mathematics curriculum which we wish to teach to non-western peoples, and we are testing to find ways of teaching it more effectively. Objective description, however, requires that we put aside this teaching goal temporarily and, without attempting to change the culture, simply describe what is present there.

A more serious block to objectivity is that we must make certain initial

assumptions about the nature of mathematics. These assumptions are drawn, as they inevitably must be, from our western experience with mathematics. Thus we run the risk of learning from our experiments that which we wish to learn, rather than discovering something significant about the culture to which we are coming. It is a matter of familiar experience in developing countries that the polite man who does not understand what you are asking will simply agree with you, rather than raise trouble. You may not learn anything, or receive what you want, but he has, from his point of view, done his best to be pleasant. And so it might happen in the present case. Unless the project is designed with great care to be as general and culturally neutral as possible, we will only discover that which we already know.

Moreover, any assumptions which we make must be clearly recognized and tested in the course of the inquiry. Assumptions cannot be avoided--indeed, science would be impossible without initial assumptions. But a proper inquiry will test the assumptions, and indicate their validity, that is, whether they make an analysis of the culture possible. This is the second presupposition, therefore, that assumptions can be recognized and tested in the course of the inquiry. We must find whether or not these assumptions allow us to speak intelligently about a large mass of data. A carefully constructed inquiry will be so designed as to indicate in what way presuppositions are denied or rendered sterile by the data.

The third presupposition, which is contained in and implied by the two previous presuppositions, is that metaphysical, unverifiable assumptions about human nature, social behavior and mathematical knowledge can be avoided. An assumption which is unverifiable in the sense that its presence or absence would

not affect the inquiry in any way is a useless and irrelevant assumption. The kinds of assumptions which must be made are self-verifying assumptions. They are self-verifying in the sense that they are fruitful in helping organize data without at the same time implying conclusions which contradict either the data or the assumptions. It is not meant here that the assumptions are given direct proofs, but merely that they are shown to be useful. Only if still further assumptions are introduced is a direct proof of our original assumptions possible. But the self-verifying proof, on the basis of utility, should always be possible for assumptions, and, if it is not, then the assumptions need not be made, and should not be made.

The fourth presupposition is that the data supplied by linguistics, anthropology, psychology and education are prior to the conclusions which are reached, or to the assumptions which are made. This is an obvious statement, but it may be ignored if it is not stated explicitly.

## (2) Stages in scientific method

The scientific method has been adequately stated so often that it is not necessary to consider it in detail here. Only the main outlines need be mentioned, primarily in order to set up a structure within which the details of our research procedure may be placed. This detailed procedure will be the subject of the next chapter.

The first stage, as indicated above, is the making of preliminary assumptions concerning both content and method. These assumptions must be chosen with great care, so that they are as general, flexible and suggestive as possible. They should be made explicit so that as few unchallenged and unexplored beliefs as possible enter into the study. Such unstated beliefs cannot be eliminated en-



tirely, of course, since no man can see himself or his opinions with complete objectivity. But they can be reduced to a minimum.

The second stage is that of formulating certain general questions, as well as the possible forms the answers may take. These questions should build upon the assumptions made at the beginning of the inquiry. Moreover, the questions should be stated in such a way that they do not dictate the answers, but rather allow for great variation in possible answers. In this way, the questions will not close doors, but instead will open them to unexpected and unexplored territory. To construe the questions too narrowly is to prejudge the results and not obtain the desired information. This is precisely the difficulty with much teaching from one culture to another. Because the teacher constructed the edifice of learning too strictly, he made it impossible for the student to draw upon relevant experiences which do not fit the prefabricated structure.

The third stage is that of gathering data which may prove useful in answering the questions. The data should be gathered in a well organized, carefully controlled fashion, so that answers based on the data can be verified. It may be that the assumptions and questions were inadequate, in which case more data will be needed at a later time, but for the moment their adequacy must be assumed, and only data relevant to these assumptions and questions gathered. Too much data is as great a difficulty as too little. If there is too much, the inquiry cannot focus itself, but wastes its efforts in jumping from topic to topic, from experiment to experiment.

The fourth stage is forming hypotheses on the basis of the data, in answer to the questions, and within the framework of the assumptions. If the first three steps were performed properly, the fourth step should be relatively easy, as long

as the generality of the hypothesis is consistent with that of the data. These hypotheses may suggest further questions, or even further assumptions, requiring a return to earlier stages in the inquiry. However, such a retracing of steps is not a loss of time, since it provides the investigator a more useful and relevant set of assumptions and questions.

At any event, it is necessary at this fourth stage to go back at least to the third stage. The hypotheses must be tested on the basis of additional data, to make sure that their apparent success in explaining the data was not purely adventitious and coincidental. The new data which are gathered are thus used in the fifth stage, which is the testing of the hypotheses.

From this point forward, the procedure involves a successive refining, sharpening and generalizing of the hypothesis, using further data to test and modify statements. And, when at a certain point it no longer seems possible to generalize or modify or sharpen the hypotheses, and they are supported by all data which may be gathered, these hypotheses are accepted as final conclusions. The questions are answered, and the problem is solved.

b. Research methods in specific disciplines

(1) Linguistic

The specific methods required by the linguist are used in the stages of gathering data and testing hypotheses. In the first place, it is necessary to work through informants in studying languages not known by the researcher. There are several requirements for working effectively with informants. The first of these is that the informant be considered in every sense a full member of the research project, so that he not only understands what is going on, but feels emotionally committed to it, and is able to contribute useful ideas. The second is that the informant be, if possible, thoroughly conversant with both languages and both

cultures under consideration. Thus it is preferable that he be a person who grew up within the non-western culture, and then received a western-type university education. The third is that the informant be used to pretest all questions and hypotheses and data-gathering techniques. Much time can be saved in this way by making efficient use of his knowledge of the culture and the language. The fourth is that the informant do as much of the questioning of non-literate persons as possible. Fifth, if possible, two informants should be used so that they can check and aid each other.

The second important linguistic requirement for research is that the research team know as much as possible of the language. To this end, it is useful that such a project as this be carried out in languages which have been thoroughly analyzed, and for which adequate instruction materials are available, so that time need not be spent in preliminary analysis. If the researcher learns the language, he will find that his work in gathering and analyzing data and preparing hypotheses is both easier and more fruitful.

The third requirement is that information be obtained in a culturally relevant setting, using culturally relevant situations and materials. Ideally, the research team should travel to a town possessing the culture in an isolated and relatively pure form. The relation between the research team and the people being studied will be discussed further in the section on anthropological research methods.

The fourth requirement is that linguistic behavior be obtained and recorded in a controlled fashion. For example, the language used to describe fields of attention is best found by having informants put words into open sentences. In this way, the material can be organized into hierarchically arranged substitution classes of terms. Paradigm sentences should be used, and the non-literate infor-



ments should be encouraged to make their own substitutions in these sentences in order to fit new situations. If the form of a statement remains the same, while the content varied, then the terms obtained will parallel each other. These open sentences, which can also be called elicitation frames, should, of course, be so designed that they do not themselves supply the desired answers.

All other linguistic requirements simply make specific general requirements of the scientific method. Thus, for instance, several village informants should be used to ensure the non-idiosyncratic nature of answers. The elicitation frames should be so constructed as to study one question or one concept at a time. It is not necessary to state more such requirements at this point, since their formulation follows the general pattern, and they will suggest themselves naturally as they are needed.

## (2) Anthropological

Since anthropological studies are an essential adjunct to linguistics in order to determine the meaning of terms in the language, the principles of proper research in the two fields are bound to be closely related. Particularly important is the requirement that research be carried on in a town marked by as nearly pure and isolated a form of the culture as possible. If that culture is a traditional tribal culture, then the research must be as far from the main currents of western civilization as possible, which, in practical terms, means as far from the road as possible. If the culture being studied, however, is a transition culture, combining western and tribal practices in a new synthesis, then the research should be at a crossroads, where the two cultures meet.

When a town or village is chosen for study, it is necessary that the research team gain the trust, respect and help of the people of that community. This means,

first and foremost, that the people must be treated as human beings, with all the rights and dignity that that status implies. It means second that an attempt must be made to understand and respect their culture as a whole, not belittling it in comparison with any other culture. Third, it means attempting to explain the purpose and procedure of the research project, so that the people have a sense of sharing in a useful and significant enterprise. Fourth, it means living as much as possible within the life of the community for the period of study, although not so much as to make research difficult. Fifth, it means gaining particularly the goodwill and confidence of the older leading citizens of the community, so that they lead others to cooperate and assist as needed. Finally, it means the researchers conducting themselves in a dignified, moral and sensitive way.

A third important point is that all tests take into account a total view of the culture. In this way, gross errors can be avoided, which might arise if conclusions were drawn on the basis of isolated bits of evidence instead of a total view of the society. Anthropology takes as its field of interest the whole of the life of the people, and we should do likewise in this project. We do not wish, in this project, to make large statements about the totality of the culture, but we are concerned that what statements we do make be within that framework. This requires that all tests use culturally relevant materials and situations, and be conducted in the language of the people.

A fourth important point follows from this, namely, that legitimate comparisons be made with parallel situations and through parallel tests in western culture. This means that translations, both linguistic and non-linguistic, should be done with sensitivity to cultural differences and cultural parallels.



For instance, one culture may be accustomed to counting with stones, and another to counting on the fingers. If counting is to be compared, the two groups should be allowed and encouraged to use their own procedures, and not forced to follow a standard procedure. The investigator should then interpret the differences and similarities between two cultures each using its own procedure.

### (3) Psychological

Many of the same warnings which were made in the previous two sections continue to apply here, since the psychological tests which are performed must be done within the linguistic and anthropological framework already set up. Thus we need not repeat here what was said above, but can go ahead to specify certain methodological details which are relevant to psychological testing.

In the first place, experiments should have statistical validity. This means several things. It means that tests should study specific, concrete concepts, their formation and their level of significance, and should avoid vague generalities. It means further that each test should be designed to study one or at most two concepts at a time. If a test is not designed in this way, it will possess too many variables to make valid conclusions possible. Statistical validity means also that each test should be so framed that its conclusions can be stated quantitatively. For example, this may require that a rate of learning be tested in terms of time of performance or the number of trials required. Statistical validity further means that the number of subjects for each test should be sufficient to eliminate the possibility of significant random variation, and it means that these subjects should not observe each other or discuss the material—a thing difficult to avoid in a village setting.

In the second place, all experiments must be set up in such a way that the

results in one culture can be compared with results of similar experiments in another culture. This requires first of all that the experiments be reproducible, which is, of course, a general requirement for all scientific experiments. When the experiments are reproduced in a different cultural setting, the conditions should be altered without altering the concept being tested for. Conditions should be altered, however, in such a way that the variables remain the same. For instance, even though in one culture pictures can be drawn on a blackboard, in another culture it might be that the pictures must be drawn in the sand. Great care must be taken in finding comparable circumstances for the tests, lest the results of comparison be misleading.

In the third place, psychological testing must be accompanied by linguistic testing. Thus persons should be requested to verbalize the results of the tests in which they have participated. In this way, we will test not only concept formation and concept recognition, but also concept articulation and concept expression. Moreover, for certain concepts, questioning may be the only method to elicit the desired information. In such a case, it is necessary to observe all the precautions mentioned previously concerning linguistic method.

#### (4) Educational

Once again, all the precautions described above must be applied here, since educational testing involves linguistics, anthropology and psychology. In particular, we must use the tools of those other disciplines to find how persons learn in any given culture. We are interested in both formal and informal learning, and we must devise tests relevant to both.

The tests used in the case of the traditional, tribal setting are not different from the tests described in previous sections, and thus we need add nothing here.

However, where new teaching materials are being tested in the cross-cultural situation, there are a number of procedural cautions to be observed. In the first place, new materials should be first tested using only experienced teachers who understand both the materials and the pupils. In this case, the quality of the teaching is known and only the texts and methods are being tested. Secondly, there should be control classes, under similar circumstances, where the new materials are used with western-oriented classes, and where classes in both cultures use the older texts and curricula.

Finally, after the materials have been tested, it is important to explore the possibility of teaching their use to teachers unfamiliar with the new approach. These teachers should be chosen from both cultures which are involved in the cross-cultural contact.