

Practical Suggestions for Field Work in Mathematics
(with special application to Kpêlê language and culture)

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Introduction

Mr. Wealar is a fourth year student at Cuttington College who has studied both linguistics and anthropology. Mr. Crabb teaches both of these subjects at Princeton, but, through the generosity of E.S.I., spent several weeks at Cuttington College at Christmastide, 1963-64.

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These suggestions are made for general use, especially with African languages and cultures, but the illustration and validation has been limited to Kpêlê. We are attempting to be "practical" in that the procedures here given are of a step-by-step nature that ought to be able to be followed by any field investigation.

General Considerations

It is nearly always possible to initiate contact with any language and culture through the services of bilingual speakers who have had significant education in a European language. It is suggested that the bilinguals in question should have spent at least twelve of their childhood years

in the culture to be investigated. The use of those who were removed to a modern urban situation at an early age is to be discouraged at this point. In addition, bilinguals who are fluently literate in the language to be investigated are of much greater use during these early stages than those who have had no such experience. Not only can the literate speaker make much better notes, but he also has a far deeper (and more exactly verbalized) knowledge of the structure of his own language.

The experiences of the senior author lead him to recommend the simultaneous use of two informants (as these bilinguals are usually called) during all initial stages of field investigation. The opportunity to lapse meaningfully into the language being investigated on the part of the informant(s) often provides the necessary stimulus for recall or analysis. Even more pragmatically, the presence of another speaker serves to offer some check on the natural desire to please the investigator even at the price of accuracy.

One of the chief difficulties in any such investigation is getting across the matter at hand or in communicating the dimensions of the problem itself. Some misrepresentation of the aims of the investigator is almost bound to arise, but this can be minimized in communication with educated as opposed to uneducated informants. Furthermore, education

involving some knowledge of other cultures on a comparative basis is essential to a clear understanding of one's own culture. As has been pointed out by previous anthropologists, a person cannot both "live" culture and "study" it as an object at some remove at one and the same time. Therefore, initial understanding must come from your educated contact.

However, field work among uneducated informants still living their culture cannot be dispensed with. For one thing, the old men may be repositories of special knowledge which is otherwise inaccessible. And, even more important, the observation of behavioral culture in action always leads to the discovery of new tools and insights. So, as will be outlined below, we definitely suggest that the investigator and his educated contacts pack up and move into the field whenever appropriate.

1. The first sessions with informants.

Your educated informants will be your invaluable colleagues, and there is no reason not to treat them as such from the very first. This means, firstly, making clear to them just what your purpose is. It may not be generally recognized that this requires a tremendous amount of previous thought and note-making on the part of the investigator. That is, he must know himself what his purpose is! There is no sense in burdening your colleagues with your own lack of

preparation. And one corollary of this attitude is that as your purpose changes or becomes more sharply defined during the course of the investigation, the informants are not to be kept in the dark about such developments but rather constantly informed of the zigs and zags of your own thought.

Some informants are not very happy to be referred to by that name. The senior author usually gives them research titles like "research assistant" instead. The junior author does not object to any name which accurately reflects the type of work he is doing.

It is recommended that money matters be made clear from the very first. These discussions should be phrased so that payment is in connection with working with you and is not the result of working for money.

The first sessions should explore mutual interests in the mechanics of the language itself rather than more general cultural items. It is even a good idea to discuss the techniques of orthography itself, perhaps down to the level of handwriting, since the initial misunderstandings which will result from your strangeness to one another can most easily be resolved in matters so concrete. Also this will develop an appreciation of the automatic elements in the behavior of each of the participants - automatic elements which are usually elevated to ethnosyncracies when they can so easily be put in perspective as being merely idiosyncracies. This

process can be much better accomplished in respect to visual traces of idiosyncratic behavior than in other aspects of cultural behavior.

If you have only a most rudimentary knowledge of the language to be investigated, the activity just outlined will lead naturally to letting the informants teach you more about the language. The extent to which you want to learn will of course determine the length of this phase.

2. Language Lessons and Mathematics.

Make clear to your informants, who are now functioning in the role of teachers, that aspects of the language which show how the people think or reason on a mathematical basis are of particular interest. For instance, in Kpêls counting might immediately be taught. This could be done by the informants actually having palm kernels or stones which they count and you repeat. They can also write the same numerals in words for you to pronounce. In this way you would discover that if you observe the counting of objects there is no necessity for the person counting out loud to announce the names of his objects each time. You will hear only (as he puts down each stone or kernel from his hand onto the surface he is counting objects onto): táan, veers, zaaβa, náan, ñólu, òsida, òsifeers, òsisaaβa, òsináan, puu, táan, veers, zaaβa, náan, ñólu, òsida, òsifeers, òsisaaβa, òsináan, puu, buu feers, táanpuu, buu saaba, táan.....puu, buu náan,

táan.....puu, buu lóolu, taan.....puu, buu òsida, taan.....
puu, buu òsifeers, taan.....puu, buu òsisaaba, táan.....
puu, buu òsináan, táan.....puu, ònùn tónò, táan.....puu,
ònùn tónò pòlu buu tónò, taan.....puu, ònùn tónò pòlubuu
féers, táan, etc.

By this time both your patience and that of your teacher will probably be exhausted, and anyway the basic decimal nature of the counting system as used in counting behavior will be quite obvious.

These counting numerals should be practiced many times until they are learned so well that they can be identified whenever they appear in just this shape in the field.

Continuing in this manner will give you many vocabulary items which your informants will volunteer as being mathematical in nature as well as some of the sentences and situations in which they can be used. Additional vocabulary items of this nature which might be taught by a Kpêlé teacher are: zêei 'set', gbùlu 'group', bele 'row', gau feers 'few', damáa 'many', òsi-téi 'one by one' (feers-feers etc.), têsés 'surpasses', kélés-kélés 'ring-shaped', zamai 'mid-point', òáa kólé 'divide it', òuai bó 'divide it', gbulâ 'half', gbua 'a piece of it, a portion of it', pèlès 'added, united', gelee 'all of it', òye 'ten', wála 'thousand', táman 'million', yelu 'how many', di kpónoi 'they are many'.

3. Contrastive Analysis.

It is now generally recognized that there is seldom an exact equivalence between a word in another language and its English gloss. The place which the words occupy in their respective semantic structures as well as the range which each covers in semantic space is nearly always different. By "contrastive analysis" we mean the discovery and explication of these systematic differences between English and, in this case, Kpêlɛ.

As an example, we start with the spontaneously produced Kpêlɛ-word-with-gloss gbùlu 'group'. The informants are asked to describe the usage of the English word in their experience. An answer might be: "The word group is used in English to indicate a set of things or people." The investigator then asks whether this sentence is true of the Kpêlɛ word gbùlu. In this case the answer was "yes". Therefore, in some sense, the entire English sentence quoted above can be translated into Kpêlɛ and that should next be requested. However, in order to control the information this must be done by ordered stages.

- 1) The word gbùlu is used in Kpêlɛ to indicate a set of things or people.
- 2) The word gbùlu is used in Kpêlɛ to indicate a set of sen or núu.
- 3) ñooi gbùlu is used in Kpêlɛ to indicate a seêi of sen or núu.

4) ñooi gbùlu a sɛŋ seêi da núu seêi lè.

Even with no further knowledge of the language, it is obvious that the Kpêls equivalents of group and set in our sentence occupy very different grammatical slots. This leads to the realization that, at least in folk English, group and set are interchangeable: a set is also a group of things or people. It is also the case that gbùlu and seêi can be interchanged in the sentence above, therefore this grammatical difference does not mark any significant contrast in semantic structure.

This leads immediately to the interesting question as to why gbùlu is glossed 'group' and not 'set', and vice versa. This question has three parts: why do we make the distinction between group and set in English, why is the distinction between gbùlu and seêi made in Kpêls, and why are they matched as they are by bilinguals?

To begin with, seêi conveys an idea which is not conveyed by gbùlu. One can say: "koni seêi saaβa ká tí, koni téi-tsi kéβo di sù." ('Those are three sets of stones with one stone in each set') but one cannot say: *koni kpùlu saaβa kátí, koni téi-tsi kéβo di sù. In other words, seêi is a "setting" or "setting-down" of one or more objects or people, whereas kpùlu always indicates more than one. The senior author feels very strongly that this distinction is only valid in English after technical definition by the mathematician and that a naive English speaker would not use set

to refer to less than two members. Therefore, there is a step in the teaching of the new mathematics that can be eliminated for Kpêlê speakers: a set of one is an intuitively present reality already.

4. Amplifying Behavioral Usage.

At this point it need not be assumed that everything which you want to know about these two words has been presented. A behavioral usage in other terms than mere linguistic behavior can usually offer new insights. However, you must be careful that the non-linguistic behavior elicited is natural to the culture and to the linguistic behavior which you wish to have accompany it. In this case, the informants have already indicated that the counting of stones is part of the culture. Therefore, the investigator might place four stones in a position of four "sets" of one stone each and ask for a sentence using the word seêi. The response might be: "koni seêi náan ká tí" (Those are four sets of stones). Then when some stones are added to all or some of the "sets", this sentence is still elicited unchanged. However, no sentence including the word gbùlu can be said about the first situation of four stones with each one being in its own "set". A new dimension of meaning is introduced when the investigator adds a stone to each of the "sets" (resulting in four "sets" of two stones each) and the word gbùlu still cannot be used. However, if one more stone is

added to each, resulting in four "sets" of three stones each, then either of two sentences can be formed using the word gbùlu. Either: "koni gbùlu náan" (four groups of stones), or "koni gbùlu seêi náan" (four sets of groups of stones). First of all, we learn from this that part of the Kpêlê meaning of gbulu is a collection of no less than three things or people. Further, we learn that the two words can occur together in the same phrase. Still another sentence describing the last situation would be: "koni saaβa seêi naan" (Three stones set four times). Since, in fluent English, this would be expressed as "Three stones times four", the gloss 'times' for seêi is often found. Therefore, for the Kpêlê speaker, the operation "times" was spontaneously described by the junior author as "adding the sets". Thus we see again that the "new" mathematics for English speakers is the "old" mathematics for Kpêlê speakers.

5. Elicitation Frames

A continuing investigation of seêi and gbulu should produce a sentence which can be systematically varied. One such sentence might be "zeeêi a zeêi saaβa" (They are set in three sets). This sentence (which may be called a frame) consists of four words in order, each of which fills a slot. These slots can be given letters in the order in which they appear: A,B,C,D. In the sentence above, A is zeeêi, B is a, C is zeêi, and D is saaβa. All the words which can be

substituted for any one of these words while the others all remain unchanged will be called a substitution class and will be named by the letter of the slot it fills.

The substitution class in which we are initially most interested is C :

A	B	C	D	
zeeêi	a	zeêi	saaβa	'sets'
		gbúlu		'groups'
		duyón		'bunches'
		bele		'rows'
		etc.		etc.

6. Componential Analysis.

It should be possible to find a form of definition which will define each word in a substitution class as against all the other words therein. An example in English would be: chairs are all those movable objects designed for sitting which will accommodate only one person. Those features of the definition which serve to differentiate the thing defined from others of the same class ("movable" so as to exclude seats and "one person" so as to exclude benches) are the components of the definition.

The best form of such a definition in Kpêlê (elicited as a normal sentence type in another context) is: kwa kε (1) kelee.....(2).....naa tolîi kwa ké mà (3). ("Every (1) which is given the name (3).") In this sentence the words which fill the slot (1) are more general terms which include the word to be

defined (3), which in turn is differentiated from other words included under the same general term by the components listed in (2).

Such a componential definition of gbulu might be:

kwa kɛ sɛŋ kelee, a kɛ zêi tonɔ sù a dámaa kɛlɛ ve gayã ná da ñónɔ ve laa ni a ñɛli, láa tolíi kwa kɛ mà gbulu. The components of this definition include 'many' (three or more), 'not grown together', and 'not ropelike'.

7. Mapping Semantic Space.

When a great number of components have been isolated and put in some structural model, this model can be considered a mapping of the semantic space by which speakers of the language operate. The particular model of interest in this project will of course be one including quantification and measurement.

8. Verifying the Model in the Field.

Procedures for validating and extending the data gathered from bilinguals in the field must be worked out in advance. It is very important not to ask for activities and judgments on the part of less educated people which are completely foreign to their experience and prejudices. For instance, the asking of questions may in itself have a very negative value in the culture. The junior author suggests that in his culture there are games which may be played instead to force people to answer questions.

Furthermore in asking questions it is always best to avoid "second person questions" - those phrased in English with you. There are two reasons for this: firstly, when the question is translated into the African language it might come out either in second person singular or plural in an uncontrolled way, and secondly there can be emotional reactions on the part of the people questioned if the question is put in such a personal way. In most (if not all) African languages there is a word for 'person/people' which in usage corresponds to the English word "one" in "how does one do this?" (instead of "how do you do this?") or to the German word "man" in "Wie tut man das?". In Kpêlê this word is núu as in "núu a yíñi kè lei?" (how does one or how do people do this?)

It is a good idea to have one-word labels for as many of the concepts and operations that you are going to be eliciting in the field as possible. It is important to know that the operations which we call "counting" and "measuring" have corresponding contrastive labels in the culture to be investigated. In Kpêlê these are: nòno 'count' and gòon 'measure'. It will always be possible to find out which sort of behavior people are actually doing if their own labels are already known.

Another practical hint is that most African languages have a label for the role of the investigator and his

associates as viewed by the people they are studying. This label is usually translated into West African English as stranger. It will be a good idea to find out in advance just what the local expectations of role behavior in the status "stranger" are before plunging into the local scene. It is of interest to note that this role is by no means a new one in most African societies.

Tape recordings should be used liberally in the field. It is a good rule not to erase anything during any stay in the field itself - useless tapes can be recorded over on subsequent field trips. Tapes can also be used as a stimulus for participation by the people being studied. Since the problem of exactly what you are doing is always a difficult one, it is a good idea to have some distinguished member of the group who now lives in some large urban or academic center make a tape recording of his own understanding of your aims and motives in the local language or local dialect that you can play for everyone. In addition you will be taping all sessions with local informants, but encourage your educated contacts to take notes in their own language at the same time. Also you should be making notes yourself of visual and spacial features of the sessions that will not appear on the tape.

It is extremely important to encourage those people who are eager to help you to do so in their own way. Especially

if they want to draw pictures or make models of any kind, this can be an invaluable way of getting an insight into their conceptualizations. In general, let them teach you by their own methods - the methods they choose will be part of the lesson itself.

Conclusion

We are happy to be able to report that this outline was sufficient to enable Dr. John Gay to design an excellent field experiment for eliciting those words and operations in which he was interested.

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