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7 Informal Modes of Learning and Teaching: The Case of Zinacanteco Weaving

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Our two studies of Zinacanteco weaving emerged from an interest in the effects of culture on cognitive development, and in how cultural differences are reflected in cognitive differences. Western psychologists have generally studied how people from very different cultures — specifically traditional non-industrialized ones — perform on tasks testing cognitive skills from the psychologists's *own culture*. These skills are, in addition, often products of Western education, largely *formal*. To avoid this ethnocentric pitfall, it is necessary to test people from a traditional culture on the ability to "do their own thing", to use skills that are important in their own cultural environment. These skills would of course derive from their own educational system, typically *informal,* and would occur in everyday life situations rather than be specially set up for educational purposes.

We selected weaving as the most complex technical skill acquired by all Zinacanteco women. Because weavers weave patterned cloth, we identified pattern representation as a cognitive skill which could be fostered by knowing how to weave. For our first study, we devised an experimental test of pattern representation strategies (Childs, 1970; Greenfield and Childs, 1972, 1977). Our study asked the following questions. Does knowing how to weave a given pattern affect the weaver's mental representation or concept of that pattern? Can a specific skill like weaving promote a general ability to represent abstract linear patterns? How do the cognitive effects of this aspect of informal education compare with the effects of formal schooling? We thus hoped to elucidate the issue of how specific cultural experiences foster the development of particular cognitive skills. We also hoped to provide information about the cognitive nature of learning a manual skill.

I. SETTING AND CULTURE

The Zinacantecos are a Mayan people dwelling in the highlands of Chiapas, Mexico, near the Guatemalan border. They are ethnically distinct and take pride in their traditions. They wear distinctive clothing and speak their own language, Tzotzil, rather than Spanish.[1] There are approximately 8000 Zinacantecos, of whom about one-fifth live in the major hamlet of Nabenchavuk, site of our studies. Within Nabenchavuk, houses are grouped in clusters reflecting partrilocally extended domestic groups, and are interspersed with cornfields and flower plots. Beans and tortillas constitute the staple diet. The cash crop is corn.

Men hold most of the important religious and political roles; women are influential in these spheres only through their husbands or in their old age. To be influential, a man must be *p'ih*[2] or clever. Advancement along any of the available lines of power involves detailed organization of one's life, especially in its economic aspects (Cancian, 1965). Male Zinacantecos participate in the modern Mexican economy: they rent land to grow corn; they sell corn to non-Indian Mexicans (*Ladinos*); and they buy items like candles and cotton thread. Female Zinacantecos have almost no contact with Ladino culture.

A. Informal Education

Blanco and Chodorow (1964), studying children's work and obedience in Zinacantan, found that most chores were done on command, although older girls tended to do more chores autonomously. Another pertinent finding was that almost all commands are obeyed; yet almost no discernible reinforcement takes place. Young boys and girls do essentially the same household chores, but at about nine years boys begin to help with men's work, primarily hoeing. In learning to do chores, the children are acquiring the skills of their parents. Mead (1943) contrasts the intergenerational continuity promoted by this process with modern education, which promotes discontinuities between parents and children.

B. Schooling in Nabenchavuk

Nabenchavuk has two schools — a state school built about 40 years ago,

[1] Superior figures in the text refer to Notes at the end of this Chapter on p. 313.

and a new federal school, built in 1966. The second school is said to be the result of a request to the authorities made by the leaders of the community. The large population of the hamlet (the 1960 census figure was 1427) and the poor quality of the teaching in the older school prompted their action. The effectiveness of teaching in all Indian schools in Chiapas is questionable: teachers are often sent there because they have not performed well elsewhere; few know anything of the oral Indian languages, and their Spanish teaching methods are based on rote performance. Not all children go to school; but in recent years both interest and attendance have been increasing, and now girls are beginning to attend.

C. Weaving in Zinacantan

One reason given for not sending girls to school is so that they should learn to cook and weave at home. Weaving is of great importance in Zinacantan: women weave almost all clothing on backstrap looms. The two most visible, and, by Zinacanteco standards, most beautiful garments are the *pok' k'u*ul*, a cotton poncho worn by all men, and the *pok' mocebal*, a cotton shawl worn by all women. Boys and girls wear smaller versions of the same red and white striped garments. Though some variation is allowed, certain distinctive elements of the two patterns remain fixed. The defining features of the two patterns can be seen in Fig. 1, where two possible versions of a *pok' k'u*ul* and two possible versions of a *pok' mocebal* are shown.

The representation of these patterns, which are the only ones ever woven in cotton, was the focus of our study. The weaving process itself is long and complicated. The first two steps — spinning and dyeing — are not necessary for all garments. The next step — winding the warp threads onto a frame — gives the threads their first shed and gives the final piece of cloth its striped pattern. Thus the patterns are differentiated at the warp-winding stage. Information about later stages of the weaving process will be presented in connection with our procedure for studying the acquisition of weaving skill.

Blanco and Chodorow (1964) report that children from at least age two might use weaving equipment such as a shuttle as a toy, carrying it around for instance. Thus they have opportunities to familiarize themselves with the objects they will later use in serious weaving. Girls learn the easier steps of weaving first — boiling warp threads and dyeing wool. Weaving itself comes next, then warp-winding, and finally spinning.[3] By age 12 or 13 a girl can weave without adult supervision. Not all Zinacanteco women become highly skilled, but all attain some degree of proficiency.

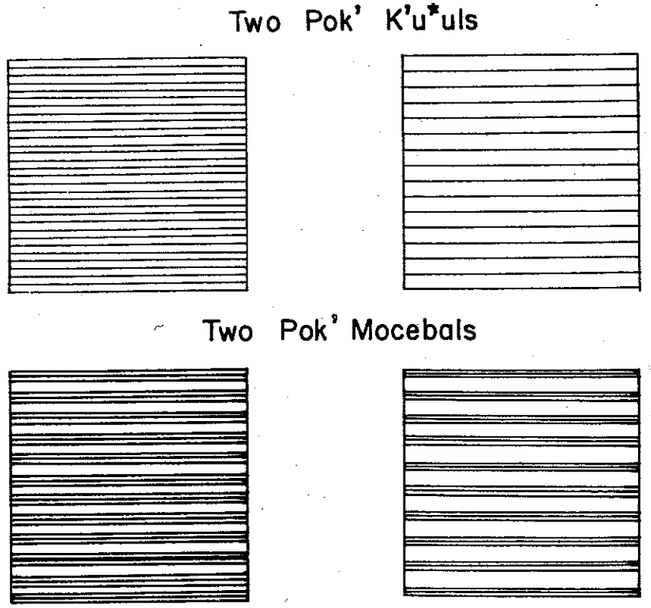

Fig. 1 Zinacanteco woven patterns. Top: two *pok' k'u*uls;* Bottom: two *pok' mocebals.*

II. ASSESSING THE EFFECTS OF WEAVING ON PATTERN REPRESENTATION SKILLS

A. Experimental Tasks

In principle, we followed the strategy suggested by Price-Williams (1975)[4] of starting with a familiar task, and first varying the context, next the materials, and finally, the task itself. One may thus judge the extent to which a person is capable of generalizing the skills involved in a specific task beyond the context in which they were originally learned. The task itself consisted mainly of placing wooden sticks of different colours and widths into a wooden frame to make different striped patterns. The materials and procedure are described in detail in Greenfield and Childs

(1978). The first two problems of the experiment involved doing a familiar task with strange materials in an unfamiliar context. We asked subjects to use our coloured sticks to make representations of two items of their clothing — the *pok' k'u*ul* (Pattern 1) and the *pok' mocebal* (Pattern 2). These two problems constituted our greatest degree of cultural familiarity. The two highest degrees of cultural familiarity schematized by Price-Williams could not be included: the first level of familiarity would have been the weaving process itself, in which no variation was permitted; while the second level would have outraged Zinacantecos by using the real materials of weaving in an artificial experimental context.

The two woven patterns were equally familiar but not equally complex. We asked for the simpler pattern — the *pok' k'u*ul* — first. Since children dress exactly like adults, each subject was wearing one of the garments. The other garment was also present, either in the *pok' k'u*ul* of our informant or his son or in the *pok' mocebal* that the experimenter wore. Various widths of red, white, pink and orange sticks were available for these first two tasks. The different kinds of stick gave the children the opportunity to employ several strategies for representing the difference between the two patterns.

We next shifted to an *unfamiliar task* — pattern continuation: we started a pattern, with three repetitions of its repeating unit, and asked the child to finish it, doing it the same way. Our six continuations went from more to less familiar along two dimensions — pattern and colour. In the first task (Fig. 2,[5] Pattern 3), we started a simple red–white alternation, similar to the configuration of the *pok' k'u*ul,* and asked the child to continue it. Pattern unfamiliarity was correlated with pattern complexity in the continuation tasks, as shown schematically in Table I. Thus, in comparison

Table I
Characteristics of the patterns

Familiar tasks with unfamiliar materials: pattern representations		Unfamiliar tasks with unfamiliar materials: pattern continuations		
			More familiar colours	Less familiar colours
Less complex pattern	Pattern 1 (*pok' k'u*ul*)	Less complex (more familiar) patterns	Pattern 3	Pattern 6
↕		↕	Pattern 4	Pattern 7
More complex pattern	Pattern 2 (*pok' mocebal*)	More complex (less familiar) patterns	Pattern 5	Pattern 8

with Pattern 3, Patterns 4 and 5 (Fig. 2) were not only more unfamiliar, but also complex, for their repeating units were larger and included more differentiated parts. Only the narrowest red and white sticks were used in the demonstration; but the larger red and white sticks and orange and pink sticks of all sizes were available for the children.

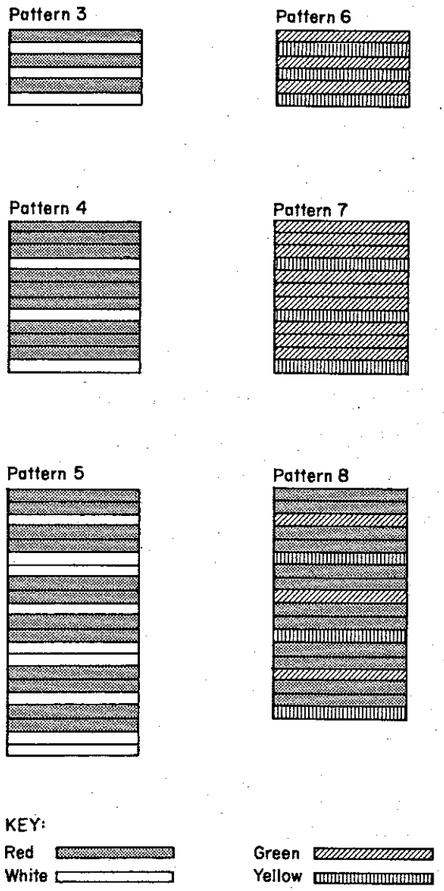

Fig. 2. Modals for pattern continuation.

We then switched to colour combinations (green and yellow; green and yellow and red) that did not appear as Zinacanteco clothing patterns. These models (Patterns 6, 7 and 8, Fig. 2) formed a sequence of familiarity and complexity in a sequence parallel to that of the first three. At this point in the experiment we put in a growing pattern to give the subjects a chance to stop merely imitating our behaviour and do some expanding of the original pattern (Pattern 9, Fig. 3). Three correct continuations of the pattern are possible, as shown in the figure. Continuations by repetition or

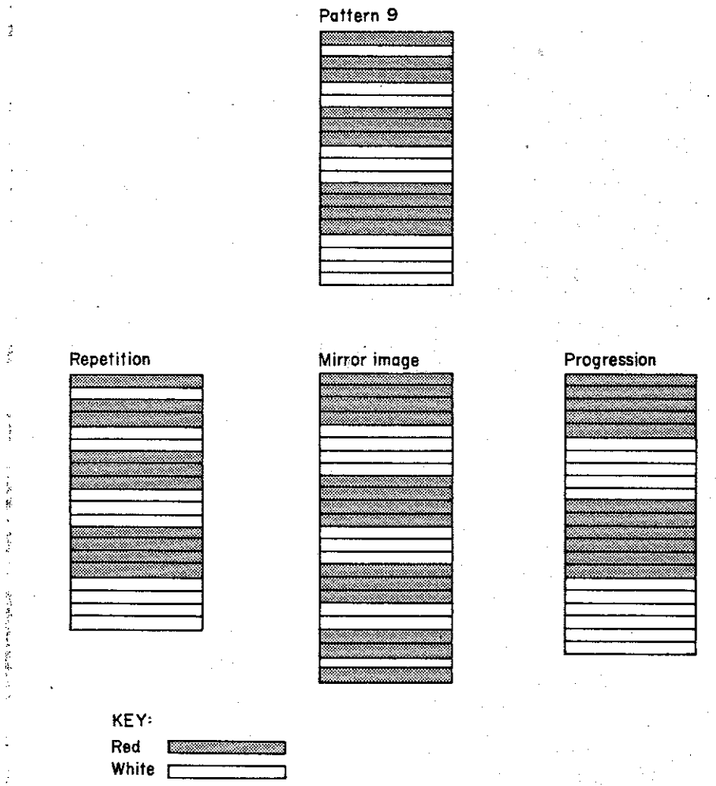

Fig. 3 Model for growing pattern at top; below are three possible continuations, (i) repetition, (ii) mirror image, (iii) progression.

mirror image are imitative strategies, whereas progression requires going beyond the stimulus to create something new.

B. Participants

The data to be reported here were contributed by adolescents between the ages of 13 and 18. Girls are generally skilled weavers by this age, while boys do not learn to weave. They were divided into groups by sex and schooling. There were eighteen unschooled adolescents; nine female and nine male, and there were nine schoolboys. Schoolgirls were not included, because none existed in this age range. In addition, thirteen unschooled adolescents, nine female and four male, and three schoolboys contributed data for the first two problems.

In terms of design it was not possible to separate sex from weaving skill as all girls weave, and boys never do. We were therefore dependent on the pattern of results across tasks to detect distinct effects of these two variables. In order to supplement the division according to sex and schooling, we asked questions which could reveal relevant differences in weaving experience. After determining the steps of the weaving process the girls had learned, Childs asked them specifically which garments they had woven and wound warps for, to see if their knowledge of the construction of the woven striped patterns represented was first-hand.

III. REPRESENTATION OF FAMILIAR WOVEN PATTERNS

A. Effect of Weaving Experience

Table II shows how the subjects represented the *pok' k'u*ul* and *pok' mocebal*. Examples of the two garments were shown in detail in Fig. 1.

There were several different ways of representing the patterns. More girls than boys showed detailed analysis of the pattern (Fig. 4): the crucial feature in this type of representation is maintaining the configuration of stripes in the two patterns, including the thin white stripes in the *pok' mocebal*. Although this type of representation was more than twice as frequent among girls than boys, experience with specific aspects of weaving did not seem to make any difference. The two girls who had not wound the warp of a *pok' mocebal*, the stage at which the pattern is created, both used analytic representations. This can probably be explained by the fact that weaving in Zinacantan is not a private skill. At times it takes two people to handle a loom: threads broken at one end cannot be mended by the weaver, kneeling at the other, without reducing the necessary pressure on

the warp. In addition, weaving and winding are usually done in the afternoon, when the more essential tasks are finished, and in the company of neighbours or relatives. It seems certain that the girls who had not themselves wound or woven the designs had watched, helped and criticized

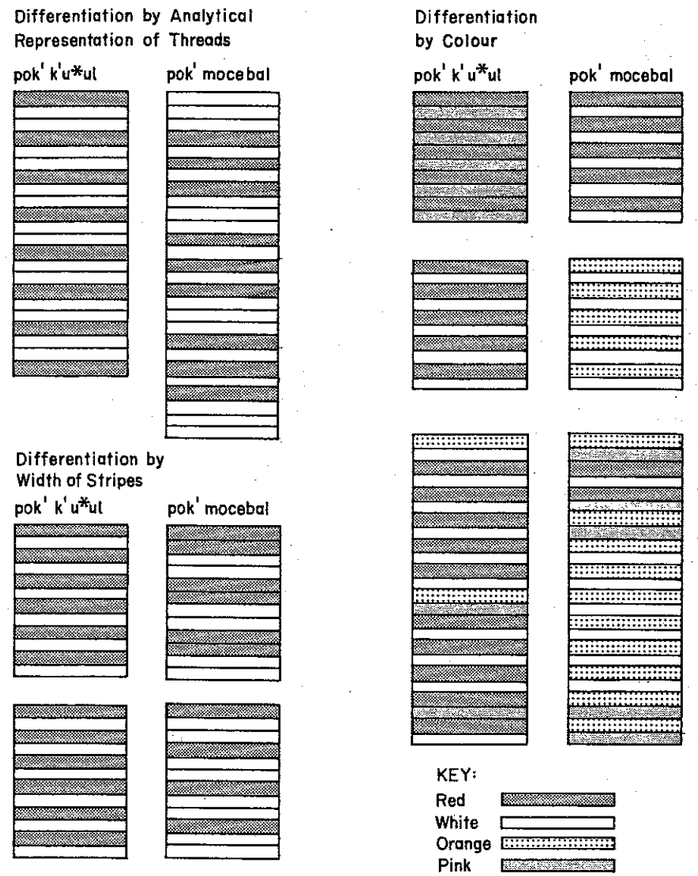

Fig. 4 Zinacanteco ways of representing the woven patterns. Upper left: differentiation by analytical representation of threads, maintaining pattern configuration. Lower left: differentiation by width of stripes. Right: differentiation by colour. (In each pair, the *pok' k'u*ul* representation appears on the left, the *pok' mocebal* representation on the right.)

their friends. All, moreover, carefully examined every piece of cloth they had not seen before, pronouncing it good or bad. Boys, in contrast, never take even an auxiliary role in the weaving process; nor do they engage in the detailed examination of woven material.

Boys are clothes-conscious too, but their representations of the two woven patterns show that they consider a different aspect of the patterns significant. When the *pok' k'u*ul* is seen from a distance, the pattern looks like a solid pink or light red colour. Therefore the *pok' k'u*ul* gives the impression of being "more red" and the *pok' mocebal* of being "less red", even though the threads in the two garments are exactly the same colour. This aspect of general appearance was chosen by four out of 13 of the oldest boys as the essential difference between the patterns. Figure 4 gives three examples of differentiation by colour: the boys used pink sticks instead of white, and orange instead of red, to express the visual effect of greater and lesser "redness". None of the girls used colour to differentiate the two woven patterns. The role requirements of a Zinacanteco woman *vis-à-vis* clothing are different. Girls need to know and use the detailed aspects of the patterns more than boys and so are more apt to choose those aspects when representing them.

A third feature, used equally by both girls and boys to differentiate the woven patterns, is width of stripes. But boys and girls had different ways of representing this differentiating feature. Examples of the method used more frequently by boys are shown in Fig. 4. The *pok' mocebal* is represented as having broader white stripes and, sometimes, broader red stripes by the addition of more narrow sticks. The distinct red and white parts composing the red stripe of the *pok' mocebal* are not preserved: the broad stripe is constructed as an undifferentiated element. When the girls used stripe width to differentiate patterns, they usually used the wider blocks to represent wider stripes, in contrast to the boys. Thus, a wide red stick could be used to form an abstract representation of the three thin red stripes separated by two thin white stripes in the *pok' mocebal*.

These sex differences, significant at the 0·01 level (Fisher's Test, one-tailed), must relate to weaving skill rather than to other aspects of sex differentiation, for the pattern of sex differences is reversed in the novel pattern continuations, as we will see.

B. Effect of Schooling

School experience seems to have had a strong influence (Table II): the boys with school experience represent the woven patterns more like the female weavers than like the male non-weavers. Like the unschooled boys, the

Table II
Percentages in different groups representing the woven patterns (*Pok' K'u*ul* and *Pok' Mocebal*) in various ways

	Weavers: unschooled female Zinacanteco adolescents (%)	Non-weavers: unschooled male Zinacanteco adolescents (%)	Schooled male Zinacanteco adolescents (%)	Female American college students (%)
Patterns differentiated by analytic representation.	33	15	50	0
Patterns differentiated by *abstract* analytic representation.	0	0	0	67
Patterns differentiated by width of stripes, represented *in detail.*	17	39	8	0
Patterns differentiated by width of stripes represented *abstractly.*	22	0	0	33
Patterns differentiated by colour.	0	31	8	0
Both patterns the same or differentiated ambiguously.	28	15	34	0
Both patterns constructed randomly (no differentiation).	0	0	0	0
	$N = 18$	$N = 13$	$N = 12$	$N = 6$

schooled boys did not know how to weave; but their frequency of analytic representations is significantly higher ($P < 0{\cdot}01$, two-tailed Fisher Test).

An interest in the effect of formal education led to a comparison with a group of six first-year students at an American university. These female students, lacking all experience with the woven patterns, were shown a *pok' k'u*ul* and a *pok' mocebal* and asked to represent them using the same sticks and frame as the Zinacanteco subjects. Although one cannot attribute group differences to one specific factor, the results are interesting: this sample had the highest proportion of all groups of analytic representations (Table II); but they were of a different sort (Fig. 5).

While maintaining the configuration of stripes, most of the college group simplified their representation of the broad stripes, using a single wide

stick instead of a group of narrow ones. They differed significantly from both unschooled Zinacanteco weavers and schooled non-weavers in omitting the detailed depicition of individual threads from their analytic representations ($P < 0{\cdot}01$, Fisher Test, two-tailed). In sum, this was the only group to use simplified or abstract pattern elements within the context of analytic representations which accurately preserved the configuration of

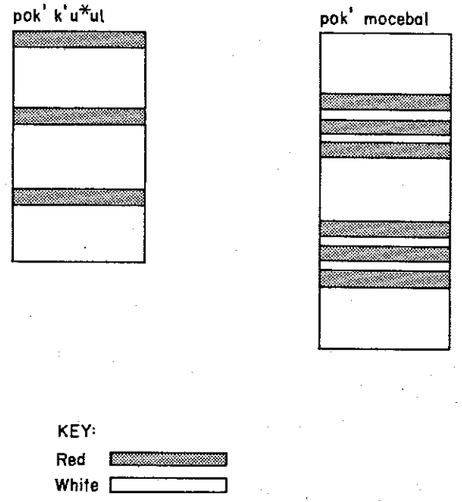

Fig. 5 American college students' representations of the woven patterns.

stripes of the original material. A clue to the potential influence of specific training was provided by the remark of one student whose strategy differed somewhat from the majority of her group. A potential specialist in visual studies, she chose to differentiate the two patterns by width of stripes alone, saying that her art teacher was always telling her to simplify things and leave out unnecessary details. This student, and one other using width of stripe to differentiate the two patterns, employed broad sticks to represent broad stripes. Note that Zinacanteco weavers were the only other group in which this abstract representational strategy was manifest (Table II).

C. Generalization to Novel Patterns

The seven pattern continuation tasks (Figs. 2 and 3) assess generalization of representational skills to novel patterns. The notion that knowing how to weave would, in itself, promote a general skill in pattern representation is disconfirmed.By adolescence the boys, who are non-weavers, show a decided superiority in accurate pattern continuation: they average 6·1 out of 7 possible correct continuations whereas the girls, who are weavers, average only 4·6. This difference, significant at the 0·02 level by the Mann–Whitney U test (two-tailed), indicates that some factor other than weaving skill is critical in promoting the general ability to represent linear patterns. Schooling has no effect on overall performance with novel patterns: the schooled are no different from the unschooled adolescent boys in number of correct continuations: both groups complete about six patterns correctly on the average.

IV. WEAVING AND OTHER CRAFTS IN THE DEVELOPMENT OF COGNITIVE SKILLS

Our results show that knowledge of weaving greatly influences the representation of Zinacanteco clothing patterns. Construction of the patterns in our experimental tasks appears to reflect the perceptual requirements of the cultural task in which the patterns are embedded. However, since analytic representations were constructed by two girls who had never created the two patterns in the actual weaving process, it is impossible to conclude anything about the relation of pattern representation to a specific aspect of weaving experience. Our second study concerning how girls actually learn to weave does, however, support the idea that girls have already learned how to carry out a great deal of the process before they sit down to weave their first piece of cloth. We can conclude that the weavers' analytic representations of the Zinacanteco patterns reflect general involvement with and concern about the weaving process.

Weavers also tended to use wide sticks to represent a stripe composed of a number of threads, whereas the non-weavers more frequently used several sticks placed next to each other. Thus, knowing how a woven pattern is constructed can apparently lead to a more generalized concept of the pattern, as well as foster a more analytic representation. While these two characteristics of the weavers seem somewhat contradictory, pattern analysis and generalization can be integrated, as the performance of the college students shows, for they used generalized stripes while accurately representing the configuration of stripes in both woven patterns. It seems

that the effect of weaving knowledge on the conceptualization of woven patterns lies more in the analysis of pattern configurations than in the detailed representation of threads *per se*.

The high frequency of analytic representations among the weavers confirms the notion that a craft develops the component cognitive abilities necessary to its performance. This effect directly parallels the effects of pottery-making knowledge on conservation of clay substance in the study of Price-Williams *et al.* (1967, 1969). Generalized representation of individual stripes through the use of broad sticks, on the other hand, would seem to constitute a cognitive *effect* rather than a *component part* of the weaving process itself.

Knowledge of weaving did not, however, foster a general proficiency in pattern representation, as is shown by the girl's performance on the continuation tasks. One possible explanation for this is that the girls did not weave enough for their skills to become generalized; but the fact that the weavers actually performed more *poorly* on pattern continuations than the comparable non-weavers belies any interpretation based simply on amount of weaving experience. The crucial factor may be that Zinacanteco culture develops general problem-solving skills more in males than in females, particularly the skills useful in carrying out economic transactions. Perhaps, then, concrete practical experience develops *specific* component cognitive skills — as in potters (Price-Williams *et al.*, 1967) and Mexican weavers — whereas other cultural influences, economic problem-solving for instance, develop *generalized* cognitive performance — the representation of novel patterns by adolescent boys in our study, the conservation of liquid quantity and other conservation concepts in the Price-Williams *et al.* (1967) study. Unlike the process of weaving, renting land, selling corn, and buying supplies generate a wide variety of concrete problems which are to be solved with generalized mathematical skills.

Lave's (1976) study of the cognitive effects of tailoring in Monrovia, Liberia is consistent with findings about effects of pottery-making and weaving. It is clear that tailors are involved in a multitude of economic transactions, and we would therefore expect tailoring to have generalized as well as specific effects on pertinent cognitive skills. Lave tested tailors at varying stages of apprenticeship on two sets of mathematical problems — ones met in the course of tailoring and ones which would not occur in tailoring. Stage of apprenticeship (independent of age) was a significant factor in performance on both sets, although the effect was greater for the tailoring problems. Experience with a variety of problems or patterns, stands out as the most reasonable factor promoting the *generalization* of cognitive skills to novel contexts. Tailoring, in Monrovia, would seem to have this quality. Scribner and Cole (1973) have offered this explanation

for the failure to generalize problem solutions which they observed among unschooled Kpelle.

Generalization of a cognitive skill may also not occur when it would violate traditional practice. A study of the effects of another practical skill — flower selling — on classification would seem to demonstrate this point (Greenfield, 1974). Because Zinacanteco flower sellers make bouquets consisting of flowers of one species and of approximately the same length, we thought these subjects might be particularly skilful in using various criteria (colour, length, species) to make bouquets of flowers and that this skill might generalize to unfamiliar abstract materials (rods differing in colour, length, and diameter). However, flower sellers did not do better than other children with either flowers or rods. Retrospective analysis of the task, which involved sorting materials by one criterion (e.g. length) and re-sorting them by another (e.g. colour), showed that it violated traditional practice. Flower sellers do not take apart perfectly good bouquets to make new ones, a requirement of the re-sorting element of our experimental procedure.

V. THE ROLE OF FORMAL SCHOOLING

The first six pattern continuation tasks (Patterns 3 to 8, Fig. 2) showed schooling to have no definite effect on the growth of representational skill. Only in the response to the growing pattern (Pattern 9) was there a suggestion that school experience might make a difference to the representation of novel patterns: two schooled boys were the only participants who made this pattern "grow" beyond the concrete details of the model (see Fig. 3, "progression"). Zinacanteco culture places great stress on doing things the "true" (*baz'i*) way, and socialization is probably geared to producing someone likely to conform to traditional modes of behaviour, as Brazelton *et al.* (1969) have observed. Very likely most children treated our model of the growing pattern as something to be emulated rather than extended. But school, with emphasis on learning principles transferable to any context, could be erosive of the notion of the *baz'i* way.

Although school experience had minimal effect on pattern representation in general, it had a large effect on representations of the two Zinacanteco woven patterns. This outcome was quite unforeseen. Adolescent schoolboys represented the thread-by-thread configuration as often as the female weavers. It could be that the first effect of formal schooling is to induce analytic self-consciousness about elements in one's own culture. More likely, however, is the effect of schooling in fostering the ability to translate a principle from one concrete context — the woven material —

to a different one — wooden sticks in a frame. In our experiment only the woven patterns demanded this translation, and these patterns were the only ones to elicit substantial differences between schooled and unschooled groups. Goodnow (1962) found the only difference between Western schooled and unschooled Chinese boys was on tasks requiring mental transformations rather than concrete operations, and she hypothesized (1968) that here is where the largest cognitive differences between cultures will appear. Mental transformations may be a particular case of the outcome of formal schooling in developing context-free cognitive operations, especially where schooling introduces a written language into an oral culture (Greenfield and Bruner, 1969; Greenfield, 1972). In fact, an intrinsic characteristic of reading and writing is translation between two media or contexts, the oral and the visual. Similarly, representation of the woven patterns requires a translation between two media, cloth and wood. Because this translation aspect of schooling would be present wherever literacy were taught, it seems a reasonable account of the means by which formal schooling influences representation of the woven patterns.

The idea of a specific effect of schooling fits in with another of Lave's (1976) findings: that formal schooling is more important than tailoring experience as a determinant of the performance of apprentice tailors on *novel* mathematical problems, which would not come up in connection with tailoring. Mathematics is taught in Liberian schools, whereas the continuation of visual patterns is far from the school curriculum of Zinacantan. While schooling in Nabenchavuk may demand the solution of novel problems in general, this quality also appears to be a characteristic of the traditional education of a male Zinacanteco. It seems safe to conclude that the informal education of male Zinacantecos fosters enough skill in dealing with novel problems for our pattern continuations tasks. Just as translation between media is a relevant characteristic of formal schooling for the representation of cloth patterns in wood, so mathematics training is relevant to performance on novel numerical problems. And in each case — Zinacantan and Liberia — the relevant feature of school education has an effect on the pattern of cognitive skills manifest in a test situation.

VI. FROM EXPERIMENT TO NATURAL SITUATION

Whereas anthropologists generally study psychological processes in their everyday context, most cross-cultural psychologists utilize experiments or some type of testing situation (Cole and Bruner, 1971). We concluded from our first study that the very use of these research methods constitutes

a contradiction in terms, if the goal is to assess the development of skills valued by a traditional non-industrial culture. We reasoned as follows. Any experiment or test, by its very nature, requires the use, in a novel situation, of skills acquired in some other situation. Hence an experiment requires cognitive *innovation*, often called generalization, a term which leaves the innovative aspect implicit rather than explicit. For Americans, and, to varying degrees, other Westerners, generalization is important because innovation has positive value: it allows us to adapt to constant change and to solve the ever-novel problems that come our way. But in a traditional society which both values and has stability, the reverse is true. Innovation, and hence generalization, has a negative value; it constitutes a threat to tradition. Therefore, *any* experiment carried out in such a society requests people to use a cognitive skill — innovation — that is not valued and therefore not fostered by their own educational practices and processes. For this reason we wanted to get away from an experimental situation altogether and study a skill in its natural context.

A natural context that appeared to be of great psychological interest was that of informal education itself — the everyday situations in which some skill is developed in a particular culture. In our second study we set out to investigate the interactions that constitute *learning* from the point of view of the incipient Zinacanteco weaver, and *teaching* from the point of view of her instructor. The fact that the development of weaving skill in Zinacantan is an example of "no failure" learning is of both theoretical and practical interest. By "no failure" learning we mean that all girls succeed in learning this fairly complex technical skill. Therefore, we can ask about the processes of interaction between the learner and her environment associated with this successful skill acquisition. Understanding "no failure" learning also has great practical interest; books like "Why Johnny Can't Read" (Flesch, 1955) and "Why Johnny Can't Add" (Kline, 1973) indicate that formal education has many failures. If we knew something about a successful process of informal education, we could perhaps use this knowledge to remedy problems in formal educational systems. As Scribner and Cole (1973) point out, even in Western cultures much education takes place in informal settings. Here too information about the processes involved in a "no failure" method of skill acquisition could be of great practical value.

Many accounts of informal education have been based on ethnographic method (e.g. Mead, 1931, 1943; Middleton, 1970; Read, 1960). In some cases (e.g. Fortes, 1938; Mead, 1930; Raum, 1940) the level of concrete detail is fairly high, but the supporting examples are not part of a body of systematic data. The only exception at the time of our study was the comparison of children in six cultures (Whiting and Whiting, 1975) by

observation of social behaviour in general rather than of skill learning in particular. Hence, there was a clear need to add a systematic data base to the unsystematic observations of informal skill learning generated by the field notes of ethnographers.

Older anthropological accounts sometimes seem to consider informal educational practice to be infinitely diverse from culture to culture. For example Mead (1931) says "primitive education, the process by which preliterate peoples induct children into the cultural tradition of the tribe, is characterized by a very great variety of theories and practices" (pp. 399–400). The work of later psychological anthropologists such as the Whitings has, in contrast, attempted to state functional relationships which can account for psychological and social regularities within cross-cultural diversity. This approach is particularly useful for a study like ours which seeks to investigate a specific example of informal education for evidence of universal psychological processes.

At the same time, psychologists have developed techniques for the study of informal education. Their results also suggest functional relationships in educational processes. A number of studies originated in the realization that children's performance in school is strongly influenced by early home environments, and they are based on the assumption that the mother provides a major part of this environment. Some of the major studies in this area have been done by Hess, Shipman, Brophy, and their colleagues (Hess and Shipman, 1965, 1967, 1968, 1972; Brophy, 1970; Hess *et al.*, 1968) and Bee and her colleagues (Bee *et al.*, 1968; Bee *et al.*, 1970). All differ from our study in observing interaction in situation unnatural in at least three aspects: the task was determined by the experimenters, not the subject; the setting was unfamiliar; and the mothers' behaviour was influenced by instructions to "teach" or "help" their children. Another difference is that these studies involved only preschool children, whereas ours covers the age range from seven to adult. These studies are, however, a source of analytic concepts and hypotheses for data analysis.

A final source is the approach from anthropological psychology. Here, Scribner and Cole's (1973) article on the cognitive consequences of informal education draws generalizations from anthropological work and suggests some psychological relationships which our study was well-suited to test.

VII. PARTICIPATION, COOPERATION, AND DEVELOPMENTAL SEQUENCING

The theme of participatory learning is implicit if not explicit in much discussion of informal education (e.g. Read, 1960). Scribner and Cole

define informal learning as that which "occurs in the course of mundane adult activities in which the young take part according to their abilities". This idea has a long history in anthropology (Fortes, 1938; Hogbin, 1946; Kneller, 1965). Such participation implies that, initially, the learner is, in fact, cooperating with the teacher, that joint effort is required to complete a task which the learner could not do alone. Fortes (1938) in fact, lists cooperation as one of the three principal learning mechanisms employed in Taleland (Ghana). Thus, Scribner and Cole's definition implies a hypothesis about developmental sequencing which can be tested by our data: that, as the learner gains increasing experience, cooperative work will decline while independent weaving by the learner increases. Koech (1974) extends the description of a developmental sequence in his study of the Kipsigis system of traditional education in Kenya. He states:

> First the child observes. The child then participates in a minimal way. And gradually the child graduates to perform the task independently (p. 563).

A similar three-step sequence is described by Philips (1972). We used our data to test the generality of this three-step developmental progression from observation to cooperative participation to independent weaving.

From a psychological perspective our hypothesis is a test of Kaye's (1976) concept of "shaping" or the Wood *et al.* (1976) concept of "scaffolding": intervention by a teacher that enables a child to solve a problem, carry out a task, or achieve a goal which would be beyond his unassisted efforts. Scaffolding consists essentially of the adult "controlling" those elements of the task that are initially beyond the learner's capacity, thus permitting him to concentrate upon and complete only those elements that are within his range of competence (Wood, *et al.*, 1970). The extent of scaffolding decreases as the learner develops the skill. Our data from a natural situation where neither learner or teacher has received any instructions can be tested against the experimentally controlled mode of an ideal "tutorial" situation of Wood *et al.* (1970). On the side of the learner, Wood *et al.* found that the frequency of unassisted achievement increased with age, reflecting an increase in learner participation and a decrease in the need for teacher participation or "scaffolding". This is basically the progression described above from observation of informal education in other cultures. Another aspect of scaffolding is its relation to task difficulty: the teacher should intervene selectively at the harder parts of a complex task sequence. This was another hypothesis which could be tested with our data, and constitutes a step towards understanding the relation between the internal structure of a skill and the methods used to teach it. Another sort of simplification consists in providing easier tasks earlier in

the learning process, so that the learner has a better chance of success even without teacher intervention (cf. Kaye, 1976). In weaving, this can be done by giving more inexperienced weavers simpler articles to weave, and our data were used to explore this possibility.

Fortes (1938) notes the unity of the world of children and adults in Taleland. Kneller states that "the primitive child is always in close touch with the adult version of the skill that he is learning" (1965, p. 76), and that he can immediately see the relevance of these skills for his own survival. Hence, Kneller claims, the informal learner in a non-industrial society is intrinsically interested in learning and does not become listless, unlike the school child. Fortes (1938) makes a similar point about the Tallensi:

> The child's training in duty and skill is always socially productive and therefore psychologically worthwhile to him; it can never become artificial or boring (p. 58, Middleton, 1970).

This claim contains an implicit hypothesis that can be tested in our data: that the learner will be highly attentive in an informal learning situation. Perhaps because school education emphasizes generalized tools, like mathematics, divorced from a specific functional context (Scribner and Cole, 1973), it becomes too intellectual, hence lacking "the motivation to be found in the informal education of life" (Brubacher, 1962, p. 36). Another motivating factor is thought to be the personal nature of the relation between learner and teacher. The teacher is someone well-known to the child, usually a relative (Mead, 1943; Fortes, 1938; Whiting and Whiting, 1975). Fortes (1938) and Mead (1964) speak of identification as one of three major learning mechanisms. We looked to find out who in fact serves as teacher when the time comes for a Zinacanteco girl to learn to weave.

VIII. MODES OF LEARNING: OBSERVING, PARTICIPATING, AND SPEAKING

Scribner and Cole (1973), Hambly (1926), Kneller (1965), and Todd (1913) in surveys of the anthropological literature, Fortes (1938) Raum (1940), Mead (1928, 1930) and Hogbin (1946) in ethnographic reports, have emphasized that children learn by watching and imitating what they have seen. More recently Cazden and John (1971) have drawn together evidence from psychological testing and ethnographic work to show that the traditional cultures of Native American children emphasize visual observation rather than speech in their learning processes, further concluding that

"informal learning does not promote verbal formulation on the part of the learner any more than it does on the part of the model". Our data permitted a fine-grained test of these contentions. In addition to examining the role of observation and modelling, we were able to look at verbal formulation by both learner and teacher.

A. The Role of Explanation

Fortes (1938) observes that Tale children rarely asked "why?" questions, as does Hogbin (1946) for Wogeo, New Guinea. Fortes concludes that this is because so much Tallensi learning occurs in real-life situations where meaning is intrinsic to the context. We shall examine our data to test the generality of this negative relationship between participatory learning and "why?" questions. Raum (1940) noted that Chaga adults rarely gave explanations. Kirk's (1976) laboratory comparison of maternal teaching techniques among rural, urban, and suburban Ga samples in Ghana showed that verbal justification and explanation was rarest in the rural sample where traditional informal education was most important. One would expect infrequent explanations by the teacher to be associated with a low rate of learner questioning, although Hogbin states that Wogeo teachers give detailed explanations even though learners do not ask "why?". This relationship will be explored further with our data.

E. Goody has recently studied the acquisition of weaving skill among the Gonja in Ghana; her data will eventually make an interesting comparison set with our own. Her early results (Goody, 1978) show that learners rarely ask questions. She concluded that questions were a prerogative of high-status people in general, so that a person of relatively high status (e.g. teacher) questions a person of relatively low status (e.g. learner), but not vice versa.

B. Verbal Commands and Obedience

Adults are likely to exert pressure to comply on children when children are participating in economically important tasks. One would therefore expect that such pressure would be exerted on Zinacanteco girls learning to weave, for weaving has great economic importance in the household economy. This hypothesis can be tested in our data by examining the frequency of commands relative to other types of verbalization. Some empirical support for this relationship already exists. Munroe and Munroe (1972, 1975) found that Kikuyu children in East Africa were directed by

older people more than 50% of the time in various household tasks. Whiting and Whiting (1975) found that mothers in the simpler societies where many household tasks are given to children in general told their children what to do more than mothers in more complex societies where household tasks are more rarely assigned to children. A similar pattern was found by Kirk (1976) in her comparison of teaching styles among rural, urban, and suburban Ga mothers. Rural mothers, members of the least complex society in which children were most often assigned chores, were distinguished by their frequent use of imperatives, especially positive commands.

The Munroes indicate that compliance training has generalized effects beyond the situations in which it takes place. They compared American and Kikuyu children from five to nine years of age in responding to both prohibitive (negative) and prescriptive (positive) commands given by mother and a stranger in an experimental situation. American children, who do not generally participate in important household tasks (Whiting and Whiting, 1975), were equally compliant in response to the prohibition, but much less compliant in response to the positive command. It is precisely positive commands which are important for household tasks while negative commands would function to keep children out of physical danger or to check antisocial behaviour. These latter two functions would be equally relevant to both societies whereas the former would be more relevant to the Kikuyu. Hence, the tendency to be obedient generalizes and the pattern of generalization conforms to the differential function of obedience in the day-to-day life of each culture. Similarly, Graves (1968) found that urban mothers gave relatively more negative, relatively fewer positive commands to their preschool children in Uganda and Colorado than did rural mothers. She emphasized that opportunities to perform important household tasks were much rarer in the city than in the country, and so the frequency of positive commands decreased relative to negative ones. We would expect positive commands to predominate over negative in our situation, again because it is a situation of participation in an important household task.

C. Extrinsic Verbal Reinforcement

The role of praise and criticism in informal education appears to be quite variable from culture to culture (Mead, 1931; Minturn and Lambert, 1964), and one might therefore conclude that extrinsic reinforcement is peripheral rather than essential to learning. Brophy (1970) found that an emphasis on pre-response instructions to the child rather than post-response feedback (reinforcement) was associated with effective teaching. Hess and Shipman's (1965) analysis of the same data emphasized, in contrast, the positive value of praise in comparison to criticism. Neither Brophy nor Hess and Shipman present direct data linking how mothers taught with what children learned, so that it is hard to evaluate their claims. These claims can, however, be considered in the light of our own data. Another side to the question of reinforcement is provided by Lepper *et al.* (1973). They found that extrinsic positive reinforcement for an intrinsically rewarding activity reduces the intrinsic interest of that activity for nursery school children. A culture might tend to avoid extrinsic reward where the activity to be learned is of intrinsic interest. Zinacanteco weaving should be just such an activity.

D. Combining Language with Other Modes

Thus far the role of linguistic behaviour has been considered from a functional perspective. It may also be considered from a cognitive point of view with the emphasis on requirements for information transmission. Bruner (1966) has stated that since informal learning takes place in an action context, words are relatively less important than in school learning. Greenfield (1972) pointed out that children who have not been to school use language in a more context-dependent manner than children who have some formal school education. That is, unschooled children formulate messages whose communication value depends relatively more on the non-verbal context that the messages of school children (Greenfield *et al.*, 1966). Kirk's (1976) laboratory comparison of maternal teaching techniques in rural, urban, and suburban Ga environments revealed that mothers from the rural environment where informal education plays the greatest role used non-verbal channels of communication to a greater extent than mothers from the other two more westernized environments where school-based learning plays a relatively greater role in the educational process. Hence, the claim is that it is not merely a question of comparing the amount of language but also the structure of its use. Scribner and Cole (1973) point out that discussions of informal learning as non-verbal are over-simplified because they ignore the many different functional uses of language in everyday life. Children and adults are always learning through the medium of language, outside the school as well as in it. What is special about the school situation is that there language becomes almost the exclusive means of exchanging information. It is self-evident that when linguistic forms carry the full burden of communication, the amount of information available to the learner is restricted. Compare the many rich

sources of information available to the child who learns to weave by watching and doing. In our study we have asked how various sources of information are combined and coordinated by learner and teacher. How does the combination vary with stage of learning, type of task, and physical situation of the teacher and learner?

One of our hypotheses stemmed from the notion that verbalization becomes less informative, more redundant, the greater the extent to which a given message is carried by the non-verbal situation. We expected that teachers' verbal messages would be more specific or self-contained when the teacher was separated from the learner-weaver by a relatively greater physical distance. That is, when the teacher was not physically able to use the non-verbal context to carry part of the message, the verbal part would become more frequent and context independent. It is not so much the case that some people use language in a more context-independent way than others, but that some situations require more context-independent speech. This hypothesis was an extension of Greenfield and Smith's (1976) finding that at an extremely early point in language development, the one-word stage, children use their single word to encode the most informative, least redundant element of the message — that part that is least obvious from non-verbal aspects of the situation. Similarly, telegraphic ellipsis in adult conversation (Holzman, 1971) seems to follow the same rule: do not express those elements of the message that are most obvious from the non-verbal context. It follows that more elements will be communicated linguistically in situations when fewer elements can be communicated non-verbally.

A second hypothesis was that the redundancy between modes (verbal and visual) of teachers' messages to learners would decrease as learners became more proficient. This hypothesis was based on a study by Greenfield (1971) which indicated that multimodal representations of a concept by the teacher were necessary at the initial stages of learning for preschool children, whereas representation in a single mode (verbal) sufficed at later stages. Again our hypothesis was base on the underlying premise of universal sensitivity to pragmatic factors rather than cultural differences.

IX. LEARNING HOW ZINACANTECOS LEARN TO WEAVE

A. Introducing our Study to the Zinacantecos

Video recording has complex cultural significance in Zinacantan, for soul-loss is an ever-present danger. The evil eye responsible for soul-loss

can operate through a camera lens, and our bulky video equipment could not possibly be ignored. Children are the most susceptible to the evil eye; their souls, much less stable than those of adults, can be dislodged by a mere stumble. We did all we could to make ourselves less strange. We had worked together in Nabenchavuk for two summers, and for one of us, Childs, it was her third year of familiarity with the Tzotzil language. We wore Zinacanteco dress, which previous work had shown to be important in reducing tension.

We tried to allay fear of our equipment by de-emphasizing its mysterious qualities. We recorded children's voices to play back for them. We played back as much of each subject's videotape to her and her family as the batteries would allow. We gave each subject, in addition to money, a polaroid photograph of herself to keep. All this was in an attempt to counteract the feeling that a photograph or recording, if taken away from the space its object occupies, takes something away from that object. Although we did manage to film 14 subjects, we were not successful in eliminating fear of the camera. Our tapes ran out at about the same time that our chief informant, Xun Pavlu, decided that it would be too dangerous to look for more subjects. Ten of our 14 subjects were related to each other, by blood or marriage, indicating the severe limitations on even Xun's powers of persuasion. We will never know if the girls and their teachers relaxed enough before camera and gringos to learn and teach in a "normal" way. However, the groups at most tapings were not deterred from normal joking and gossiping. In any case fear was a constant and not a variable factor in our study.

To understand our methods of data collection and analysis, one must first understand the Zinacanteco loom and how it is set up.

The Loom The backstrap loom used in Zinacantan has no existence without the piece of cloth that is being woven on it; it consists of a leather belt, rope, string, thread, and seven sticks.

Preparation The weaver chooses the thread and winds it in a figure-eight pattern as long as the desired length of her cloth. She makes as many figure-eight loops as will give her the desired width. If there are to be stripes, they are put in at this point as different-coloured warp threads. The figure-eight winding, or criss-cross configuration, is essential in making the two basic sheds, or spaces necessary for weaving. The warp threads are boiled in starch to give them strength and stretched between two loom end-sticks to dry. One end-stick is attached to a tree or post by a rope, the other to the leather backstrap, and a stone or heavy object is placed inside the backstrap to hold the threads taut (Fig. 6).

Step 1 — separating (Fig. 6). The weaver places a stick between the upper and lower warp threads and above the cross in the threads. She then

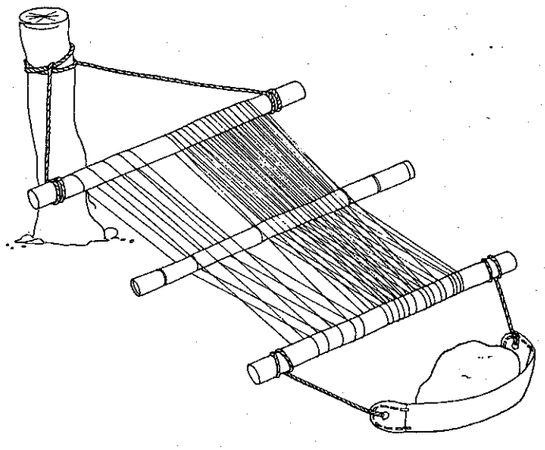

Fig. 6 Backstrap loom: warp threads stretched between two end-sticks.

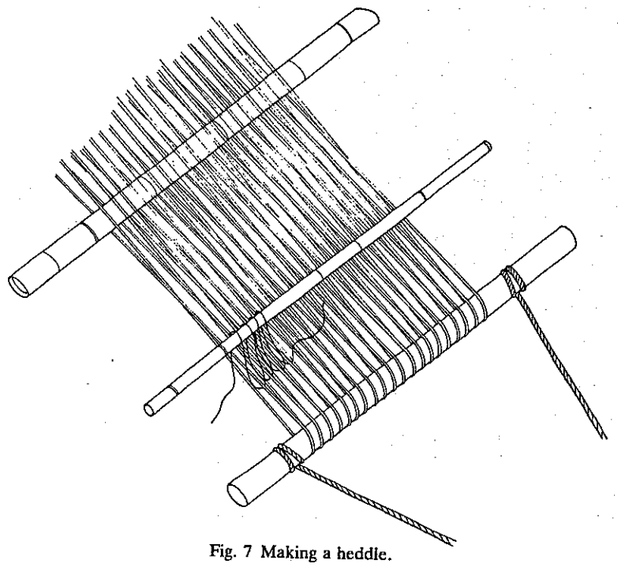

Fig. 7 Making a heddle.

separates the threads one by one, and distributes them evenly along the bottom stick.

Step 2 — making a heddle (Fig. 7). The device that enables a weaver to change sheds is called a heddle. In Zinacantan, it is made out of a long stick and some thread: the stick is laid on top of the warp threads; then the end of the thread is passed between the upper and lower threads below the cross, and a series of loops is made, each attaching one of the upper threads to the heddle stick. Thus the heddle is connected to every alternate thread of the warp. The two ends of the heddle thread are tied together on top of the heddle stick.

Step 3 — selvaging (Fig. 8). To make a selvage, or finished edge, a selvage string is placed at the bottom in place of the thicker loom stick. First the warp threads are distributed exactly as desired along the bottom stick, making sure that any stripes are lined up evenly. A selvage string, heavier than the threads, is tied to one end of a new end-stick, passed between the upper and lower threads below the cross, and tied to the other end of the new stick. With the new stick lying on top of the upper threads, the rest of the selvage string is wound around and around it, passing through the warp threads at equal intervals (about half an inch). Figure 8

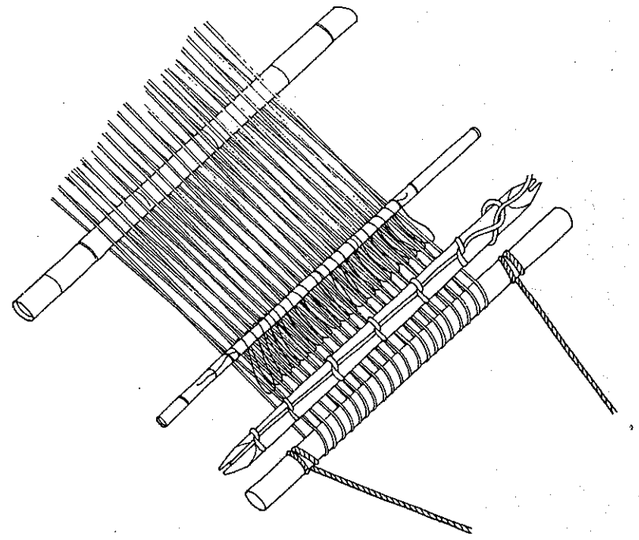

Fig. 8 Putting in the selvage string.

shows how the loom looks at this point in the process. When the loops are completed they are tightened, holding the selvage string, and therefore the warp threads, tight against the new stick. When the end of the selvage string has been tied in a third knot, the old end-stick is released from the weaver's belt, and the new one is pulled towards her and attached to the belt to take its place.

Step 4 — weaving. The weft thread is wound around a stick to make a bobbin, and is passed through the shed or space created by the old end-stick. Then this stick is removed and Shed 1 is made (Fig. 9). Shed 1 is the space created when the large bamboo stick separates the upper and lower warp threads. Threads 1, 3, 5, etc., are underneath the stick and threads 2, 4, 6, etc., are on top of it. The beater, a heavy carved stick with a narrow edge, is inserted into this space to enlarge it. The weaver lays the beater flat with its narrow edge facing her and pulls it towards her sharply two or three times. This beats the weft thread into place. The weaver turns

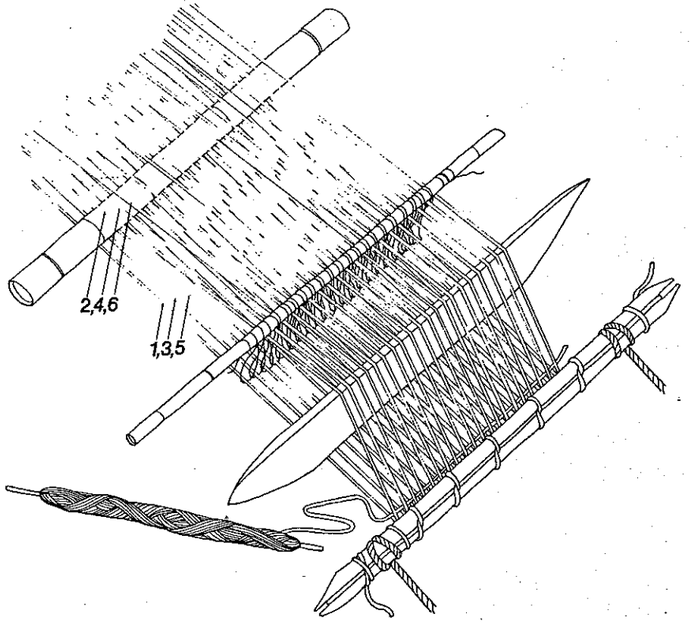

Fig. 9 Starting to weave: shed 1.

the beater to hold the shed open, and passes the bobbin through the shed. She then removes the beater and creates Shed II by lifting the string heddle which raises the lower warp threads (Fig. 10). She inserts the beater into this new space to enlarge it. Thus Shed II is the space occupied by the beater, with warp threads 2, 4, 6, etc., underneath it, and threads 1, 3, 5, etc., on top of it. The position of the threads relative to the bamboo stick does not change. The weaver beats down the weft thread with the beater, turns the beater to hold the shed open, passes another weft thread through it, and removes the beater, allowing the warp threads to return to Shed 1. She continues to weave, alternating Sheds I and II, and creating cloth as she goes. We use the term "cycle of weaving" to refer to the repeated sequence including both Shed I and Shed II.

Step 5 — turning it around — "hoyih". To make sure that both ends of a piece of weaving have a finished selvaged edge, a few inches are woven at one end and then the whole piece is turned around and the bamboo stick

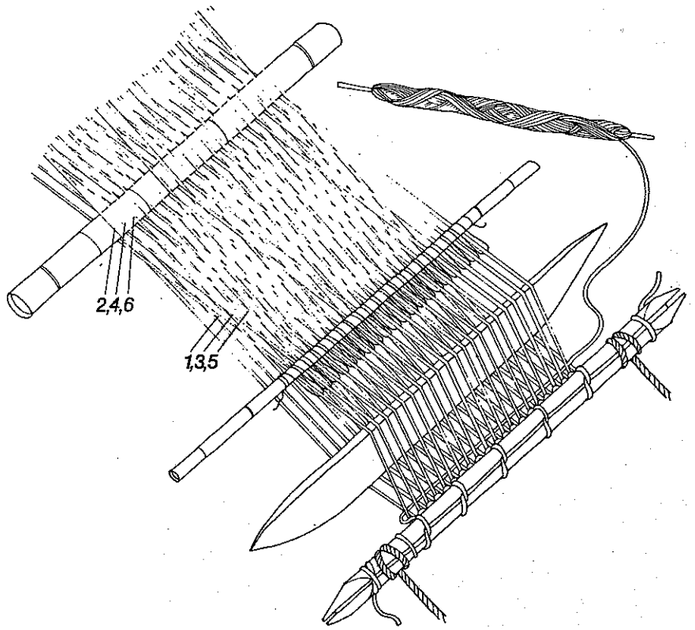

Fig. 10 Starting to weave: shed 2.

and the string heddle are moved down to the new bottom end. After the threads are separated at that end a new selvage string is attached. Weaving is begun again and continued until the other end is reached.

Step 6 — finishing-off a piece of work. We did not tape this activity, but it should be included as part of the weaving process. To make an invisible joint between the material woven from the second end and the original few inches of weaving, smaller and smaller bobbins and beaters are used, and the last few rows are done with a needle and smoothed out with a nail. The piece is then removed from the loom; the selvage strings are pulled out, and the weft threads redistributed.

B. Collecting the Data

We decided to tape only 8–10 min of a given part of the weaving process and then stop and wait for the next activity to begin. Unfortunately, this decision was taken after we had started taping, and so not all our subjects were recorded doing all the activities. There were always relatives and neighbours present at our tapings, and of course ourselves: one of us (Greenfield) holding the camera, and the other (Childs) walking around trying to keep people from being nervous about the camera. We found that some preliminary conversation with learner and teacher was necessary to allay fears of the equipment. If an awkward silence prevailed, or if a teacher gave only whispered directions, we tried to relax the participants by saying: "If there is anything you want to say to her, say it. If there is anything you want to teach her, teach it."[6]

C. Analysing the Data

We chose three segments of the weaving process that seemed to promise the most for comparison: (i) *Selvaging:* from the end of the second knot until the end of the third knot in the selvage string; (ii) *First cycle of weaving:* from the first sign of actual weaving (picking up the bobbin, asking for it, asking for the beater) or from the tying off of the third knot of the selvage string, whichever came first, until picking up the bobbin for the second cycle; (iii) *Later cycle of weaving* (the third cycle whenever possible): from touching the bobbin to begin the cycle until touching the bobbin to begin the next cycle. We had taped instances of all three of these segments for most of our fourteen subjects.

For each subject we coded data as follows.

(1) Background data: weaving experience and age. (See Table III, columns 1 and 2; Table III also presents the data analysed for each subject.) The ages of our subjects, supplied by their mothers, were not completely accurate. When we discovered that weaving was not closely correlated with age, we tried to sample girls at various levels of experience. These levels are presented in the first column of Table III.

Table III
Characteristics of sample

Number of Articles previously woven	Age	Article currently weaving	Duration of analysed segments: Selvaging (min) (s)	First cycle of weaving (min) (s)	Later cycle of weaving (min) (s)
0	9[a]	baby garment	3 14	4 16	2 24
0	11[a]	baby garment	4 24	5 22	1 20
0	8[a]	bag	– —	— —	59
1	9	tortilla bag	1 13	16 20	– —
1	8–10	tortilla bag	3 47	4 11	2 49
2	12–15	money bag	4 08	7 58	54
2	12[a]	skirt	8 04	5 19	4 39
4	13[a]	baby garment	1 51	2 47	35
many	13–15	skirt	– —	– —	35
many	15[a]	poncho	3 16	1 57	2 31
no data	11	poncho	3 53	3 47	1 46
no data	9	skirt	4 29	2 46	1 35
no data	7[a]	bag	– —	— —	1 14
no data	11–12	woollen baby skirt	6 41	4 25	3 02

[a] These ages are from single estimates made at the time of the study. All other ages are from two estimates given a year apart. Double numbers show disagreement in the ages.

(2) We wrote down the names of all the people who appeared at the weaving session and their relationships to the weaver. If we knew neither names nor relationships, we recorded approximate ages. Later, using family trees and the videotapes themselves, we organized the people present by sex and by approximate age.

(3) Using a stopwatch, we recorded the number of seconds the teachers were doing the task and the number of seconds they were doing nothing. For the girls, we timed three activities: doing the task, observing the teacher doing it, and paying no attention at all. We also recorded the number of seconds that the teacher and the learner were doing the task together. The figures in the last three columns of Table III show no developmental pattern in the length of time for any of the three segments.

We knew that the duration of any given segment could be greatly affected by the size of the piece of cloth or the amount of time the teacher was actively participating. In order to compensate for this variability we calculated a series of percentages using the number of seconds in each of the timed activities mentioned above as a numerator, and the total number of elapsed seconds as a denominator.

(4) To analyse interaction between teachers and learners we developed a particular coding system. For the teachers, we recorded as interactions all the initiations of activities, physical or verbal. If the activity was verbal, we recorded what type of physical activity was going on at the same time, and vice versa. In addition we recorded the proximity of the teacher at the time of the interaction. Thus, each interaction of the teachers had three aspects: physical, verbal and spatial.

Physical activity of the teachers:

(i) Doing the task. A teacher could be doing the task alone or with the girl.
(ii) Guiding the girl's body. This could be pushing the girl into position or out of the way, or simply hitting her.
(iii) Pointing to something. Sometimes teachers pointed behind the girl's backs and were not seen, but we still considered pointing to be a part of the teacher's activity.
(iv) Doing nothing. This was recorded only when an utterance was made in the absence of any physical activity.

Verbal activity of the teachers: (The unit of a verbal activity consisted of one sentence. Sentences usually contained only one verb, unless two clauses were connected by an "if" or by a "because" as in (9) below. We used semantic criteria for classifying incomplete sentences, e.g. (5), (8) below.)

(i) Specific positive commands. (*Lean back. Lift it up.*)
(ii) Specific negative commands. (*Don't put it in like that.*)
(iii) Specific statements. (*It's finished. The stick didn't go in.*)
(iv) Specific questions. (*Where is the bobbin?*)
(v) Vague positive commands. (*Like this. Look.*)
(vi) Vague negative commands. (*Not like that. No!*)
(vii) Vague statements. (*O.K. That's good enough. Not yet. Hmmm. That's what I said.*)
(viii) Vague questions. (*Like this? What?*)
(ix) Explanations. (*If it doesn't go down properly, stick it in like this.*)
(x) Positive reinforcing remarks. (*Good.*)
(xi) Negative reinforcing remarks. (*Bad. Hurry up. You don't know how! Dummy!*)

(Numbers (xii) to (xv) were not addressed to the girl, but to other people nearby.)

(xii) Positive remarks relating to the task. (*She's weaving well.*)
(xiii) Negative remarks relating to the task. (*It's really bad. She doesn't understand. Laughter.*)
(xiv) Neutral remarks relating to the task. (*She's just beating it down.*)
(xv) Non task-related comments. (*Where did you buy your shawl?*)
(xvi) Unintelligible. Most utterances recorded as unintelligible were probably specific positive commands (1) or specific statements (3). Intonation and length of utterance helped to place other not-quite-intelligible utterances, as vague, negative, or questions, but gave no clue to help distinguish these two categories.
(xvii) No utterance. This was only recorded when a physical interaction was made in the absence of any utterance.

Proximity of the teachers:

(i) Outside of camera range (and out of reach of the loom).
(ii) Standing within camera range (and therefore close enough to reach the loom).
(iii) Kneeling on the ground beside the girl.
(iv) Inside the loom (having taken the girl's place).
(v) There was no teacher at all.

For the girls, only the verbal aspects of their interactions were recorded. (Proximity was not relevant as a learner variable, while the categories of physical activity defined for teachers, above, were virtually non-existent for the learners or derivable from other categories.)

Verbal activity of the girls:

(i) to (ix) These types were the same as for the teacher. Some of them (ii, vi, ix) did not, in fact, ever occur, but they were still considered to be possibilities.
(x) Non-task-related comments (addressed to others).
(xi) Non-task-related comments (addressed to the teacher).
(xii) Unintelligible.
(xiii) No utterance. (This was only recorded if a girl made no utterances at all in an entire segment.)

D. Reliability

We were able to make tests for reliability on two aspects of our data analysis: the timing of both teachers' and learners' activities, and the

physical activity of the teachers. Space forbids a full report here; but agreement was in general satisfactorily high.

X. OBSERVATION AND PARTICIPATION: RESULTS

Zinacanteco girls weaving their very first article looked amazingly expert in comparison with a beginners' class of adult American women observed in Cambridge, Massachusetts. It seemed likely that they had gained this proficiency by watching older girls and women weave. Our video records indicate that, on the average, one girl under six was visible near each weaver. These incidental data indicate that young girls have plentiful opportunity to observe.

Observation continues to be important as the girls begin to weave their first piece of cloth. During the two segments which involve a new process — selvaging and the first cycle of weaving — beginners observe their teachers more than they participate (53% of the time). The first row of Table IV shows how the percentage of time spent observing the teacher drops sharply for girls working on their second piece of material and continues to decline with increasing experience. The great attentiveness of the learners becomes clear if we look at the second row of Table IV, which

Table IV
Percentage of time spent observing the teacher, distracted from weaving, and participating by weavers at different stages in learning to weave

	Previous weaving experience			
	None ($N = 2$)	One piece of cloth ($N = 2$)	Two to four pieces of cloth ($N = 3$)	Expert ($N = 1$)
Observing	53[a]	28	14	0
Distracted	8	5	0	0
Participating	39	67	86	100

[a] These percentages are based on the selvage and the first cycle of weaving. Because there was little opportunity for observation in the later weaving cycles, these data are discussed in a later section on task simplification.

shows the percentage of time the learner was distracted from the weaving — neither watching nor participating. Inattentiveness was very infrequent. Thus, our videotape records document the important place of observation hypothesized for the early stages of learning to weave. They also lend support to the notion that learners will display a high degree of

attentiveness when they are learning a skill that is crucial for their group.

The large proportion of time spent observing among beginning weavers actually has a second significance: if the learner is watching the teacher, then the teacher is actually doing the weaving; this one form of simplification or scaffolding. But there is a second, lesser degree of teacher intervention: the teacher may do the weaving cooperatively with the weaver. The thesis of developmentally graded scaffolding would predict that taking over at difficult points would predominate at early stages, while cooperative help would predominate at later stages in the learning process. We compared intervention of the two types at different stages. For the totally inexperienced learners, teacher intervention was cooperative 36% of the time; for those who had woven one piece of cloth before, the proportion was 47%, and for those who had previously woven two to four items, the proportion was 76%. Thus, as the learner becomes more experienced, there is a clear increase in cooperative help by the teacher and a decrease in taking over. Intervention of all kinds decreases as weaving skill increases: girls without previous experience work on their own only 7% of the time; girls who have completed one previous article, 52% of the time; after two to four articles, 58%; and expert weavers work independently all the time.

Although our results do not indicate the presence of three distinct stages — observation, participation with teacher, and independent weaving — there are developmental trends in the predicted direction for all three processes. The correlation between teaching techniques and skill level, rather than age level, indicates a good "match" between learner characteristics and teacher input. Because of the lack of correlation with age, developmental results are presented in terms of stage of weaving experience throughout this chapter.

XI. THE EFFECTS OF TASK STRUCTURE ON TEACHING TECHNIQUES

The first cycle of weaving is intrinsically more difficult than the later cycles because it constitutes a complete change from what has gone before and because there are special technical problems associated with "getting started". For the completely inexperienced weaver the first cycle is also her introduction to weaving. If we compare overall teacher intervention during the two cycles (excluding cases where there is no intervention during either cycle or where comparative data are not available), we find that every one of the eight teachers intervenes less on the later cycle. The difference is

quite dramatic: teachers participate in the weaving 65% of the time, on the average, in the first cycle, but only 16% in the later one. Thus, we have clear-cut evidence of selective intervention in the interests of task simplification.

Another type of developmental sequencing lies in the presentation of simpler tasks at the early stages of the learning process. We found that learners were given small articles to weave. This is of particular significance with a backstrap loom because the weaver forms part of the frame and must maintain tension by leaning back. Much greater strength is required to do this for larger items. The warp threads are longer and there are more of them. Of the five least experienced weavers (cf. Table III) all were working on small items (three on bags and two on baby garments). The two expert weavers, in sharp contrast, were both weaving larger items, one a woman's skirt, the other a man's poncho. Nonetheless, the small items are not for play, but real things needed by the weavers' families. The relevance of the weaving skill is apparent from the very beginning of the learning process, unlike that of skills usually taught by formal education.

XII. THE SOCIAL CONTEXT OF LEARNING TO WEAVE

The teacher is not the stranger of a formal classroom situation but a close relative, usually the mother. Of the 12 girls who still had teachers eight were being taught by their mothers. The mothers of two of the remaining four had died. One of these was taught by her father's second wife, the other (whose father had not remarried) by her father's sister. Of the remaining two girls one was taught by an older sister, the other by an aunt. Hence, all were learning within the context of a well-established relationship. Furthermore, weaving is a skill handed down from generation to generation. Whereas the skills which a girl could learn at school (reading and writing Spanish) would make her different from her mother, learning to weave solidifies intergenerational continuity among female Zinacantecos.

Another striking feature of the learning situation is that it involves a group. This is not the group of strangers so common in Western formal education. Instead it is a group composed primarily of close relatives and extended kin. Thus, on the average, there were 11 people present besides the learner: the average number of close relatives was seven; of more distant relatives or neighbours, four. Our less systematic observation confirmed that weaving is indeed a social event. For instance, one group surrounding a weaver included her mother (teaching her), father, four

siblings (including two younger girls), two unrelated adult men, and one unidentified child. While weaving is most definitely women's work, it is often done in the company of men. In this it contrasts with the "housework" of an urban, industrial society. The fact that learning to weave, like the weaving of the expert, takes place in a group context must reinforce its social importance for the learner.

XIII. THE ROLE OF LANGUAGE

As Table V shows, the rate of verbalization from teacher to learner is quite high: it does not fall below three utterances per minute. Remarks from teacher to learner which were unrelated to weaving were extremely

Table V
Rates of verbal interchange between teacher and learner at different stages in learning to weave

	Previous weaving experience		
	None	One piece of cloth	Two to four pieces of cloth
Teacher's average number of utterances per min	5·8[a]	8·0[b]	3·3[c]
Learner's average number of utterances per min	0·9[a]	0·3[b]	1·2[c]

These figures are based on all available analysed data. Because there were no reliable differences between segments, it seemed wasteful and unnecessary to discard segments or subjects with incomplete data. The footnotes describe the source of each block of data in detail.

[a] Two teachers (learners) contributed data from all three segments, one from a later weaving cycle only.

[b] One teacher (learner) contributed data from all three segments, one from selvaging and the first weaving cycle only.

[c] Three teachers (learners) contributed data from all three segments.

rare — fewer than one per teacher — and have thus not been analysed separately. Overall, the teacher dominates the linguistic interchange, although Table V also indicates that the most experienced learners achieve the highest degree of balance with the teacher in verbal interchange.

While none of the teachers had received formal schooling, a single one of the learners had been to school for two years, and it seemed worthwhile to examine this case separately. The girl was weaving her second piece of cloth, and we compared the balance between learner speech and teacher

speech for this girl with that of the other learner who had previously woven one item but had not attended school. The difference was considerable: the schooled girl produced 11% of the total speech uttered by learner and teacher together, the unschooled girl only 3%. While individual cases cannot be conclusive, the results accord with the idea that schooling promotes verbal formulation.

More interesting is how qualitatively different types of utterance were made. We divided the intelligible utterances addressed by teacher to learner into five mutually exclusive functional types:

commands — composed of specific positive commands (e.g. *Lean back*); specific negative commands (e.g. *Don't put it in like that*); vague positive commands (e.g. *Look*); and vague negative commands (e.g. *No*!).
statements — composed of specific statements (e.g. *It's finished*) and vague statements (e.g. *O.K.*).
questions — composed of specific questions (e.g. *Where is the bobbin*?) and vague questions (e.g. *Like this*?).
explanation — (e.g. *If it doesn't go down properly, stick it in like this*).
reinforcing statements — composed of positive reinforcing statements (e.g. *Good*) and negative reinforcing statements (e.g. *Bad*).

Table VI presents the relative frequency of different types of verbalization in the three different segments. A striking feature is the low frequency

Table VI
Percentage of different kinds of verbalization used by teachers at different points in the weaving process

	Winding	First cycle of weaving	Later cycle of weaving
Commands	70	74	48
Statements	25	16	40
Questions	4	4	9
Explanations	1	3	0
Reinforcing statements	0	3	3

These figures are based on the nine girls who had teachers and for whom data are available for all three segments.

of questions and explanations. Clearly, Zinacanteco girls are not learning by the Socratic method. The near-absence of explanations may be the phenomenon anthropologists had in mind in characterizing traditional education as minimally verbal. Specific statements, however, may often be implicit explanations of implied commands; for instance, "It's falling" really

tells the girls to take action *because* something is falling. Specific statements in fact increase as the learners become more experienced, from 2% to 24%. Thus explanations, at least implicit explanations demanding an inference from the non-verbal situation, are more frequent than is first apparent.

Commands are the most frequent kind of verbalization, and may be either positive or negative. Overwhelmingly, the teachers' imperatives are positive (86%) rather than negative (14%). This echoes Blanco and Chodorow's (1964) observations of Zinacanteco chore commands. In the context of socialization, the imperative mode is primarily an instrument of positive direction. The much more infrequent reinforcing remarks, however, are primarily negative. Because extrinsic reinforcement has been so controversial in American education, we thought it interesting to investigate its role in the process by which Zinacanteco girls learn to weave. Blanco and Chodorow (1964) had noted that verbal reinforcement for doing chores was very infrequent and Table VI shows that this holds true for our findings. Only ten comments could be considered extrinsic reinforcement, and yet there is no such thing as a learning failure: every woman can weave. Eight out ten of the reinforcing remarks were disparaging comments of some sort (e.g. "*You don't know how!*"). Also, extrinsic verbal reinforcement, rare as it was, was used only at the early stages of the learning process (see ahead to Table VII); thus, those who received the predominantly negative reinforcement were those most likely to make errors.

Extrinsic verbal reinforcement also occurred in another, more indirect form: when the teacher spoke to people other than the weaver, who could,

Table VII
Percentage of different kinds of verbalization used by teachers at different stages in learning to weave

	Previous experience		
	None ($N = 2^a$)	One piece of cloth ($N = 2$)	Two to four pieces of cloth ($N = 3$)
Commands	91	83	53
Statements	4	12	40
Questions	1	3	6
Explanations	2	1	1
Reinforcements	2	1	0

These figures are based only on selvaging and first cycle of weaving, as the later cycle was systematically different (see Table VI).
[a] One teacher did not say anything during one segment; this did not contribute to the percentages, which are a per-segment average.

of course, hear. In fact, all the extrinsic reinforcing remarks addressed to others were made by women teaching the complete novices: there were 15 such remarks, all but one of which were negative — again, a preponderance of criticism over praise. Perhaps more interesting is the fact that indirect extrinsic reinforcement, via comments to others, occurs more frequently than direct reinforcement (16 vs 10 instances in the total sample). Comments to onlookers make extrinsic reinforcement a group process.

The same categories were used to analyse the learner's speech (except that the category of reinforcing statements was irrelevant). While our data agree with those of Goody (1978) in that the learners ask few questions in an absolute sense, questions do constitute a relatively high proportion of their total utterances, averaging 32% in the total sample. In this they contrast sharply with the teachers (Table VII). There is no clear developmental trend, although there is a tendency for the least experienced weavers to ask the smallest percentage of questions (13%). Again, the schoolgirl differs from the unschooled learner at the same stage of weaving experience: a higher proportion of her utterances are questions (56% vs 25%). This hints that schooling may indeed promote verbal interchange, even where the task to be learned is a purely manual one. Another general aspect of the learners' speech was that it was almost never off the topic of weaving. Only one weaver made any unrelated remarks, and only two such utterances at that. Thus talking, like looking, indicates great attentiveness to the task at hand.

A. Adaptation of Language Use to Task Structure and Stage of Skill Development

Table VI also indicates that teachers adapt their speech to the task: from first to later cycle of weaving, we see a sharp drop in commands and a sharp rise in statements. In fact, all seven of the teachers who talked to the learner in both segments decreased their proportion of commands from the first to the later cycle; all but one also increased their proportion of statements at the same time. Because the first cycle may be considered more difficult, we can conclude that directives are used where the task is less problematical. A closely parallel pattern appears if we look at the teachers' types of verbalization at different stages in learning to weave. Table VII shows that there is a decrease in commands and an increase in statements as the learners become more experienced. Again, the greater the learner's difficulty, the more the teacher uses commands. More generally, commands decrease and statements increase with experience, whether the experience accrues from current or past projects.

B. Combining Language with Action.

Is it the case that informal education involves a very close relation between verbal utterances and the non-verbal context? We evaluated this claim by classifying teacher-initiated interactions according to whether they were purely verbal, purely non-verbal, or a combination of the two. Recall that the possible non-verbal interactions were: doing the task, guiding the girl's body, or pointing to something. For the least experienced learners, the majority of the teacher-initiated interactions (68% per segment) combine verbal and non-verbal elements. This figure declines steadily with increasing experience, reaching 34% for the most experienced girls. When verbal and non-verbal elements are combined there is often partial or complete redundancy between the information conveyed in the various modes — visual, proprioceptive and verbal. Thus, teachers construct less redundant messages as the learners gain experience. Studies in the United States (e.g. Greenfield, 1972) have indicated that redundant instructions involving several modes are most effective at early states in learning new material. Thus, this progression away from redundancy constitutes another example of effective developmental sequencing of instructions.

Commands, statements and questions were classified as either specific or vague. Overall, specific utterances predominated, accounting for 71·4% of all commands, statements, and questions. A vague utterance, however, can actually be quite specific if accompanied by certain types of non-verbal behaviour. For instance, the vague command "Do it like this" becomes specific when accompanied by a demonstration. If we take non-verbal behaviour into account, the degree of specificity of the teacher's utterances was even greater, for 76% of the vague utterances were accompanied by either pointing, demonstration, or guiding.

All these findings yield a picture of the Zinacanteco teacher as a person who communicates with the learner specifically rather than vaguely and who adapts her verbalization both to the stage of the weaving process and to the developmental stage of the learner.

XIV. METHODOLOGICAL INSIGHTS AND ISSUES

It turns out that one cannot study the development of a skill which one lacks oneself. We realized that coding categories, even for seemingly straightforward categories like "pointing" and "guiding the hand", cannot be used without an understanding of the fuller context of activity. For instance, it is very difficult to distinguish communicative pointing from

finger waving if one is unfamiliar with the technical aspects of weaving. Hence, it was necessary for us, the researchers, to learn to weave (although we did not become expert weavers).

This point leads into an examination of the meaning of reliability. We found it very difficult to train an independent observer who was unfamiliar with Zinacanteco culture and with backstrap loom weaving. When Childs and the second observer disagreed, it seemed invalid to weigh their opinions equally, as would be done on the standard assumption that one person can learn to use a given coding system as well as another. Because we realized that background knowledge of the behaviour and its context was as important as specific knowledge of the coding system, we used Childs as the criterion coder and tested the possibility of training a second person to this criterion. A general suggestion is that coder training be described, not only in terms of a coding system but also *vis-à-vis* the background knowledge required. This knowledge is generally taken for granted and therefore goes unrecognized.

A second issue concerning reliability relates to the effect of raw data records, like videotape, on the standard assumptions. Another hidden assumption of interobserver reliability seems to be that one cannot go back to check what *really* happened. But permanent records mean that it *is* possible to go back and check. Since reliability is in the service of validity, it should reflect the observers' *ability to resolve disagreements by going back to the data.* Information about the resolution of disagreements might form part of the report of reliability checks.

XV. CONCLUSIONS

We have used the case of Zinacanteco weaving to focus on two interrelated issues. The first concerns the cognitive effects of learning to weave; the second the interactional processes by which the skill is acquired. As for the first issue we found that weavers represented familiar woven patterns more analytically than non-weavers; but formal schooling, without weaving experience, has the same effect. We therefore suggest that the representation of familiar woven patterns by wooden sticks involves translating from one medium to another and that an analytic approach is fostered by the intermodal translation experience involved in school subjects. The fact that weaving experience does not lead to skill with novel patterns, as revealed in pattern continuation tasks, shows that the cognitive effects of a craft skill need not generalize beyond the requirements of the craft itself. The absence of generalization represents, from the point of

view of Zinacanteco culture, not failure, but success in the attempt to maintain their traditional way of life as a relatively powerless minority surrounded by the alien culture of Spanish-speaking Mexico. However, Zinacanteco boys, who are exposed to the novelty of modern Mexican culture, are better than the weaving girls at continuing novel patterns.

Scribner and Cole (1973) have identified two correlated cognitive effects of informal education in a traditional society: absence of generalization of principles of solution to new problems and absence of verbal formulation of these principles. The first was exemplified in our study of cognitive effects of learning to weave. The second appears in the process by which weaving skill is acquired: teacher impels learner to *do* rather than *say,* through heavy use of imperatives in her own speech; and learner responds by weaving a lot and speaking little. Contrary to some accounts of informal education in traditional societies (Cazden and John, 1971), teacher verbalization is very much a part of the process of instruction.

The interaction by which weaving skill is imparted and acquired is remarkable for its systematic nature (despite the statement by an adult Zinacanteco that the girls learn to weave "by themselves"). Conceptual emphasis is on learner rather than teacher; yet the teacher's behaviour is far from haphazard. It is adapted to the skill level of the learner. Both physical and linguistic behaviour of the teacher varied as a function of the learner's stage. The balance between teacher and learner verbalization changed with skill development, with the learner eventually taking a more active role in conversational interchange. Thus, Zinacanteco teachers "match" their interventions and requirements to the developmental level of the learner. They intervene with a developmentally graded set of "scaffolds" that allows the learner to succeed from the very beginning. These scaffolds reflect task structure as well as developmental level. The notion that learning an important household task is self-motivating is borne out by (i) the high level of visual attentiveness and (ii) the near-absence of extrinsic verbal reinforcement.

If these findings constitute general characteristics of "no failure" learning situations, then they should be applicable to education in industrial societies. Specific methods must vary according to stage of skill development and the nature of the task to be learned, but obviously informal modes of learning and teaching can involve highly organized patterns of behaviour. For this reason, they deserve serious consideration as adjuncts to the school-based education that predominates in industrialized societies. Informal education may be better suited to the transmission of many skills, especially practical ones. In addition, the inclusion of informal modes in the educational process should broaden the range of learning skills available to a given individual. For children who have not been raised in

school-orientated families, the techniques of informal education may be more familiar and therefore more conducive to successful learning.

Fortes (1938) made the following statement about education in traditional, non-industrial societies:

> It has been shown that the training of the young is seldom regularized or systematized, but occurs as a "by-product" of the cultural routine. (p. 15, Middleton, 1970).

While learning to weave in Zinacantan is most certainly a by-product of the cultural routine, its process is nothing if not systematic, a quality that is all the more impressive because of its completely informal context.

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Notes

1. For a more complete and detailed account of Zinacanteco culture the reader should consult "Zinacantan: A Maya Community in the Highlands of Chiapas" by E. Z. Vogt (1969).
2. Tzotzil words are written throughout in the orthography used in the Tzotzil–English, English–Tzotzil Field Dictionary adapted from R. Laughlin's "Tzotzil–English Dictionary". For reading purposes, *x* is pronounced as "sh" in English, *c* as "ch", and *z* as "ts". The apostrophe indicates a glottalized consonant. The asterisk indicates a glottal stop.
3. Blanco and Chodorow (1964) report that spinning is the first weaving-related task to be learned, in contrast with our results. As our inquiry into these matters was more extensive, it seems likely that our data are the more reliable.
4. This concept of experimental design was originally presented in a talk at Harvard University in 1966.
5. The figures are not made to scale in relation to the wooden frame. Only the relationship between the widths of the sticks is accurate.
6. *a ti mi *oy k'usi cavalbe, albo. Ti mi *oy k'usi cacanubtasbe, canubtasbo.

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