

Chapter 6

Children, material culture and weaving

Historical change and developmental change

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INTRODUCTION

The Soviet psychologist and semiotician, Lev Semenovich Vygotsky, pointed to the connections between cultural development and individual development (Vygotsky 1962, 1978). He suggested that as children grow, they acquire the use of tools and speech through social interaction, these cultural forms being themselves the product of historical development (Scribner 1985). The ideas of Vygotsky form the central core of a prominent theoretical strand of developmental psychology – the socio-historical approach (e.g. Rogoff and Wertsch 1984; Wertsch 1985).

Yet, despite the importance of socio-historical theory, the developmental implications of historical change have not been studied in a direct, empirical manner by comparing the development and socialisation of one generation with that of the next. Our two-decade follow-up investigation of weaving apprenticeship among the Zinacantecs, a Maya group in Chiapas, Mexico begins to fill this gap. Across a span of more than twenty years, we have studied two generations of mothers and children as their society moves from subsistence to an entrepreneurial cash economy. Because such economic changes transform human relations, Vygotsky, in the tradition of Marx and Lenin, would have expected this economic transformation to change the social processes of ontogeny (Scribner 1985). Weaving apprenticeship is just such a social process of ontogeny.

Insofar as the process of socialisation prepares the next generation to participate in society, it should change when the conditions faced by that next generation differ from the environment in which their parents grew up. Socialisation is intrinsically future oriented – it prepares children for an adulthood that has not yet arrived. It follows that changing socialisation patterns should be a key component of the psychological adaptation to social change. But does socialisation really work this way? An important question is, in conditions of change, do parents merely recreate the socialising process that they underwent as children? Or is there a capacity to develop new methods and processes as societal conditions, in this case, economic conditions, change? What, if any, are the consequences of such changes in socialisation for the development of children?

Furthermore, there is a connection between socialisation and cultural artefacts. In non-industrial societies, children are socialised to produce cultural artefacts through a process of informal education or apprenticeship; in this study the artefacts produced are woven

and embroidered textiles. What is the relationship between pedagogical methods of informal education and the nature of the cultural artefacts that are produced?

Artefacts in the form of tools are also a means of socialisation and informal education. What therefore is the relationship between pedagogical methods of informal education and the cultural tools that are utilised in the apprenticeship process? Are historical changes in pedagogy reflected in changes in the tools that are used in the learning process? If we are to answer these questions in the most rigorous way possible, longitudinal, diachronic study of families across more than one generation is required. The evidence must be both behavioural *and* historical. It is precisely this sort of controlled empirical historical data that has, up to now, been lacking and it is precisely this kind of evidence that is presented in this chapter through the study of the domain of weaving apprenticeship in a Zinacantec Maya community in Chiapas, Mexico.

Vygotsky also emphasised another kind of change – developmental change – although his notion of developmental stages was less detailed than that of his contemporary, Piaget (1967). Vygotsky and Luria (1993) saw 'the ability to make use of tools' as 'indicative of psychological development' (ibid.: 174). The second part of the chapter examines the tools of weaving apprenticeship and relates them to cognitive development (integrating notions from Piaget and Vygotsky), historical development, and historical constancy in Zinacantec culture.

THE STUDY

In 1969 and 1970, I carried out a number of studies on culture, learning, and cognitive development in Nabenchauk, a hamlet of the Tzotzil-speaking agrarian Maya community of Zinacantan in Highland Chiapas. My collaborator in this research was Carla Childs (cf. Childs and Greenfield 1980; Greenfield and Childs 1977, 1991; Greenfield *et al.* 1989). The Zinacantecs had been very successful at carrying a traditional, albeit syncretic, Mayan way of life into the modern world (Vogt 1969). Corn and beans were their most usual crops, supplemented by peaches in more recent years.

Weaving was the cultural domain on which our research focused. The activity of weaving and the cloth it produced were central to the creation of both cultural and gender identity. Weaving apprenticeship was utilised as a means to investigate processes of informal education, teaching and learning in a society in which education does not traditionally take place in school. Figure 6.1 depicts a 1970 weaving learner seated in a prototypical Maya backstrap loom, which design goes back to ancient Maya times (Figure 6.2).

1970: Weaving apprenticeship, textiles and cultural conservatism

In 1970, we concluded that the goal of Zinacantec education and socialisation was the intergenerational replication of tradition (Greenfield and Lave 1982). This was in accord with broader cultural goals of maintaining the *baz'i* or 'true' way of acting; the 'true' way being the Zinacantec way (Vogt 1969). The manner in which weaving was taught in 1970 fostered this goal of cultural conservation. Our videos of weaving apprenticeship revealed the instructional process to be a highly scaffolded, relatively error-free one, in which the teacher, usually the mother, sensitively provided help, models and verbal direction in

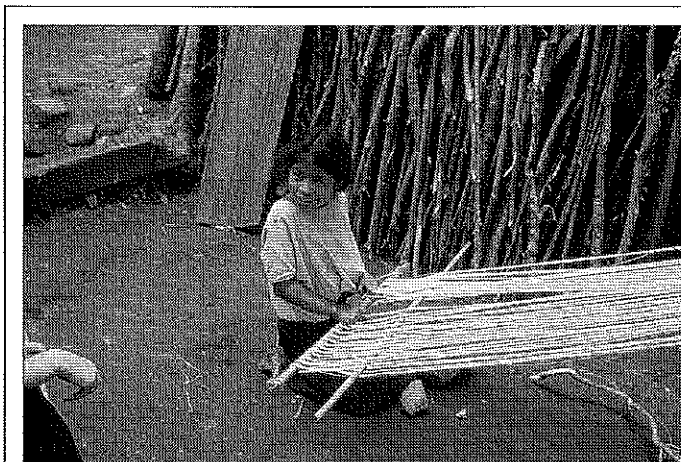


Figure 6.1 Katal 1 seated in a backstrap loom. Nabenchauk, 1970

Source: Photograph: Sheldon Greenfield

Note: Numerals after subject names refer to codes in our database and identify subjects by family and generation

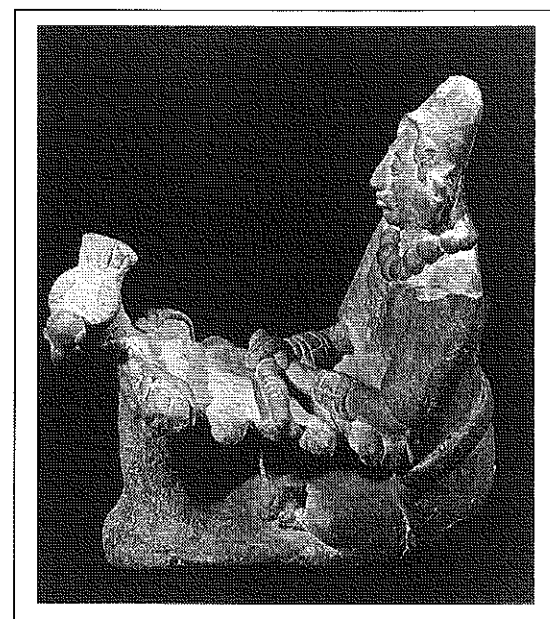


Figure 6.2 Ancient Maya statue of a woman seated in a backstrap loom. This statue is a ceramic from Jaina, Campeche, 700–900 AD

Source: Photograph: Museo Nacional de Antropología e Historia de México

accord with the developmental level of the learner (Childs and Greenfield 1980; Greenfield 1984). The learner had little chance to make a mistake, let alone experiment and innovate.

Thus, the maintenance of tradition excluded the value of innovative creation. The relatively conservative nature of the value system and culture was manifest in the stable repertoire of woven patterns, limited to two red-and-white striped configurations, one multi-colour stripe, and one basketweave pattern.

1970–1991: Economic transition from subsistence to commerce

Side by side with the emphasis on cultural tradition was a process of economic change, already in motion in 1970, from corn-based subsistence to money-based commerce (Cancian 1990, 1992). This process was accelerated when the Mexican Government made it possible for Zinacantan communities such as Nabenchauk to acquire vans and trucks. Men who were farmers went into the transport business; in essence, they became entrepreneurs, often buying and selling other people's goods. Based on the fact that commercial entrepreneurship entails an ideology of innovation, I made a series of predictions regarding changes in informal weaving apprenticeship and changes in textiles, the artefactual products of weaving.

Implications of economic change for weaving apprenticeship and woven textiles: predictions from theory

I developed a theory (Greenfield 1984; Greenfield and Lave 1982) that there is a contrast between the goals of two methods of informal education: scaffolding plus observation of models (as we found in 1970), on one hand, versus relatively independent trial-and-error learning on the other. Whereas the first is adapted to the transmission of tradition (and was what we found in 1970), the second, with its emphasis on the learner's own discovery process, is adapted to the development of skill in innovation. If innovation had entered the culture as a value orientation in response to entrepreneurship, I thought that weaving education would make a corresponding shift away from scaffolding (or developmentally sensitive guidance) to a more discovery-orientated and independent trial-and-error process.

A second related prediction was that woven artefacts would no longer be limited to a small stock of patterns. Instead, weavers would constantly innovate new patterns. Innovative pattern representation was conceived as a major change in cognitive processes associated with weaving.

Both these hypotheses were formulated on the basis of theory alone (Greenfield and Lave 1982). I had not been back to Zinacantan in twenty-one years. With Carla Childs, I returned in 1991 to test these predictions.

HYPOTHESIS 1: HISTORICAL CHANGE IN WEAVING APPRENTICESHIP

According to my theory, the old method of observation of models, in conjunction with receiving developmentally sensitive help, would change. Earlier the teacher had carefully built a scaffold of help for the learner, providing help before the learner had an opportunity to make a serious error (Childs and Greenfield 1980; Greenfield 1984; Greenfield and Childs 1991; Greenfield *et al.* 1989). In this situation the learner received very little opportunity to make a mistake, let alone explore. We therefore predicted that *methods of teaching and learning would have changed to a more independent trial-and-error approach.*

In order to test this hypothesis, we went back to study the daughters of our 1970 weaving subjects. We had fourteen in our original sample, one of whom, Katal 1, is shown in Figure 6.1. Between 1970 and 1991, Katal grew up and had five daughters of her own. Four were old enough to weave and became subjects in our historical replication twenty-one years later. In all, we succeeded in locating fourteen daughters (of seven mothers) whose mothers had been in our study of weaving apprenticeship in 1970 and who were old enough to weave for our study in 1991 or on another visit in 1993, some for the very first time. As before, we videotaped the apprenticeship process.

In addition, we expanded our sample of weaving learners to 58, so that we would be able to statistically examine the effects of various new factors, such as attending school or selling weaving, on the methods of informal education. The additional weaving learners were from the same group of extended families from which the original fourteen learners had been drawn in 1970; many were nieces or godchildren of the 1970 sample of weaving learners. This chapter focuses on well-controlled historical comparisons from the two epochs. The qualitative findings presented here have been confirmed by quantitative analysis of the entire sample (Greenfield *et al.*, in press).



Figure 6.3 Mother helping Katal 1, age 9, with her weaving. Nabenchauk, 1970

Source: Video: Patricia Greenfield

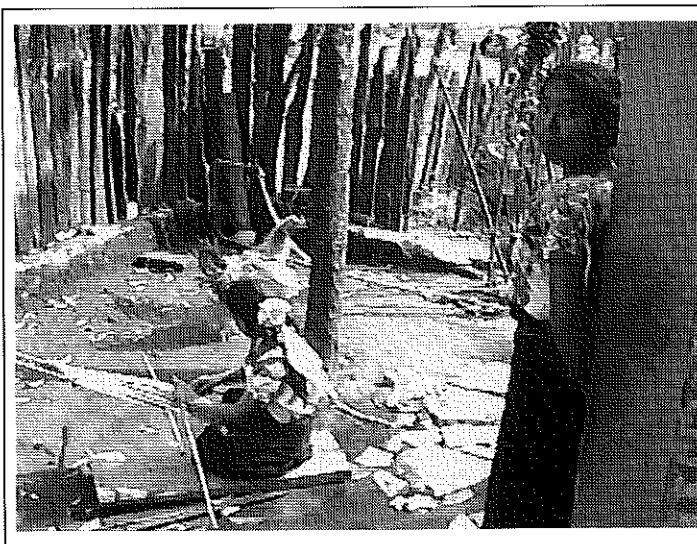


Figure 6.4 Weaving learner (Loxa 1-201, about age 9) and teacher (older sister, age 12 or 13). Loxa is the daughter of Katal 1, shown learning to weave in Figure 6.3. Nabenchauk, 1991

Source: Video: Patricia Greenfield

ship process. Indeed, our quantitative analysis confirms that commercial involvement of mother and daughter is causally linked to a change in the relationship of the weaving teacher from older generation to peer generation (Greenfield *et al.*, in press).

Apprentice weavers

The video frame of Katal learning to weave shown in Figure 6.3 symbolises weaving apprenticeship, circa 1970. She was nine years old at the time of the study. Her mother served as her weaving teacher and was continuously present, helping and guiding her.

Her mother was so involved that there were often four hands on the loom. This scene from Katal's weaving apprenticeship in 1970 is very different from the way Katal's daughters learned to weave in 1991. Learning to weave is a developmental process. Therefore, for comparative purposes, I observed a daughter who was about the same age as Katal had been in 1970. Figure 6.4 shows a frame of Katal's daughter, Loxa 1-201, learning to weave in 1991.

The first major difference to note is that Katal, the mother, is not even present. Katal had assigned an older daughter, Xunka', age 12 or 13, to serve as the teacher. This change from older-generation to peer-generation teachers was one of our more general findings (Greenfield *et al.* in press).

Katal, the mother, was at home, but chose not to be part of the weaving session. In point of fact, she was embroidering a blouse to sell on order. This situation illustrates a direct connection between the commercial involvement of mothers and changes in the apprenticeship process.

The second, and even more important difference, is that in Figure 6.4 the older sister is not paying visual attention to her younger sister, the weaving learner, despite the fact that the younger sister is in fact a novice. Indeed, in one scene, Loxa had to call the 'teacher' twice to get her attention.

The teacher's behaviour is in sharp contrast to that of their grandmother in Figure 6.3. Figure 6.3 shows a typical scene from 1970: the teacher/mother was in constant visual contact with her daughter's weaving activity and therefore consistently anticipated her need for help. Teacher, rather than learner, took the initiative when help was required.

In sum, the 1991 weaving learner, as illustrated in the comparison of Figure 6.3 and Figure 6.4, had become much more independent. The movement from interdependence to independence (Greenfield 1994; Markus and Kitayama 1991) is also illustrated by the greater physical distance between learner and teacher in 1991 (Figure 6.4), compared with 1970 (Figure 6.3). The difference in teaching styles is all the more amazing given the fact that we generally learn how to teach from the way our mothers taught us (Childs, personal communication). In addition, compared with her sisters, Katal is temperamentally most like her mother (Loxa's grandmother), so, on the basis of both her mother's genes and her mother as model, one would have expected Katal to have followed her mother's teaching style with her own daughters. The fact that she did not is a powerful example of adapting teaching to changed conditions in the space of a single generation.

A different 1970 weaving subject presents another controlled comparison. We observed one family (No. 146) in which there were two weaving subjects in 1970 the same age as Loxa and her sister Xunka' (approximately age 9 and 13). Given this identical configuration of siblings, would the role of mother and older sister have changed in the twenty-one intervening years? One would predict from the theoretical model that mother and elder daughter would be more involved in guiding and helping the learner in 1970 than a similar pair would have been in 1991. This is precisely what we found.

Figure 6.5 shows a frame from the 1970 video of Katal 146. Note that the mother is close at hand; analysis of their action and interaction from the video showed that she was helping (e.g. making a measuring stick to be used in the weaving process) and advising the older daughter on how to help the learner. There was a hierarchy of control from eldest (mother) to next eldest (older sister) to youngest (learner). Both mother and older daughter were very attentive to the learner's needs and were constantly involved in the learner's weaving.

This is a very different scene from that shown in Figure 6.4, twenty-one years later, with the same configuration of gender, age and family relationships. In Figure 6.4, the older sister is uninvolved, physically distant from the learner, and inattentive to her needs. The 1991 mother uses the older sister as a *substitute* for herself as teacher. In contrast, the 1970 mother uses the older sister as an *adjunct* (Figure 6.5). Rather than a hierarchy of control from elder to younger, in 1991 both sisters (teacher and learner) are operating quite independently of the immediate authority of the older generation.

In 1970, the flow of authority from elder to younger was a central value in Zinacantan society (Vogt 1969). By 1991, this age-graded hierarchy was disappearing in many areas of life (Collier 1990). Indeed, it was disappearing in the basic economic system, where dependence on the land held by the older generation was being replaced by independent entrepreneurship (*ibid.*). The movement away from an age-graded flow of authority was particularly dramatic in weaving where older women do not even know all of the new techniques mastered by their daughters.

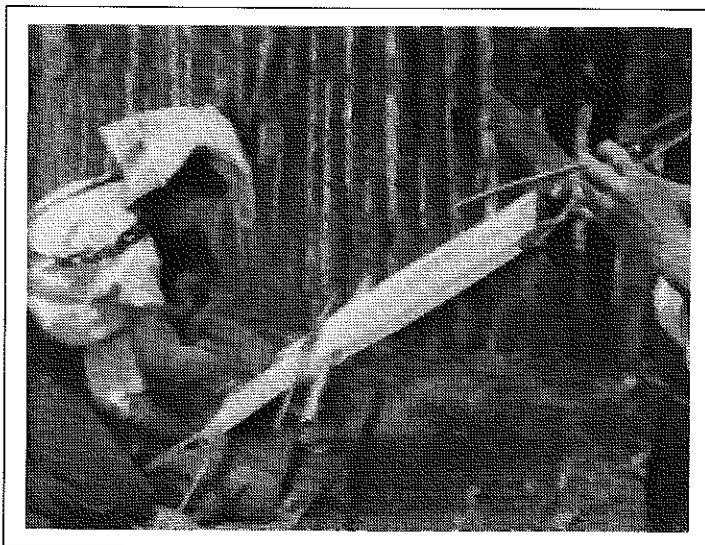


Figure 6.5 Katal 146, age 9, learning to weave with the aid of her mother (partly shown on right) and older sister, age 13, (left). Nabenchauk, 1970

Source: Video: Patricia Greenfield

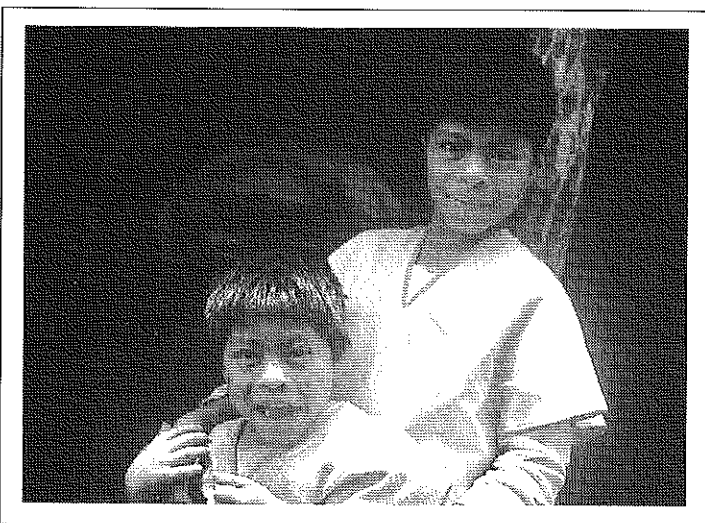


Figure 6.6 Two Zinacantec brothers, Marian 1 (left) and Antun 1 (right) dressed in ponchos utilising the woven stripe that was standard in 1969 and 1970. Nabenchauk, 1970

Source: Photograph: Sheldon Greenfield

In sum, we found more independent learning in 1991 than in 1970, whether we compare Loxa, our 1991 learner, with the way her mother learned to weave in 1970, or we compare her with another 1970 weaver matched for the family configuration of people on the scene. These examples support our first hypothesis that between 1970 and 1991 the weaving novice became more independent, receiving less guidance and modelling from the 'master'.

HYPOTHESIS 2: HISTORICAL CHANGES IN WOVEN TEXTILES

According to the theoretical model, independent trial-and-error learning should be associated with pattern innovation. The reason for this is that if you are experimenting independently you might create or discover something new. Thus, in the domain of woven textiles I predicted that patterns would no longer be limited to a basketweave and three striped patterns. Instead, there would be an ongoing process of pattern innovation and creation.

When we returned in 1991, the extent to which this historical hypothesis was confirmed was quite astonishing. Changes in the men's poncho illustrate the growth of innovation and creativity in the domain of woven textiles.

Figure 6.6 shows the old-style male poncho, made from a uniform striped material. The two brothers in the photograph are dressed alike, as would be all other Zinacantec men and boys of the epoch. The area of innovation was in the striped narrow side borders of the poncho, where the colours and their order could vary. However, this domain of 'innovation' is so small that it is not even visible in the photograph.

When we returned in 1991, a fancy brocaded border had been added to the basic style and background stripe of the poncho, shown in Figure 6.6. No two were alike. Figure 6.7a and b shows two variants of the figurative and geometric designs that were being woven through a brocading process for poncho borders. In addition, fancy (and highly differentiated) embroidery had been added to the top of each poncho (most visible in Figure 6.7a).

Furthermore, entrepreneurship and commerce were not limited to transport; they had hit textile production as well. For example, girls began to sell a new woven and embroidered commercial item called the *servilleta* (napkin, towel), designed and made for outsiders to buy.

In sum, Hypothesis 2 was also confirmed: in 1991 we found constant pattern innovation. This innovation included the creation of new motifs, the recombination of existing motifs, and the development of new tourist items.

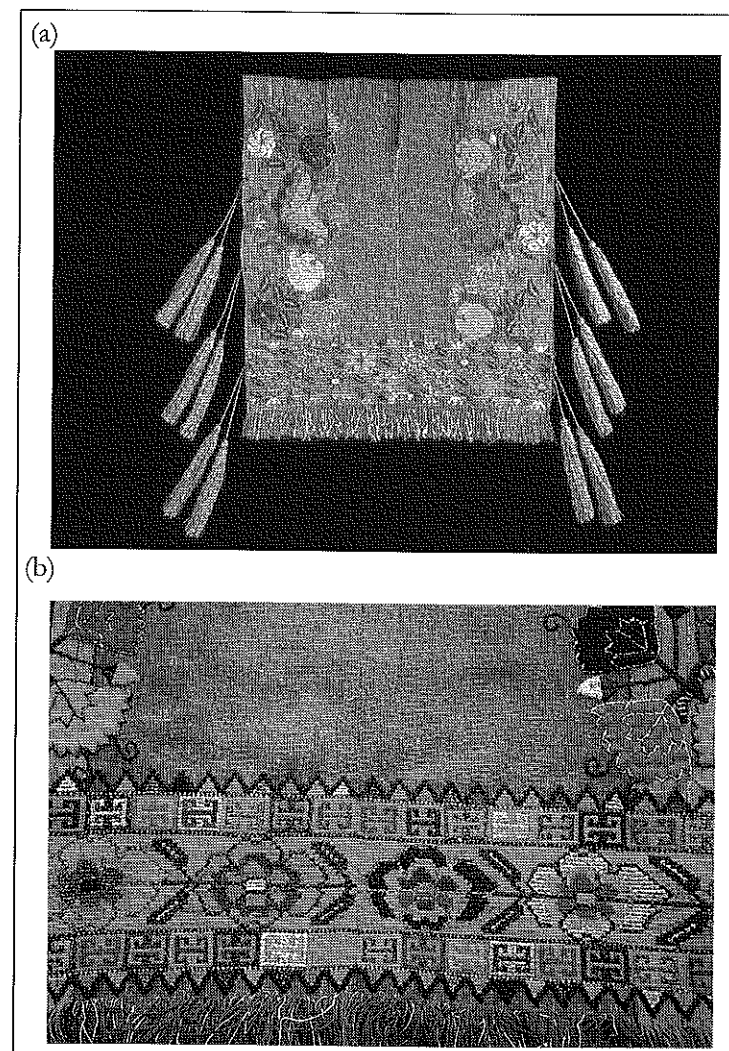


Figure 6.7(a) and (b) Two variants of an infinite number of woven brocade borders and embroidered designs for the Zinacantec male poncho. Nabenchauk, 1991

Source: Photographs: Lauren Greenfield

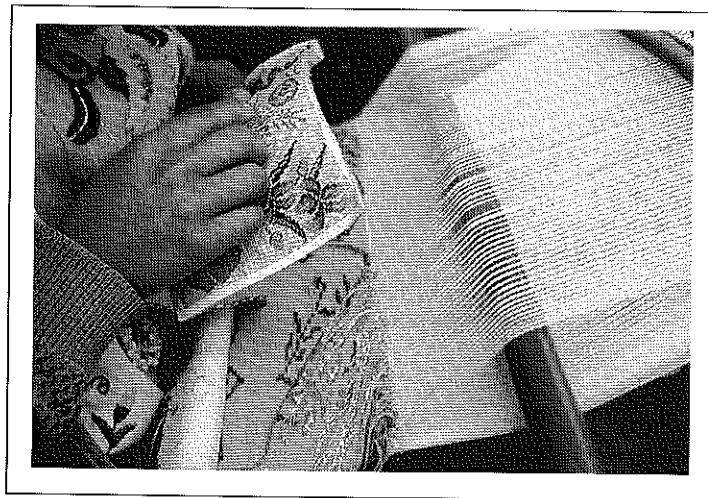


Figure 6.8 Use of a printed pattern to create a brocade weaving design. Nabenchauk, 1991

Source: Photograph: Lauren Greenfield

Paper patterns, schooling, and graphic representation

Our statistical results indicate that there is a significant relationship between schooling and the ability to use printed patterns to create textile designs (Greenfield and Maynard 1997). Schools have had a direct effect on weaving and embroidery by introducing external forms of representation (notably reading and writing) into Nabenchauk's predominantly oral culture. External representations have entered textile production by way of printed patterns. Teachers are said to have introduced printed patterns into the school. The schooling of girls itself increased dramatically from the early 1960s, when it was zero, to 1991, when the rate of exposure to at least some elementary schooling was about one-third (Greenfield and Maynard 1997).

Printed patterns were originally developed for cross-stitch embroidery; the pattern is printed on a grid of squares, and each square represents one cross-stitch (i.e. an X-shaped stitch) on a piece of embroidered fabric. Cross-stitch patterns are used in this way in Nabenchauk. However, it is much more difficult to use the patterns to weave. Unlike embroidery, weaving is not naturally organised in a grid of squares (Greenfield 1999). There are parallel warp (or frame) threads (shown in white in Figure 6.8); and there are parallel weft threads that go over and under the warp threads, at right angles to them. (In Figure 6.8, the weft are the darker threads in the woven part of the warp, to the left of the unwoven white warp threads).

It is therefore necessary to develop a representational strategy for creating hypothetical squares in order to use the printed patterns for weaving. This is exactly what Zinacantec weavers have done. One weaver told me that one square would correspond to one thread in the warp dimension and to four threads in the weft dimension (Greenfield 1999). This is a fairly complex representational code to create, especially with just a few years of formal education. Zinacantec girls have appropriated a new symbolic tool, the printed pattern,

WEAVING TOOLS, HUMAN DEVELOPMENT, AND HUMAN HISTORY

Moving on from the artefacts that are produced as a result of weaving apprenticeship to the artefacts that are used in weaving and in learning how to weave, this section begins by discussing a new tool that has facilitated the development of the brocade weavings shown in Figure 6.7(a) and (b). This tool is the printed pattern (Figure 6.8).

and transformed it, as part of the process of cultural appropriation (Saxe 1991).

Most of the older generation of mothers do not know how to weave with paper patterns. For them, the absence of formal schooling is a barrier to understanding the code of symbolic correspondences (Greenfield and Maynard 1997). Because of the much higher rate of using paper patterns in the younger generation, we see that innovative cognitive change is concentrated in the younger generation, a phenomenon that is very familiar in our own societies.

In a Nabenchauk school of the 1990s, external representation goes beyond reading and writing to the presence of graphic representations, such as

pictures, in the classroom. Pictures have also moved from school to home (Greenfield and Childs 1996). Graphic representation at school and home has had direct impact on the creation of textile designs by children. In Figure 6.9, one sees children drawing and cutting out paper patterns. These patterns can be transferred to fabric and used for embroidering blouses, shawls or ponchos.

Play weaving and the toy loom

Play weaving appears to have been a constant in learning to weave across the two generations of learners in our study; however, it is uncertain whether play weaving was done on a toy loom in the earlier period. In any case, the toy loom, as I discovered in 1991, illustrates another kind of change – developmental change. The developmental progression of weaving tools from the toy loom (at age 3 or 4) to the real loom and winding board (at age 6 or later) indicates a kind of implicit cultural knowledge of cognitive development built into the tools and their use.

My theme here is that *cultures have sets of artefacts and practices that respect and stimulate sensitive periods for cognitive and neural development*. A sensitive period is a developmental window, an age range, when stimulation of a skill will have maximum impact on the development of that skill. The *developmental timing* and *order* in which girls are exposed to various weaving tools shows implicit knowledge of, and respect for, cognitive development. Specifically, these tools show implicit knowledge of progression from Piaget's pre-operational stage to concrete operational stage (Piaget and Inhelder 1969) and the timing of this transition.

Vygotsky noted the degree to which cognitive history is contained in cultural artefacts; he also noted that these artefacts, in turn, function as tools for the stimulation of current

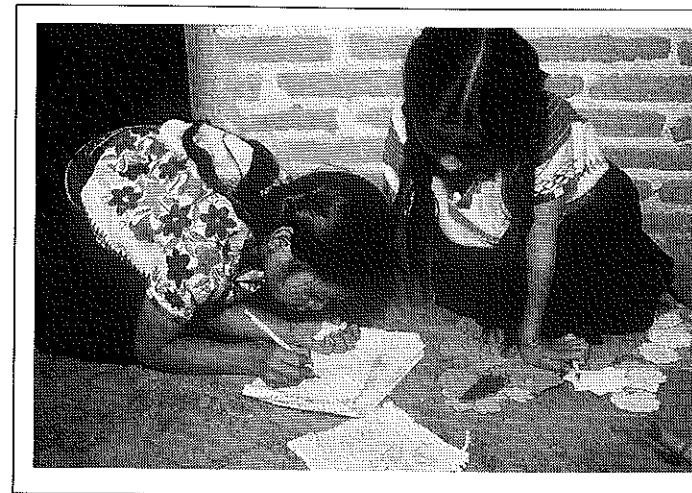


Figure 6.9 The girl on the left is drawing patterns to use in embroidering. The two girls have already made cut-out patterns to trace around, with internal designs to copy or transfer to fabric; these are seen to the right of the girls, on the ground. Nabenchauk, 1991

Source: Photograph: Lauren Greenfield

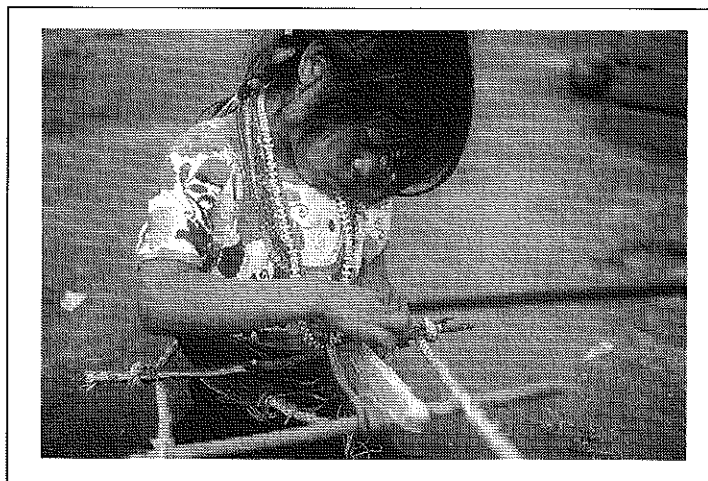


Figure 6.10 Play weaving on a toy loom. Nabenchauk, 1991
Source: Photograph: Lauren Greenfield

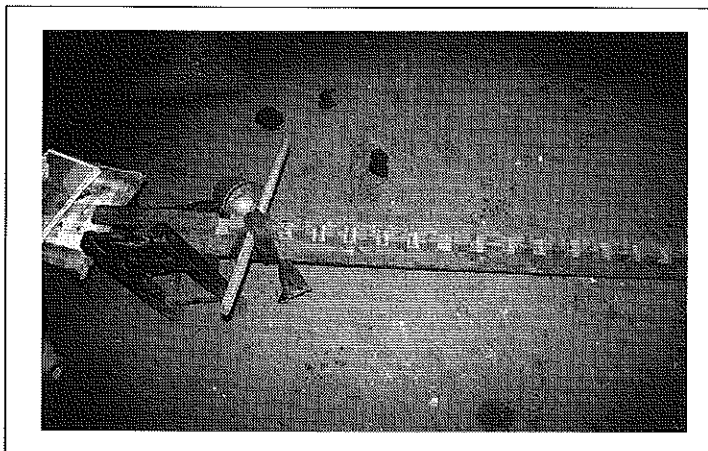


Figure 6.11 *Komen* or winding board. Nabenchauk, 1995
Source: Photograph: Patricia Greenfield

ropes permit the warp or frame threads (shown in Figure 6.10) to be wound directly onto the loom.

The real loom (shown in Figure 6.1) does not have these extra supports. Note that only the white threads (warp or frame threads) hold the loom together. The warp cannot be wound directly onto the loom because, if it were not there, the loom would collapse; there is nothing to hold the loom together before the winding starts. Therefore, a real loom must have the warp pre-wound on an apparatus such as the *komen* or winding board shown in Figure 6.11.

Winding the warp on the winding board intrinsically involves concrete operational thinking, as it requires mental transformation. The form of the warp threads, where they twist around the winding frame (Figure 6.12), is quite different from the form of the threads on the final loom, where they have been straightened out (Figure 6.1).

Complex topological transformation is required to understand the connection between how you wind and how the thread ends up on the loom. Compare Figure 6.12 with Figure

cognitive development (Cole 1996; Scribner 1985; Vygotsky and Luria 1993). I would like to take this line of thinking a step further: not only cognitive history but cognitive development can also be contained in cultural artefacts. Analysis of the cognitive requirements of a developmentally graduated set of weaving artefacts – the toy loom, the winding board, and the real loom – demonstrate this point (Greenfield 2000).

Play weaving on the toy loom, illustrated in Figure 6.10, is widespread in Nabenchauk. It begins at age three or four, in Piaget's pre-operational period (Piaget and Inhelder 1969). It is used several years earlier than the real loom and winding board, which are not used before age six, the beginning of the transition to the concrete operational stage (ibid.). Preparing the real loom to weave is a concrete operational task. However, because the toy loom is just slightly different in one respect from the real loom, it does not require concrete operational thinking to set it up. The difference lies in the ropes between the two end-sticks, one on each side (Figure 6.10). These

6.13. Figure 6.13 shows a cross-section of the warp or frame threads after being transferred to the loom. Note the difference in the configuration of threads between Figure 6.12, where the warp threads are still twisted around the winding board and Figure 6.13 where the warp threads have been straightened out and transferred to the loom (Greenfield 2000).

The important cognitive point is that a complex series of mental transformations is required for a weaver to understand the connection between how the threads are wound on the winding board and how they end up in the configuration that you see on the loom in Figures 6.1 and 6.13 (from different angles). In terms of Piagetian stages of cognitive development, mental transformations characterise the level of concrete operations (e.g. Piaget 1963).

Such mental transformations are not required for the toy loom. The extra supporting ropes or strings on the side mean that the warp can be wound directly on the loom (see Figure 6.14). Using a toy loom, a young girl winds, making repeated figure-eights between the end sticks. This process of winding figure-eights makes the cross configuration (visible in Figure 6.14 on the play loom and Figure 6.12 on the winding board) that we saw as the final warp on the real loom in Figure 6.13. In this process, there is no mental transformation required to go from winding (Figure 6.12) to the set-up loom (Figure 6.10).

The important conclusion from this analysis is that Piagetian theory is part of the Zinacantecs' implicit ethnotheory of development. Whereas Zinacantec girls start on the toy loom from age 3, they do not set up a real loom before age 6 at the earliest, the normal beginning of concrete operations. So, most interestingly, Piagetian theory is implicitly (but not explicitly) built into the developmental progression of Zinacantec weaving tools. If we think of Piagetian stages as age-dependent sensitive periods requiring environmental stimulation, then learning how to set up a real loom can be seen as an activity that actualises the



Figure 6.12 *Komen* with a few threads wound on it. Nabenchauk, 1995
Source: Photograph: Patricia Greenfield



Figure 6.13 Cross-section of warp or frame threads after they have been taken off the *komen* and put on the loom. Nabenchauk, 1995
Source: Photograph: Patricia Greenfield

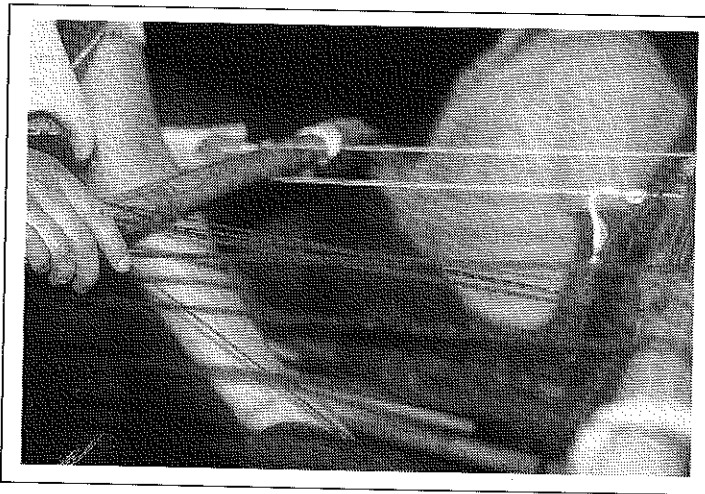


Figure 6.14 A young girl winds the warp of her toy loom. One of the two supporting loops of string is visible in white near the top of the photo. Nabenchauk, 1995

Source: Photograph: Patricia Greenfield

found a definite shift from highly scaffolded relatively errorless learning, involving a great deal of observation of models (1970), towards a much more independent form of trial-and-error learning (1991). These conclusions were reached by following families over two generations of weaving apprenticeship.

At the same time, and also as predicted, the stock of four rather carefully defined striped and basketweave patterns grew to an infinite number of complex figurative and geometric patterns, with motifs that are constantly changing and being recombined in new ways. Independent trial-and-error learning was, indeed, associated with pattern innovation, as the theoretical model predicted.

This example of weaving instruction indicates that the process of socialisation prepares the next generation to participate in society, even under conditions of societal change. In Zinacantan, a society that in 1970 was based on respect for tradition, changing socialisation patterns are a very real component of the psychological adaptation to social change. For the first time, we have empirical and direct historical evidence on this issue in the psychology of teaching and learning.

We have found that parents do not merely recreate the socialising process that they underwent as children. There is a tremendous capacity to develop new methods of cultural apprenticeship as societal conditions, in this case, economic conditions, change. These new methods entail changes in human relations, as well as changes in cultural artefacts. Changes in the creation of cultural artefacts, such as the woven and embroidered textiles in this study, imply cognitive consequences for creativity and visual representation.

More broadly, our diachronic study of informal weaving education demonstrates the intergenerational transmission and transformation of cultural elements, important mechanisms behind the cumulative quality of human culture. Most important, however, this study of three generations of Zinacantec weavers – grandmothers, mothers and daughters – exemplifies learning and teaching as key components of the human capacity to adapt to a changing environment.

developmental stage of concrete operations in a culture-specific form (Greenfield 2000). This analysis is very much aligned with Vygotsky and Luria's notion that processes of tool acquisition are an important element in 'the cultural development of a child's mind' (Vygotsky and Luria 1993: 175).

CONCLUSION

The teaching of weaving turned out to be remarkably responsive to societal changes, notably the movement from agricultural subsistence to an entrepreneurial cash economy. As predicted, we

An important part of this adaptation lies in the development of new tools. The appearance, adaptation and utilisation of paper patterns is one aspect of adaptation to a new environment. This aspect of material culture, so important to young girls in their contemporary weaving and embroidery, is tied to another socialising institution – the school – an outside influence that appears to have originated the genre and has, without intending to, prepared girls cognitively to utilise this new form of external, visual representation.

Finally, the toy loom, the real loom, and the winding board, are utilised by girls of different ages and have developmental significance. Importantly, the developmental progression of Zinacantec weaving tools from the toy loom to the real loom and winding board indicates that the Zinacantecs have implicit cultural knowledge of stages of cognitive development. Each tool is therefore available to stimulate and actualise the particular cognitive stage to which it is adapted. In the domain of textile production, children's material culture is adapted both to the developmental stage of children and to the historical stage of communities.

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Part IV

Childhood lives