induction cannot be the source of novel conceptual structures. I claim that these assumptions are unwarranted and as inappropriate in the domain of scientific explanation as they would be in philosophy or art.

Let me end by expressing my personal indebtedness to Bärbel Inhelder. Not having had the chance to talk with Piaget himself, I found in her an irreplaceable evaluator of my ideas. She was wonderfully open-minded and ready to discuss another's conceptions even if they did not always agree with her own. We are all constructivists, she once said, and we construct our own view of the world—what matters is that we try to be consistent in our thinking and that we are honest about it. The theory of schemes, she remarked, can be interpreted in more than one way —and this greatly encouraged me. I only hope that she would have considered what I have presented here as one of the possible interpretations.

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Culture and universals: A tribute to Bärbel Inhelder

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In this chapter, I use a small-scale, homogeneous society to introduce a large theory of development. After introducing the theory, I then proceed to show the broad applicability of the theory by applying it to our own large-scale, heterogeneous society. The theory links culture and biological maturation to explain development. This is very much in the spirit of Bärbel Inhelder, who respected the contributions of both biology and culture to development. The chapter that follows is presented to honour Inhelder's cross-cultural research, notably her important collaborative study on sensorimotor development among the Baoulé (Dasen, Inhelder, Lavallé, & Retschitzki, 1978).

PIAGET/INHELDER, VYGOTSKY, DEVELOPMENT, AND CULTURE

Reinterpreting Genevan stages: Age-dependent sensitive periods for cultural learning

Beginning more than 30 years ago, cultural and cross-cultural developmentalists have severely criticised the Genevan school (e.g., Cole & Scribner, 1974; Greenfield, 1966). Considering the theory of Piaget and Inhelder from a cross-cultural perspective, this chapter aims to restore balance concerning the role of Genevan theory in cultural psychology. I here introduce the idea that the stage theory of Inhelder and Piaget has an important universal element as a theory of innate potentials and age-dependent sensitive periods for cultural learning.

The notion of age-dependent sensitive periods does lead to two important points of difference with Piaget and Inhelder (1966/1969). The first is that, whereas they emphasise minimal ages for certain developments, the notion of age-dependent

sensitive periods also implies constraints on the upper age for actualising these same cognitive capacities. The really important difference, however, has to do with the issue of stage specificity vs stage generality. The sensitive period idea is that the original capacity for a particular kind of development can be general, but that the way in which it is actualised through cultural learning makes it more specific. The analogy is to language: Human beings start out with a general capacity for language, but we learn specific ones. Once we have learned a particular language, we lose, to some extent, our capacity to learn different ones. I will make the case for this principle in the domain of concrete operations. The principle contrasts in a fundamental way with the Piagetian notion of domain-general stages.

By analogy with language, the sensitive period model of development leads to the hypothesis that, once culture-specific actualisations of a cognitive stage take place through experience during the optimal maturational window, other alternative actualisations become more difficult to acquire, even by the same experience later in development. This theoretical formulation leads to a definition of stages that is less general than Piaget and Inhelder posited. In my view, the sphere of application for a given stage becomes limited by the particular experiences that have actualised the maturational potential of that stage.

On the other hand, the concepts of innate potentials and age-dependent sensitive periods also have much in common with the view of Piaget and Inhelder (1966/1969) on the role of maturation in development: "Where we do have some data, we see that maturation consists essentially of opening up new possibilities and thus constitutes a necessary but not in itself a sufficient condition for the appearance of certain behaviour patterns" (p. 154). These maturationally given possibilities provide the possibility for particular sorts of active construction to take place. In other words, the concept of age-dependent sensitive periods is in no way a statement of maturational reductionism. I would also agree with Piaget and Inhelder's important point that "Organic maturation is undoubtedly a necessary factor and plays an indispensable role in the unvarying order of succession of the order of the stages of the child's development" (pp. 154–155).

Piaget and Inhelder (1966/1969; Piaget, 1972) note that acquisitions become more variable in their time of acquisition the further they are removed from their sensorimotor origins. I agree with this, but would also go two steps further: (1) Acquisitions become more variable (and therefore more culture-specific) *not only in their timing but also in their form*, the further they are removed from their sensorimotor origins. (2) As the forms of stage behaviour become more variable and culture-specific in the course of movement from sensorimotor to concrete operational to formal operations, so too do the forms of experience that are required to actualise each stage. The notion of stages as sensitive periods for cultural learning does entail a major modification of the theory: *no longer is the presence of a stage measured by its cross-domain applicability; stages are now by definition domain-specific*. Extrapolating from Piaget (1972), I believe that the culture- and experience-specificity of formal operations is greater than for the other stages.

However, I would also assert that the principle of specificity still applies to concrete and even sensorimotor operations, although in progressively lesser degrees. My examples later in this chapter relate to the transition from pre-operational to concrete operational thought.

The Western scientist as a culture-specific developmental outcome

Although Piaget and Inhelder's concept of maturation contributes to a biologically grounded universal stage theory, I also see Genevan theory in other respects as an ethnotheory, a formalisation of Western ethnotheories of development, that is, a folk theory of development. In using the term ethnotheory, I am asserting that scientists and lay people alike have some common cultural assumptions that enter implicitly and without awareness into the very foundation of both scientific and lay theories of development.

In the 1970s, I introduced the idea of Piagetian theory as a theory of the development of the Western scientist, rather than the universal individual (Greenfield, 1974/1976). I have since realised that Piaget himself asserted that understanding the basis for Western scientific thought was his most fundamental concern (Piaget, 1965a/1977). One can infer from this statement that Piaget saw his theory and research on child cognitive development as a way of understanding the developmental pathway to mature scientific thought. In *The growth of logical thinking from childhood to adolescence*, Inhelder took a leadership role in researching the cognitive development of the Western scientist (Inhelder & Piaget, 1955/1958). However, alternative endpoints could have been selected. The ethnotheoretic aspect of Genevan theory occurs in the aspect of the human condition that Piaget and Inhelder selected as the endpoint of development (Greenfield, 1974/1976), not in the sequence of stages leading up to this endpoint.

Piagetian theory, like the Western scientist, therefore emphasises the development of knowledge of the physical world, apart from social goals. This corresponds to an ethnotheory of development in which cognitive knowledge is valued for its own sake, apart from the social uses to which it is put. This is typical of European-derived cultures (Mundy-Castle, 1974).

Needed: A developmental theory that can include cultures that subordinate the cognitive to the social

Other cultures, however, have a different ethnotheory concerning the relationship between the cognitive and the social. They treat cognitive and social development as tightly integrated, with cognitive development *subordinate* to social development (Dasen, 1984; Wober, 1974). Such cultures see cognition not as a value in itself, but as a means to social ends. This is a view that is not encompassed in Genevan theory. Thus, in Piaget's treatment of social cognition (the work on moral

judgement, Piaget 1932/1965b), the social is very much subordinated to the cognitive. The point here again concerns what is selected as the endpoint of development.

My assertion is that there are cultural differences in what constitutes the ideal, mature human being, and that the nature of the ideal in Western European culture involves a scientific rationality that is superordinate to or independent of social relationships and social feelings. Because this ideal endpoint is taken for granted as the only possibility, it then automatically becomes what needs to be accounted for in a developmental theory that is created within this type of culture.

But what about Vygotsky? This is a subject to which I now turn. Vygotsky (1962, part first published in Russian in 1934; 1978, most first published in Russian in 1956 and 1960) does, of course, have a sociocultural theory; it is the basis for the sociocultural component of the framework I am going to present. In Vygotsky's theory, the most important means to development is social interaction. Undoubtedly, one could link this difference in emphasis between Piaget/Inhelder and Vygotsky to cultural differences of the time. It does not seem coincidental that a greater emphasis on child development as a function of the sociocultural environment of the child arose in a communist country. This difference in learning mechanisms will be taken up in a moment.

However, for present purposes, I would like to emphasise the less obvious commonalties between Piaget/Inhelder and Vygotsky that stem from the fact that all were steeped in the epistemology and culture of Western Europe. Both Vygotsky and Piaget/Inhelder have selected the same endpoint of development to explain and, not coincidentally, it is a cognitive one. In other words, even for Vygotsky, social interaction functions as a means to cognitive development. Development itself is defined cognitively, in terms of language and conceptual thought.

What is needed in our field is a formal theory of development that is broad enough to be applicable to cultures in which the ethnotheory of development sees cognitive development as a means to social development, rather than vice versa. A first step would be to develop a theory of development for this alternative ideal endpoint: the person who has used his or her cognitive capacities to become wise in social relations and to achieve social goals. However, if we were to take that route, we would simply have a second ethnotheory of development in a different sort of culture from our own. What is really needed is a theory that includes mechanisms for the differentiation of these two major developmental pathways.

Mechanisms of cultural learning

Both Vygotsky and Piaget present models of learning as well as of development. Vygotsky (1956–60/1978) has an explicit model of socially guided learning. Piaget has an implicit model of discovery learning (Piaget, 1965a/1977). I hope to show that, as theories of environmental learning, both the implicit theory of Piaget and the explicit theory of Vygotsky are more tied to specific sociohistorical

circumstances than either theorist realised. I will demonstrate that each model of learning describes adaptive responses to particular ecological circumstances. The notion is that both types of learning process are part of the universal *armoire* of developmental processes, but that each is selectively emphasised as a means of transmitting knowledge under different sociohistorical circumstances; sociohistorical circumstances are seen, in turn, as having a strong economic foundation. The model that is dominant at a particular place or time does have implications for the learning processes of the individual learner, as I hope to demonstrate. Where guided learning is dominant, my hypothesis is that the learner comes to rely more on guidance as a means to acquire new knowledge, and will tend to excel at learning and applying culturally normative modes of thought, action, and feeling. Where discovery learning is dominant, my hypothesis is that the learner becomes practised at discovering new knowledge, and will tend to develop individual creativity.

A THEORETICAL FRAMEWORK FOR DEVELOPMENT

The theoretical framework has the following four principal components:

Maturational component: Age-dependent sensitive periods for cultural learning (Fairbanks, 2000; Fischer, 1987; Newport, 1988). Part (although not all) of this component is supported by Genevan stages, which I will exemplify.

Sociocultural component: The maturational component is actualised through interaction with other members of the sociocultural milieu, often mediated by:

- Activities and cultural practices (e.g., Rogoff, Baker-Sennett, Lacasa, & Goldsmith, 1995; Saxe, 1991; Scribner & Cole, 1981).
- Tools (both concrete and symbolic) (e.g., Bruner, 1964, 1977–78; Bruner & Olson, 1973; Greenfield, 1993).
- Values (e.g., Greenfield, 1994; Rabain, 1979; Shweder & Bourne, 1982).

Ecological component: The sociocultural component is adapted to an ecological niche (e.g., LeVine, 1977; Super & Harkness, 1997; Weisner, 1984; Whiting & Whiting, 1975).

Historical component (Scribner, 1985; Vygotsky & Luria, 1930/1993): The ecological niche changes over time (Greenfield, 1999a, b).

Each component has been studied individually and draws heavily on the work of others, as the references indicate. The news, both theoretical and empirical, is the specification of their interactions. These interactions are specified in the very definitions of the components, each of which directly interacts with the next one down in the hierarchy.

1. *Culture is integrated with maturation*: What matures are abilities to acquire different elements of culture through the sociocultural component of the model. This idea builds on Inhelder's theoretical view: In 1982, in *Early cognitive development and malnutrition*, a sole-authored article on the Baoulé, she wrote (p. 26): "it is not necessary to choose one or the other of the alternative terms: innateness or cultural origins of behaviour. Would it not be preferable to envision a constructivist solution …?" Her notion of construction was in terms of individual activity. My model extends this notion to social construction carried out by a biological organism in a sociocultural environment, with the subject's own activity as one, but not the only, critical element.

2. *The sociocultural component is adapted to the ecological conditions.*

3. *Ecology changes over time.*

An interdisciplinary approach, drawing on methods and concepts from psychology, anthropology, and sociology is required to test the model.

Application in a small-scale, homogeneous society: Zinacantan, Chiapas, Mexico

Because the contextual components of the theory are so complex, the model can most easily be explored in a relatively small, relatively self-contained community over an extended period of ecological change. With my colleagues Carla Childs, Ashley Maynard, and Leslie Devereaux, I have been studying socialisation in just such a community: Nabenchauk, a Zinacantec Maya village in Chiapas Mexico, over a period of 26 years.

Interaction of the maturational and sociocultural components

Interaction of maturation and cultural practices.   I will begin by considering the interaction of the maturational and the sociocultural components; that is, the interaction of a universal age-dependent sensitive period with cultural practices. The activity domain selected for this analysis is weaving, the most complex technology in traditional Zinacantec life. (See Figure 10.1 for a photograph of the ancient Maya backstrap loom, photographed in Nabenchauk in 1995.) I will begin with a physical component of weaving in order to provide a very concrete illustration of the interaction between biological sensitivity and cultural experience. I will then use Piagetian stage concepts to move to a cognitive example, where the analysis is more abstract and inferential.

The physical example has to do with the uses of the body in learning to weave (Maynard, Greenfield, & Childs, 1999). Note in Figure 10.1 that while a post forms the top of the loom frame, the weaver's body in a kneeling position forms the other end. My focus is on the physical skill of kneeling.

Figure 10.1.   Woman seated at the ancient Maya backstrap loom. Note that a post (left side) forms one end of the loom frame, the weaver's body in a kneeling position forms the other end. Nabenchauk, 1995. Photo courtesy of Ashley Maynard.

Kneeling is a universal biologically given capacity that all human beings are born with. However, it can be maintained only by experience. This is demonstrated by Molleson's (1996) research in physical anthropology. By relating differential bone development in male and female skeletons to known gender differences in work activity at the same archaeological site, Molleson shows that culturally defined experience in kneeling for many hours from a young age shapes bone development (e.g., flattens bones of two first metatarsal bones of both feet), so that the capacity to kneel for long periods of time is maintained into adulthood.

Zinacantec cultural practices provide just such experience for girls. Girls grow up watching their mothers and other older females sitting in a kneeling position with their legs under them during weaving and many other daily activities (see Figures 10.2 and 10.3). Cultural values come into play too; these are highly valued
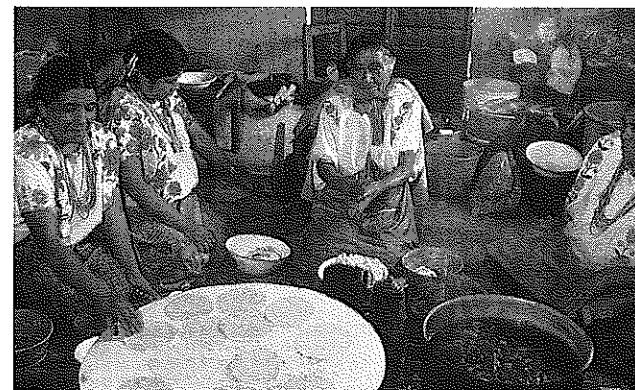

Figure 10.2.   Adult women kneeling to prepare tortillas. Nabenchauk, 1991. Photo courtesy of Lauren Greenfield.
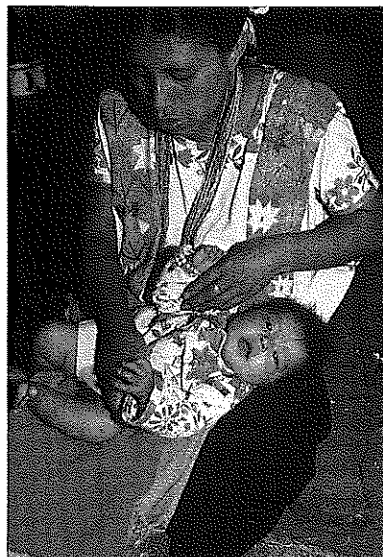
Figure 10.3.   Mother (Maruch Perez) kneeling to change her baby.

activities that define women's work. Girls learn to maintain this position through cultural activities. Starting at a young age, they kneel for many hours in a variety of situations and tasks, including play weaving at a toy loom (Figure 10.4) and drawing designs to embroider on their blouses (Figure 10.5).

The experience of my collaborator Ashley Maynard confirmed Molleson's conclusion that, without kneeling experience, the capacity to maintain a kneeling position for long periods of time can be lost with age (Maynard et al., 1999); Ashley was taught at age 23 to weave in Nabenchauk as part of an ethnographic study of weaving apprenticeship. Unlike Zinacantec girls, she had not had extended and repeated kneeling experience at a young age, and, indeed, she encountered problems in learning to weave because she was not able to kneel for long periods of time. Kneeling was very painful for her and she resorted to sitting cross-legged, much to the derision of the Zinacantecan teachers and other women who observed her weaving. The absence of culturally mandated kneeling experience at a younger age had caused her to lose her ability to kneel for the long periods required by weaving. Her experience showed that there is a sensitive period during which this experience must take place.
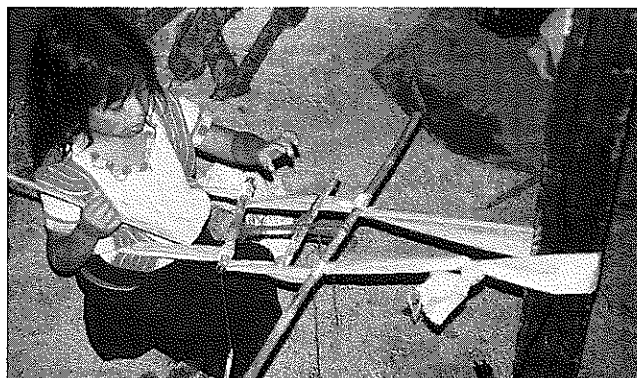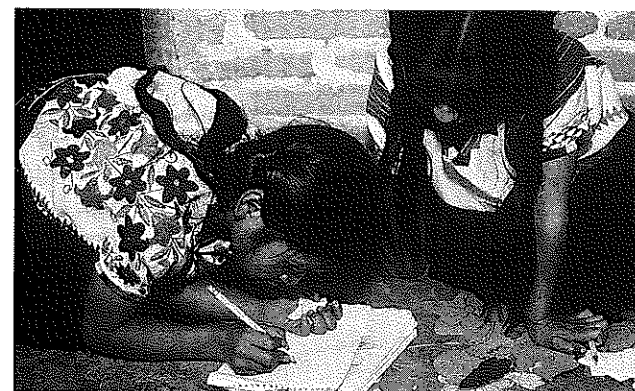

Figure 10.4.   Young girl, Rosy 1–209, kneels, as she engages in play weaving at a toy loom. Nabenchauk, 1993. Photo courtesy Patricia Greenfield. (The numerals are to identify families from our larger, two-generation study of weaving apprenticeships, e.g., Greenfield, 1999b; Maynard et al., 1999.)

Figure 10.5.   Girls (Loxa and Xunka 1–201) use the traditional kneeling position, even in newer activities such as drawing designs to embroider on their blouses. Nabenchauk, 1991. Photo courtesy of Lauren Greenfield.

Here I have used kneeling to demonstrate the interaction of biological sensitive periods with cultural practices. I now turn to more cognitive aspects of weaving, using Piagetian stage concepts. I am going to treat the timing of the transition from pre-operations to concrete operations as a sensitive period, a developmental window, that is actualised differently in different cultures.

Developmentally gradated tools.   My theme here is that cultures have sets of artefacts and practices that respect and stimulate sensitive periods for cognitive and neural development. I would like to make the argument that the developmental timing and order in which girls are exposed to various weaving tools show implicit knowledge of and respect for cognitive development. Specifically, these tools show implicit knowledge of progression from the pre-operational to the concrete operational stage and its time. Vygotsky (1934/1962; 1956, 1960/1978) noted how much cognitive history is contained in cultural artefacts and that these artefacts function, in turn, as tools for the stimulation of current cognitive development. 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. To provide evidence for this point, I analyse the cognitive requirements of a developmentally gradated set of weaving artefacts: the toy loom, the winding board, and the real loom.

Play weaving on the toy loom, illustrated in Figure 10.4, is widespread in Nabenchauk. It begins at age 3 or 4, in Piaget's pre-operational period. The toy loom is used several years earlier than the real loom and winding board, which are not used before age 6, the beginning of the concrete operational period. Using a winding board to prepare warp threads for the real loom is a concrete operational task, as I shall demonstrate later. Because the toy loom differs in just one respect from the real loom, it does not require concrete operational thinking to set up. The

difference lies in the ropes between the two end-sticks, one rope on each side (Figure 10.6, functionally equivalent to the wide ribbons in Figure 10.4). By holding together the two end-sticks (shown at the top and the bottom of the loom in Figure 10.6) , these ropes permit the warp or frame threads (the white threads in the middle of the loom in Figure 10.6) to be wound directly on the loom. Figure 10.4 shows how the end-sticks that constitute the loom are connected by a loop of ribbon (functionally equivalent to the rope in Figure 10.6) that goes around the weaver's back (hence the name *backstrap)* to the post; the tension necessary to keep the loom from collapsing is provided by the weaver, who leans back against the strap. Note that, unlike the real loom (Figure 10.7), the top and bottom end-sticks are connected by the ribbon or rope looped around them. The real loom (shown in Figure 10.7) does not have the side ropes (Figure 10.6) or ribbons (Figure 10.4) holding the loom frame (top and bottom end-sticks) together. Only the warp threads in Figure 10.7 hold the two end-sticks together. However, these threads cannot be wound

Figure 10.6.   Toy loom. Note the side ropes that hold the two frame sticks together while the warp (white threads) is being wound. Photo courtesy of Lauren Greenfield.
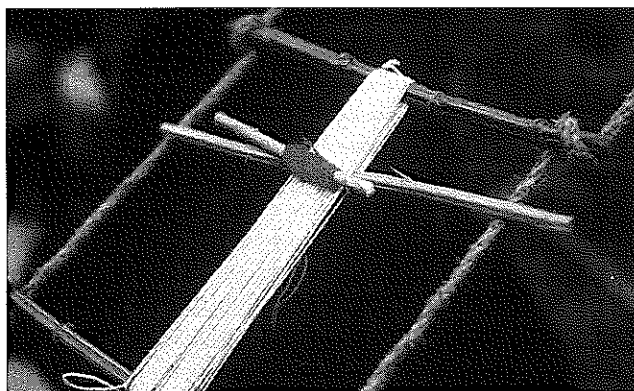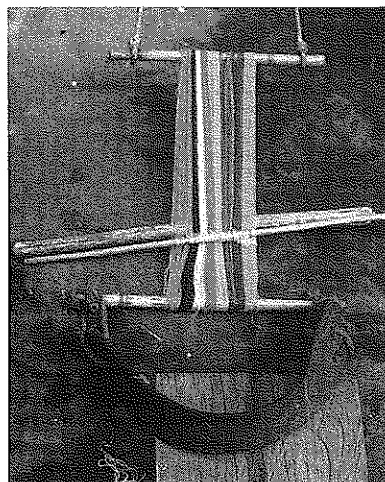

Figure 10.7.   Real loom. Note the absence of the side ropes; therefore the warp threads hold the loom together. However, they cannot be wound directly onto the loom, because the loom does not exist as connected sticks until the warp is wound. Nabenchauk, 1991. Photo courtesy of Lauren Greenfield.

directly because if the warp threads were not there, the loom would collapse; the loom has nothing to hold the two end-sticks together before the winding of the warp threads begins.

A real loom, must therefore have the warp pre-wound on an apparatus such as the *komen* or warping frame shown in Figure 10.8. My thesis is that winding the warp on a *komen* intrinsically involves concrete operational thinking. This is the case because winding on the *komen* requires mental transformation. The form of the warp threads on the warping frame (Figure 10.8) is quite different from the form of the threads on the final loom (Figure 10.7). Complex topological transformation is required to understand the connection between how you wind and how the threads end up on the loom. Let me illustrate with a sequence of photographs. Figure 10.9a shows a *komen* or warping frame, ready to begin winding. In Figure 10.9b, a girl has begun to wind the threads on the warping frame; in Figure 10.9c she has progressed a bit further. Figure 10.9d shows a close-up of the resulting configuration of threads. Compare this image with Figure 10.7, which shows how the warp might turn out (with additional winding and more colours) after being transferred to the loom. Note the difference in the configuration of threads between Figure 10.9d where warp threads are still on the warping frame, and Figure 10.7, where the warp threads have been transferred to the loom. Threads on the left side of the stick in the warping frame of Figure 10.9d go to one end of the loom (e.g., the top end-stick in Figure 10.7), while threads on the right side of the stick in the warping frame of Figure 10.9d go to the other end of the loom (e.g., the bottom end-stick in Figure 10.7).

This sequence illustrates an important cognitive point: that a complex series of mental transformations is required for a weaver to understand the connection between how the threads are wound on the warping frame and how they end up in the configuration shown on the loom in Figure 10.7. Because mental transformations characterise the Piagetian stage of concrete operations (e.g., Piaget, 1963/1977), winding a warp on the warping frame in order to set up a backstrap loom is a culture-specific concrete-operational task.
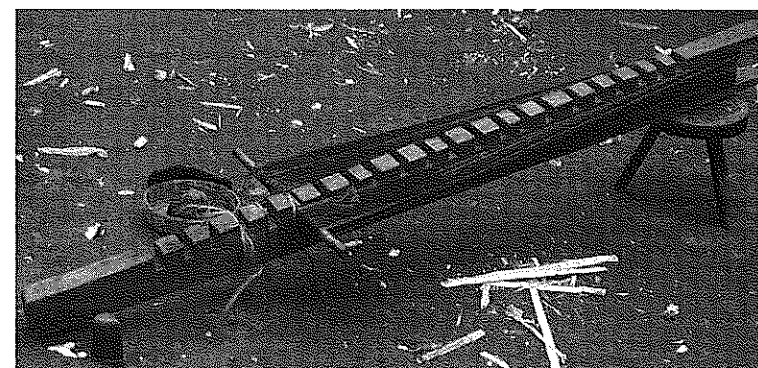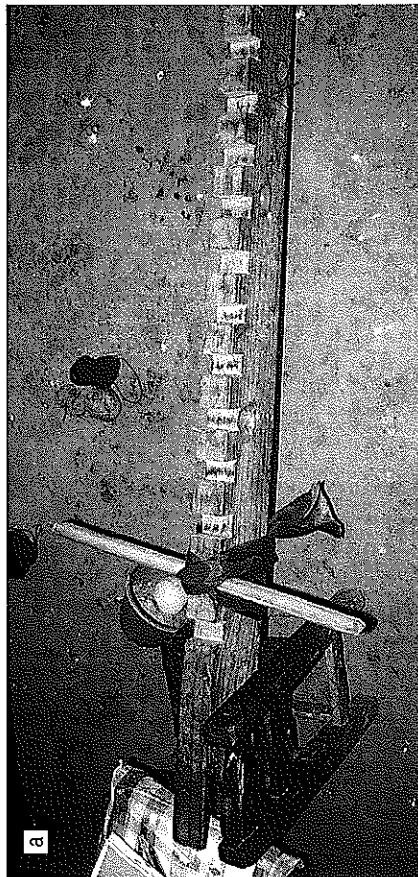

Figure 10.8.   *Komen* or warping frame. Nabenchauk, 1991. Photo by Patricia Greenfield.

Figure 10.9. Creating a warp, using a warping frame. (a) The *komem* or warping frame, ready to begin. (b) A girl has begun to wind on the frame. (c) She has wound a few more threads. (d) A close-up of the resulting configuration of threads. Nabenchauk, 1995. Photos by Patricia Greenfield.

I now compare the cognitive level required to set up a real loom with that required to set up a toy loom. Whereas to set up a real loom demands the mental transformations of concrete operations, mental transformations are not required for the toy loom. Because of the extra supporting rope (Figure 10.6) or ribbon (Figure 10.4) on the side, the warp can be wound directly on the loom. The sequence in Figure 10.10 illustrates this point. In Figure 10.10a, a young girl has just started winding the warp directly on the loom, which is already set up. The top and bottom end-sticks (left and right in the photo) are being held in place by the tension between her backstrap, held by her body, and the rope attached to a rigid support, such as a tree or a house post. Unlike the real loom, the end-sticks are connected by white string; one of the two side strings is shown clearly at the top of Figures 10.10a and b. In Figure 10.10b, the young girl continues winding the warp between the end-sticks.

In Figures 10.10a and b, the warp threads are being wound into their final position between two end-sticks. This is similar to, for example, the way warp
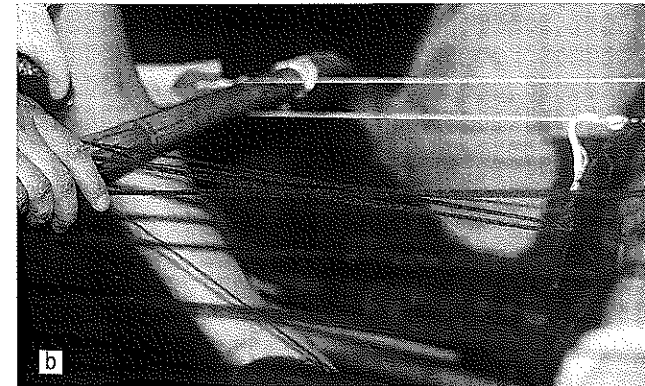

Figure 10.10.   (a) A young girl has just started winding the warp of her toy loom. (b) The girl continues winding the warp. Nabenchauk, 1995. Photos by Patricia Greenfield.

threads are stretched between end-sticks on the loom shown in Figure 10.6. Unlike winding the warp on a winding board, there is no mental transformation required to go from the winding process to the set-up loom.

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 beginning of the normal age range of concrete operations. So, most interestingly, Piagetian theory is implicitly (but not explicitly) built into the developmental progression of Zinacantecan weaving tools.

If we think of Piagetian stages as age-dependent sensitive periods, then learning how to set up a real loom using a winding board can be seen as an activity that actualises concrete operations in a culture-specific form. This activity can also be seen as the kind of constructive problem-solving process emphasised by Inhelder. As Veneziano (1998) has pointed out, Inhelder had a great love for adaptive and contextualised tasks as a method for assessing cognitive development.

Cognitive stages as age-dependent sensitive periods. What is the evidence for Piagetian stages as age-dependent sensitive periods and how does play weaving fit into this picture? I should like to draw on a new theory of primate play by Fairbanks (2000) and propose that it applies both to human play in general and to play weaving in particular. Fairbanks (2000) has developed a theory of monkey play that posits its role in stimulating neuromuscular pathways that underlie a particular adult monkey skill. She contrasts her theory with the theory that play functions as direct practice of an adult behavioural skill. She observes that the height of each monkey play form occurs years before the adult behaviour (when it would not be very useful as practice). However, the playful form is most frequent just at the time the relevant neural substrate for that particular activity is developing. For example, play fighting in monkeys reaches its height just as the neural circuitry for adult aggression is developing—but years before aggression is required in adult monkey social life.

Could this analysis apply to play weaving? There are several parallels with Fairbanks' theory and data: First, there is the behavioural parallel: Just as play fighting occurs in monkeys several years before the real thing, so does play weaving on the toy loom occur several years before weaving utilitarian items on the real loom. Second, Thatcher (1994) presents EEG evidence for spurts in neural development. These spurts are periods of neural instability that serve as developmental transition points in the nervous system. One of these transition points or spurts is in the age range of play weaving (3–5).

My theoretical interpretation of these transition points in neural development is that they are sensitive periods—developmental windows—when stimulation (often in the form of culture-specific practices) actualises maturationally specific neural circuits. It follows from this that play weaving could stimulate neural and

neuromuscular pathways that provide a foundation for the later cognitive development required to weave on a real loom. Hence, this spurt of neural development could provide a developmental window for the culture-specific actualisation of concrete operations.

Fischer and Rose (1994) identify a second spurt in neural development that occurs between 6 and 10 years of age. This is precisely the period in which weaving on a real loom begins for most Zinacantec girls. It is also Piaget's period of concrete operations, which, as I have tried to illustrate, are indeed required for setting up a real loom.

The role of values.   One aspect of values relevant to our theory is the ethnotheory of development to which Zinacantecs connect weaving. First, they are in agreement that development is important: A girl will weave when she has enough soul (implies that she is able to listen to instruction, follow instruction, do what is needed, and tolerate frustration), and this takes time to develop (Devereaux, field notes, 1991). However, there is something different here, different both from our ethnotheories of development and from our formal theories of development (specifically those of Piaget/Inhelder and Vygotsky): According to the ethnographic research of Leslie Devereaux, Zinacantecs do not value weaving as a technical skill; rather they value weaving for its social aspects: "the social interactional aspects of the learning process", the social utility of what is woven, and the enhancement of a girl's marriageability by being a good weaver.

To compare this with our ethnotheories and theories of development, the Zinacantecs do not have separate theories of cognitive and social development. For them, cognitive development is embedded in and subordinate to social interaction and the development of social activity. So, for example, one mother told us that her mildly retarded child (my observationally based diagnosis) would not be able to learn to weave. However, she explained, this was fine because the daughter had another useful job, putting thread on spools. It was not important to her that this job was cognitively much simpler than weaving. What mattered was that it made a contribution to the family. My point is the following: Cognitive development, as described by Inhelder and Piaget, may follow a common pattern across cultures, but the value attached to it does not.

This subordination of cognitive skills to social relationships and goals is part of a system of values that emphasises social interdependence in the definition of the self (Greenfield, 1994; Markus & Kitayama, 1991); this system of values is often called collectivism (Triandis, 1988). The emphasis on an individual's knowledge and technical expertise for its own sake is part of a system of values that emphasises independence and autonomy (Greenfield, 1994; Markus & Kitayama, 1991).[1] Consistent with this value system, we, in the United States or Switzerland for example, might value backstrap loom weaving if we thought it stimulated the development of concrete operational thought. However, this is not at all the way the Zinacantecs think about weaving. Instead, Zinacantecs are more

interested in the social utility than in the purely cognitive value of weaving. Zinacantec culture contrasts with ours in this respect.

Weaving apprenticeship in sociocultural context. Let me illustrate the weaving apprenticeship practices in 1970, the year we did our first video study (Childs & Greenfield, 1980). As you will see, in the course of the apprenticeship process, maturational readiness for Genevan stages was met with Vygotskian scaffolding (Greenfield, 1984; Wood, Bruner, & Ross, 1978). The inter-individual activity theorised by Vygotsky (1956–60/1978) is beautifully exemplified by the following.

Katal, age 9, was videotaped as she learned to weave in 1970. Throughout our videotaping of her weaving apprenticeship, Katal's mother, serving as her teacher, was actively engaged in a process of scaffolding (Figure 10.11) (Greenfield, 1999 a, b). She was constantly anticipating her daughter's need for guidance and helping her to complete a weaving the daughter could not do on her own. For example, at one point, the mother entered the scene without being summoned, the teacher initiating help on her own. Figure 10.11 also shows four hands on the loom: Two belong to the learner, two to the teacher. This image symbolises a paradigmatic inter-individual process and demonstrates the interdependence of learner and teacher in weaving apprenticeship in 1970 (Greenfield, 1999a, b).

We also noted that this highly scaffolded process of apprenticeship left little room for error. In fact, errors were to be avoided because weaving materials were costly and difficult to obtain. This is one aspect of the ecological component, to which the socialising process of apprenticeship is adapted.

In addition, this highly scaffolded process of apprenticeship left little room for discovery. This was a quality well suited for the maintenance of weaving tradition in a society in which learning to weave meant learning to weave a closed stock of about four traditional patterns. Because the teacher was the mother, a member of

Figure 10.11.   Video frame of Katal 1's mother, Xunka', helping Katal 1 to weave. Nabenchauk, 1970. Video by Patricia Greenfield.

the older generation, this example of weaving apprenticeship also illustrates the flow of authority from elder to younger (Greenfield & Childs, 1996). The collectivistic values of interdependence and respect for the authority of elders were implicit (although not explicit) in Zinacantec weaving apprenticeship.

Ecological component: The sociocultural component is adapted to an ecological niche

Reverence for stable tradition was related to the functionality of authority in agrarian societies, where the older generation controlled land, the essential means of subsistence and production (Collier, 1990). There was an absolute view of the world. For example, when I asked why a group of Zinacantecs were dressed like us rather than like them, the answer in Tzotzil was, "They don't know how to dress." Innovation was a negative. To be different was to gather opprobrium. This was a value judgement. Weaving was part of a collectivistic value system that emphasises the interdependence in social relations as well as respect for authority and cognitive skills in the service of social goals. This value system was well adapted to life in a subsistence, agriculturally based economy, in which the younger generation depended on the elders' land and in which co-operative exchanges of labour were required for the production of food and clothing.

Historical component: The ecological niche changes over time

In the decades from 1970 to the 1990s, there were significant economic changes in the culture of Nabenchauk. Zinacantecs moved from an agrarian, subsistence culture to a commercial society, from family- and community-held land to individually owned trucks and vans. Even woven textiles are sold—both to outsiders (see Figure 10.12) and to other Zinacantecs. In Figure 10.12, woven and
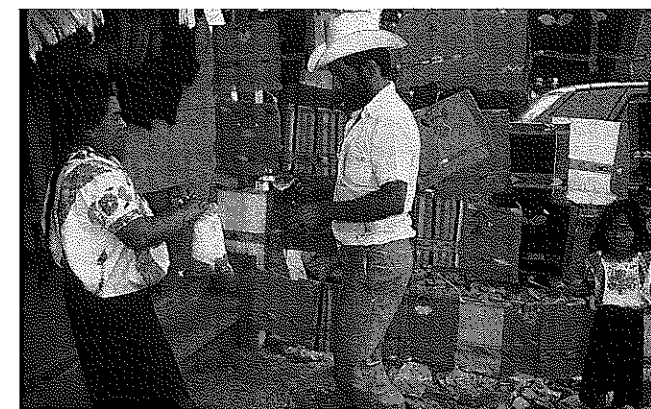

Figure 10.12.   Girls selling *servilletas* (used as tortilla covers, place mats, or hand towels) on the road at the edge of their village. Nabenchauk, 1991. Photo courtesy of Lauren Greenfield.

embroidered *servilletas* (napkins) are for sale to tourists and others who stop to buy; the *servilletas*, seen hanging in the background, are an item specially developed to sell to outsiders.

This type of entrepreneurship is part of a pattern of innovation and individualism. Innovation is seen in the change from a small closed stock of traditional woven patterns to a constant process of pattern innovation; each woven artifact is now unique, a mode of individual expression. For example, instead of a situation in which all males wear the same poncho (Figure 10.13), we found a large variety, giving a larger role to individual creativity and uniqueness (see Figures 14a, b, and c). Although the poncho shape and the background pattern of stripes have stayed the same, the woven and embroidered decoration is distinct for each poncho, and this decoration is getting increasingly elaborate (Greenfield, 1999a, b; Greenfield & Childs, 1996). Thus, the developmental outcome in terms of artistic expression has changed. Artistic expression has become more individualistic, less specified by social norms.

Commerce promotes individualistic practices because nuclear family members are regularly moving in every direction independently of each other. For instance, a child may go to a nearby market to sell fruit with a neighbour, or a father may drive 18 hours one-way to pick up some commodity to be sold. Members of a nuclear family operate more and more independently of each other as their involvement with commerce increases.

This societal level of historical change brought with it a change in the cultural practices concerned with weaving apprenticeship. This was revealed by our study of the next generation. Recall the case of Katal, who was learning to weave under her mother's tutelage in 1970. She grew up and had children of her own. In 1991, one of them, Loxa, was about the same age her mother had been in 1970, and we were able to study how she learned to weave. As with her mother's generation, we
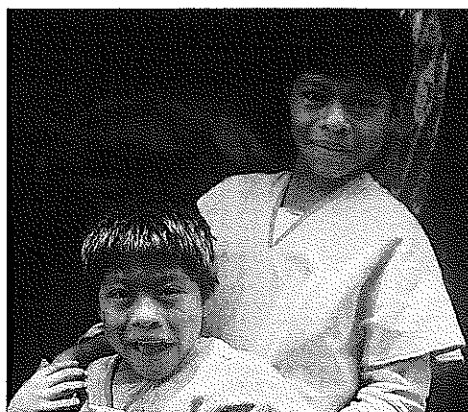

Figure 10.13.   Pavlu brothers wearing virtually identical ponchos. Nabenchauk, 1970. Photo courtesy of Sheldon Greenfield.
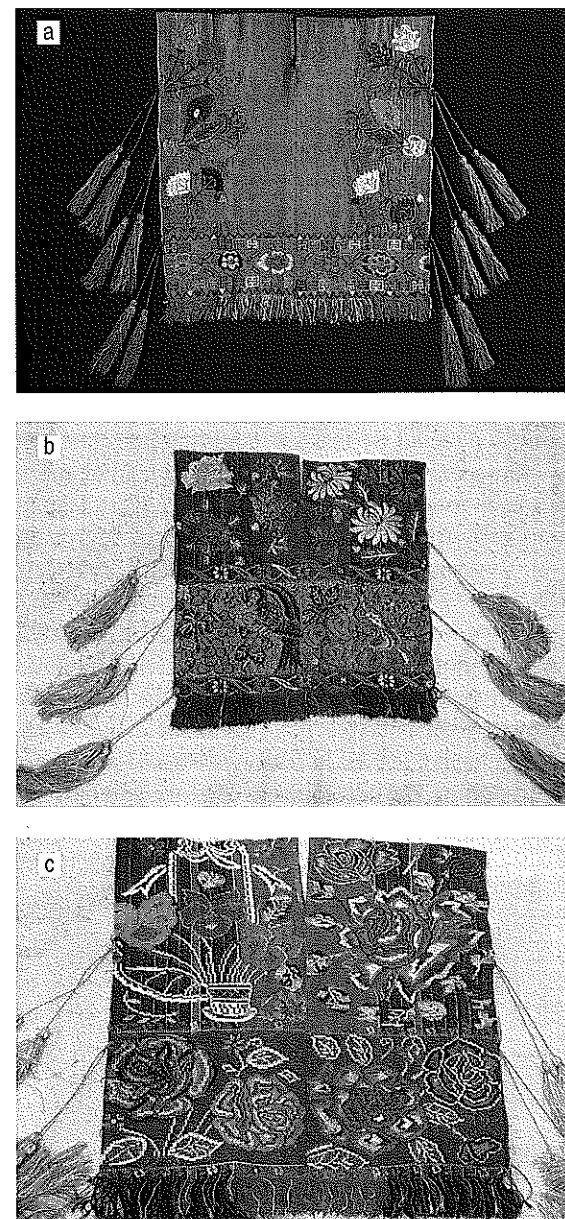

Figure 10.14.   Three distinctly different ponchos from the 1990s. (a) 1991, photo courtesy of Lauren Greenfield. (b) and (c) 1995, photos by Patricia Greenfield.

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again made a videotape of her weaving apprenticeship. Figure 10.15 presents a frame from the video that is typical in many respects.

Comparing Figure 10.11 (mother learning to weave in 1970) with Figure 10.15 (daughter learning to weave at the same age in 1991), some differences are striking. Note that in contrast to the previous generation, Loxa's mother is not present in the frame. Instead, mother has designated Loxa's older sister, Xunka', to serve as teacher. This change in the generation of the weaving teacher is related to the historical increase in innovation; that is, weaving innovation is concentrated in teenage girls.

In addition, the learner has become much more independent. Unlike her mother's teacher, Loxa's teacher does not anticipate her need for help. Note that the older sister is paying no visual attention to the weaving learner in Figure 10.15; she is also much further away from the learner than the teacher in Figure 10.11. The learner must take the initiative to summon her teacher when help is required. The scaffolding process is directed by learner rather than teacher. There has been a movement from interdependence to independence of learner and teacher. In fact, the movement has been towards the independent discovery learning favoured by Piaget (1965a) and away from the scaffolded guidance described by Wood et al. (1978), based on Vygotsky's (1956, 1960/1978) theory (Gelman, personal communication, 1991).

This method is adapted to a situation where errors are less costly, and innovation and discovery are valued. Earlier I noted that innovation in woven patterns had come to be valued. In fact, errors had become less costly too. There had been a switch from the more expensive (to buy) cotton and the more expensive (to produce) wool to the cheaper acrylic, a petroleum-based product of the 1980s oil boom in Mexico. In addition, the development of a transport business, and the local commerce that followed, made the materials (thread) easier to get. Whereas in 1970,

Figure 10.15.   Video frame of Katal 1's daughter, Loxa 1–201, learning to weave in 1991. Loxa is about the same age as her mother was when she was videotaped learning to weave in 1970. Nabenchauk, 1991. Video by Patricia Greenfield.

cotton had to be purchased retail in the city of San Cristobal, acrylic thread could now be purchased wholesale in San Cristobal and resold retail in Nabenchauk. In other words, as materials became more plentiful, easier to get, and cheaper, errors became less costly over the same historical period in which apprenticeship changed (cf., Greenfield, 1984; Rogoff, 1990).

Theoretical conclusion and summary.   A general theoretical conclusion follows: In circumstances where the goal of apprenticeship is to maintain tradition and avoid error, the Vygotskian model of socially guided learning is dominant. In circumstances where innovation is desired and errors are not too costly, the Piagetian model of independent discovery learning is dominant.

Note that there is still a process of sociocultural construction of weaving skill by which the maturational potential of a 9-year-old for learning and development is actualised in backstrap loom weaving. But the nature of the sociocultural process has been transformed in this particular family.

Testing generality and integrating levels of the theoretical model: Structural equation modelling

Was the observed historical change general? If so, was the change in fact mediated by the hypothesised change in ecological conditions? We used interview and demographic census data, plus structural equation modelling, to answer these questions affirmatively (Greenfield, Maynard, & Childs, in press). Such a model also takes account of within-culture individual differences in a way that a paradigmatic case study cannot.

Uneven social change and value conflict: Interaction between the sociocultural and ecological component

In a situation of uneven social change, some people have changed considerably towards the new more individualistic cultural practices; others have changed much less. Some members of the community have become merchants; others are still mainly in agriculture. In this situation, one might expect some conflict between the two models of learning and apprenticeship. I now want to present some ethnographic evidence for conflicting mental models of the apprenticeship process. Note that it is primarily in a situation of value conflict that values move from the implicit to the explicit level. In the conflict, we will see how underlying values are made explicit in the interpretive process of verbal discourse.

A little girl, Rosy, age 7, had spontaneously set up a toy loom. A teenage girl next door saw Rosy working, decided what she was doing was not good, and came over and undid everything. In Figure 10.16, the teenage neighbour is in the middle of taking out one set of threads in Rosy's warp (frame threads).

Figure 10.16.   A teenage neighbour taking out Rosy's warp threads because she thinks Rosy has done an inadequate job. Nabenchauk, 1995. Photo by Patricia Greenfield.

At this point it is important to present ethnographic evidence for conflicting mental models of the apprenticeship process: Clearly the teenage neighbour felt that Rosy should not make her own mistakes. Of Rosy's set-up she made the evaluative comment "bad". Rosy's mother had another model in mind: independent learning. "Let her do it by herself" said Rosy's mother Maruch. "She doesn't know how" replied the self-appointed teenage teacher. This reply reflected the older model of scaffolded, relatively errorless learning, in sharp contrast to the mother's model. Later, Rosy's mother elaborated her model even more explicitly. She told me that it was better for Rosy to learn by herself, as her older sister had done. She had neither helped nor talked to Rosy's older sister, said the mother.

Interestingly, Rosy's family was much more heavily involved in commerce than was the neighbour's family, so the conflicting models represented the two ecological niches present in Nabenchauk. Later, I asked Rosy about her own model of learning: Did she want to weave by herself or with help? She replied "by myself". Upon further questioning, she added that it was "worse" to have the girl help. So Rosy, like her mother, but unlike her self-styled teacher, had in mind the newer model of more independent apprenticeship.

We see learning to weave as but one example of two contrasting models of development mentioned earlier. These models, which I will call the interdependence script and the independence script (Greenfield, 1994), are very basic and generative. Each model is a value framework that guides development, socialisation, and behaviour across many domains.

Just as our model can explain cultural variability and value conflict in Nabenchauk, it can explain cultural variability and value conflict in Los Angeles. Here I will focus on the sociocultural level of values.

Extension of the theoretical framework to a multicultural society

Because change has been quite gradual in Nabenchauk and the Zinacantecs have kept changes pretty much under their own control in an intact community, this conflict between two models of socialisation is relatively recent and fairly mild. The Zinacantecs are just beginning their journey on the path to individualism. However, the path is much more abrupt and disruptive for the many immigrants who come from rural Mexico to the United States. Although they have been much more integrated into the modern Mexican commercial economy, more touched by formal education, and less collectivistic than the Zinacantecs, they carry with them an ancestral value system that, relative to urban Los Angeles, is very collectivistic. As our research has shown, these immigrants, many from rural backgrounds, come to the United States with an interdependent script of socialisation and development (Delgado-Gaitan, 1994; Greenfield, 1994; Tapia Uribe, LeVine, & LeVine, 1994). They meet a highly commercial, individualistic society that has a developmental script based on independence and autonomy (Greenfield, Raeff, & Quiroz, 1998; Raeff, Greenfield, & Quiroz, 2000).

This culture conflict is expressed in many ways. For example, relative to the dominant culture, these immigrants experience parallel struggles to those of Rosy —between a model that stresses helpfulness and one that stresses doing it yourself.

Here is an example: We arrived to start a study in an elementary school in West Los Angeles serving low-income Latino families. There had just been a major conflagration in the school involving the federally funded school breakfast programme. The problem, as seen by the school, was that immigrant Latino mothers were accompanying their children to school, having breakfast with them, and helping their school-age children to eat. When the school locked the families out of the schoolyard at breakfast, there was a major blow-up (Quiroz & Greenfield, 1996).

One of the problems, as seen by the school personnel, was that these mothers were literally spoon-feeding their school-age children instead of letting them eat by themselves. Such behaviour was seen as leading to dependency, rather than to the self-sufficiency advocated by the schools. On the other hand, helping the children eat their food also reflected Latino cultural values: Being helpful towards one another is a highly desirable trait. Part of this conflict between the two value systems sets independence over and above helpfulness.

How general was this conflict over school breakfasts? Would it be correct to say that it reflected two contrasting cultural models of development? With Catherine Raeff and Blanca Quiroz, I conducted experimental research to investigate these questions (Raeff et al., 2000). We administered a set of scenarios concerning social dilemmas at home and at school in two different schools. Each dilemma could be solved in a number of different ways, some consonant with an individualistic model of development and socialisation, some consonant with a collectivistic model. Parents, teachers, and children were tested in two schools. In the school I am going

to talk about here, the families were Latino immigrants from Mexico and Central America.

Here is an example of a dilemma that relates to the school breakfast example (Raeff et al., 2000). In this dilemma, which takes place at school, the issue is whether to help or not:

> It is the end of the school day, and the class is cleaning up. Denise isn't feeling well, and she asks Jasmine to help her with her job for the day which is cleaning the blackboard. Jasmine isn't sure that she will have time to do both jobs. What do you think the teacher should do?

Figure 10.17 shows the results. Just as the school was unified in the opinion that mothers should not help their school-age children to eat, so teachers were in broad agreement that Jasmine should not help Denise (Figure 10.17). Most often they thought a third person should be found to do the job (see Figure 10.17). The point, often, was to get someone who would volunteer to do the job by choice. They did not want to infringe on Jasmine's autonomy in achieving completion of her own job. Latino immigrant parents, in sharp contrast, were quite unified in their view that Jasmine should help Denise (Figure 10.17). This response paralleled their desire to help their children eat breakfast.

This pattern of results shows a strong conflict between helpfulness and independent autonomy, with Latino immigrant parents supporting helpfulness, and teachers (representing dominant societal culture) prioritising Jasmine's right to autonomy and Denise's individual responsibility for her job. The Latino children (like Rosy) are often in between, constructing their own values out of two disparate
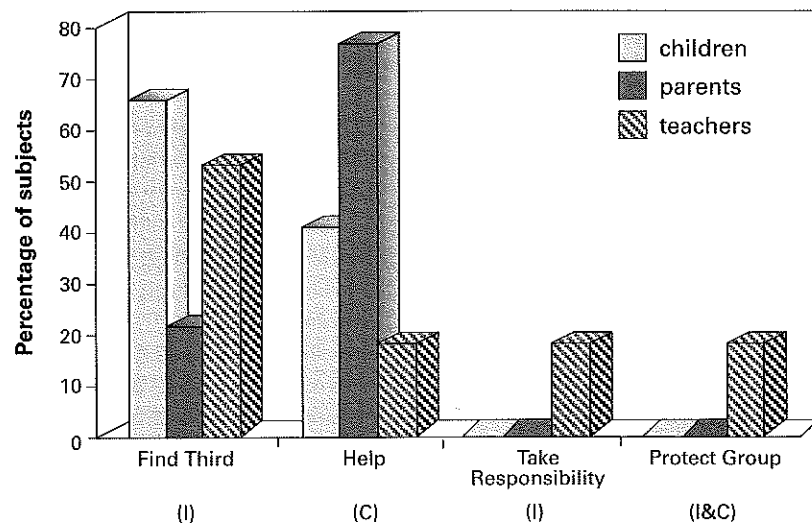

Figure 10.17.   Distribution of responses to the "jobs" scenario by Latino immigrant parents, their children, and teachers. I = individualistic, C = collectivistic.

and conflicting value systems. Here for example, they are in between parents and teachers on helpfulness (Figure 10.17).

As we saw for the Zinacantecs, another aspect of the collectivistic worldview is an ethnotheory of development in which cognitive skills are in the service of social goals. In the Latino immigrant ethnotheory, cognitive development is subordinated to social relations—just as it is for the Zinacantecs. This can lead to other kinds of cross-cultural value conflicts and misunderstandings in the individualistic schools.

Here is an example: During one of our observations of a Los Angeles pre-kindergarten class made up of mostly Hispanic children, the teacher was showing a real chicken egg that would soon hatch. While teaching the physical properties of the egg, she asked children to describe eggs by thinking about the times they had cooked and eaten them. One child tried three times to talk about how she cooked eggs with her grandmother, but the teacher disregarded these comments in favour of a child who explained that the insides of eggs are white and yellow (Greenfield, Raeff, & Quiroz, 1996, p. 44).

From the Latino point of view, the first child's answer was typical of the associations encouraged in her home culture of interdependence. That is, objects are most meaningful when they mediate social interactions. The child therefore acted on this value of interpersonal relations in answering the teacher's question. The teacher, however, did not recognise this effort on the part of the child and considered the social descriptions of the time they had eaten eggs as irrelevant; only physical descriptions of these occasions seemed to be valued (Greenfield et al., 1996). Here, the ethnotheory of development that places knowledge of the physical world as a means to social relationships is not valued or understood. Cognitive development expressed in this context is devalued.

CONCLUSION

I have tried to present a model that features a new idea: age-dependent sensitive periods for cultural learning. Because of the actualisation of these bio-logically grounded developmental windows by the sociocultural component, the implication is that the same cognitive stage will take different forms in different cultures. Just as we would not expect concrete operational children in the United States to set up a backstrap loom, so we might not expect concrete operational children in Nabenchauk to solve a problem in cross-classification (and in fact in an experiment I tried, children of concrete operational age could not do this).

Another theoretical idea that builds on Inhelder and Piaget's description of cognitive stages of development is that particular stages of cognitive development are built into various tools and that the order in which the tools are presented can implicitly respect the stages of Inhelder and Piaget. This "developmental sequence" of cultural tools illustrates how the notion of cognitive construction through

individual activity, developed so richly by Inhelder, can be expanded to incorporate the notion of cultural construction of cognitive development.

My theoretical model also explains development as an interaction among various levels: the maturational, the sociocultural, the ecological, and the historical. Thus, biological concepts are integrated with sociocultural ones. I have tried to illustrate the complex interactions among the various levels by using findings from a relatively simple, homogeneous society, a Zinacantec Maya community in Chiapas, Mexico. I have selected a part of the model, the level of symbolic value interpretations, to test in Los Angeles, where we have found the same opposition between two different ethnotheories or models of development; a more collectivistic model stressing helpfulness and a more individualistic one stressing autonomy.

Integrating theories of social and cognitive development

In the West, there is a split between theories of social and cognitive development. This reflects a split in our goals for development, a split in our ethnotheories of development. True to European-derived cultures, Inhelder has had a critical role in developing the most influential theory of cognitive development. This was an amazing accomplishment that we must now build upon as we remember Bärbel Inhelder with great admiration. In taking the next theoretical step, we need to keep in mind that, in many cultures, such a split between the cognitive and the social is not the norm; cognitive skills are seen as a means to social goals. I propose that our formal theories are only as universal as the ethnotheories they presuppose. Therefore, we need a formal theory of development that does not presuppose the dominance of cognitive development nor the split between the social and the cognitive. In conclusion, we need a universal theory that transcends culture-specific ethnotheories of development. This requires a higher-order theory that integrates different ethnotheories as alternative paths in a more universal theory of development.

ACKNOWLEDGEMENTS

NOTE

1. Piaget recognises these two cultural systems in a talk originally given in 1947 and just recently published in French (Piaget, 1998). He distinguishes societies that emphasise autonomy (which he terms "modern") versus those that emphasise "heteronomy", i.e., social conformity and the authority of elders (which he terms "primitive"). The difference between his theoretical framework and the present one is that he interprets the latter system through the lens of the former. This approach leads to the construction of a developmental hierarchy in which heteronomy is a lower, less valued developmental stage of both cultures and individuals than is autonomy. In contrast, I have tried to see each system from its own perspective, emphasising the developmental goals of each, rather than using the goals of one to negatively evaluate the other.

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CHAPTER ELEVEN

Bärbel Inhelder and the fall of Valhalla

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Alles! Alles!	All things, all things,
Alles weiss ich:	All things I know:
alles ward mir nun frei!	All things are clear now!
…	…
Mein Erbe nun	My legacy
nehm' ich zu eigen.	I now reclaim.
Verfluchter Reif!	Accursed Ring!
furchtbarer Ring!	Dreadful Ring!
dein Gold fass' ich	I seize the gold,
und geb' es nun fort.	And give it away.

—Richard Wagner (1865)
Brünhilde's *Immolation*

In the late 1980s, Jack Meacham, then editor of *Human Development*, asked me to review the Genevan school's work on strategies and procedures (Brown, 1988a). Four years later, Bärbel Inhelder asked me to prepare an English translation of *Le cheminement des découvertes de l'enfant* (Inhelder & Cellérier, 1992), the final summary of that work. In 1997, Jacques Vonèche, director of *Archives Jean Piaget*, invited me to review this subject once again for a *Cours avancé* paying homage to Inhelder's life and work. I was honoured by that request. However, rather than report Inhelder's clarifications and unravel Cellérier's fascinating new theoretical tangles in light of the final book, I thought that it might be more appropriate, given the occasion, and more realistic, given the space available, to try to place the work on strategies and procedures within the context of Inhelder's collaboration with Piaget and, to an extent consistent with her privacy, to try also to place it within the context of her personality. She was, after all, a mentor and friend for 20 years.