

Chapter 4

Consequential Transitions: A Sociocultural Expedition Beyond Transfer in Education

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I would normally avoid using a standard English dictionary definition to begin an intelligent conversation about almost anything, let alone introduce an entire chapter with one. However, our everyday use of the term *transfer* has a powerful metaphorical bearing on how we, as educators and social scientists who also happen to lead everyday lives, think about learning transfer. The *American Heritage Dictionary* (1976) defines transfer as follows.

transfer (träns-für', träns'fer) v. -ferred, -ferring, -fers. —*tr.* 1. To convey or shift from one person or place to another. 2. To make over the possession or legal title of to another. 3. To convey (a drawing, pattern, mural, or design) from one surface to another. —*intr.* 1. To move oneself, as from one location, job, or school to another. 2. To change from one airplane, bus, or other carrier to another.

Transfer involves the movement of a person, a transaction, or an object from one place and time to another in our daily lives. As a construct in educational psychology, it refers to the appearance of a person carrying the product of learning from one task, problem, situation, or institution to another. It is here that the metaphor begins to break down. Transfer is distinguished from run-of-the-mill learning by virtue of its distinct tasks and situations, yet it does not include the genesis of tasks and situations as a part of the process. Transfer is necessarily a part of our moment-to-moment lives, yet seems difficult to study and even more difficult to foster intentionally. This irony is not lost on Shweder (1980), who notes that the "everyday mind accomplishes a very difficult task. It looks out at [the] behavioral world of complex, context-dependent interaction effects and insubstantial correlations among events, yet it perceives continuities, neat clusters, and simple regularities" (p. 77).

However, the important educational issues and phenomena that underlie transfer do not dissipate with the metaphor or with irony. This chapter is an expedition

I am grateful to Asghar (Ali) Iran-Nejad and David Pearson for their patience and helpful comments; to my consulting editors, James Greeno and Yrjö Engeström, for their excellent suggestions; and to present and past members of the Transitions Research Group at Michigan State University for sharing in the labor and excitement of this expedition.

of sorts: to move beyond the transfer metaphor in understanding how we experience continuity and transformation in becoming someone or something new—a student, a machinist, a bartender, a shopkeeper, or a teacher—and how these consequential transitions may be a macrocosm of how we learn new tasks and problems.

SETTING OUT: TWO CLASSIC PHILOSOPHICAL STANCES ON TRANSFER

The concept of learning transfer has a psychological history that extends from American and European social movements for universal public education up through the triad of chapters in this volume of *Review of Research in Education* (Bransford & Schwartz, Beach, Dyson). The issues underlying transfer have a far longer and deeper philosophical history, extending back to Plato's philosophical dialogue *Meno* (1961) and to Dignaga's 5th-century system of Buddhist logic, or *Pramana*.

The problem of how individuals come to have knowledge, yet experience continuity across time and contexts led Plato to the conclusion that ideas are necessarily innate, to be uncovered through experiences with a world that cannot be directly apprehended. Individuals carry continuity with them, as opposed to continuity being located in the world. Thus, the individual and world are separated in Plato's account. Early Buddhist scholars such as Dignaga and Nagarjuna struggled with a similar problem but with a different outcome (Thurman, 1984). They formulated a concept of dependent origination to explain our experiences of continuity. Rather than locating knowledge within the individual, as did Plato, or in its opposite, the world, dependent origination allowed continuity in knowledge and identity to result from an interdependence of different systems of phenomena, such as persons and social contexts. Thus, our experiences of continuity across time and context are a function of neither the individual nor the context but of their dialectical relation (Dudjom Rinpoche, 1991). Twentieth-century intellectual work in the biological sciences (Maturana & Varela, 1980), social sciences (Herbst, 1995; Rommetveit, 1990), and philosophy (Ilyenkov, 1977; Tolman, 1991) gives Western currency to a variety of dialectical means for understanding people's experiences of continuity.

Although both stances have classic philosophical legitimacy as well as currency, most research on learning transfer and efforts at educational facilitation refract some form of Plato's solution to the continuity of knowledge, whether by opposing it in behaviorist associations built up from the environment; embracing it with an emphasis on individual psychological processes such as representational generalization, analogy, and the derivation of schemas (Dansereau, 1995; Hayes & Simon, 1977; Pressley, 1995; Singley & Anderson, 1989); or acknowledging both through a form of interaction between ontologically separate persons and environments (Salomon & Perkins, 1989, 1998). Historically, studies of transfer have located agency and explanation for the process along a Cartesian plane that cleaves individuals and social contexts. Individual agency is assumed to have

little to do with the creation of social contexts supporting transfer, just as changes in contexts are presumed to have little to do with how individuals learn and develop across them.

This is a particular theoretical and philosophical stance toward the phenomenon of transfer. Other stances are possible. Refractions of the Platonic stance are particularly powerful, however, because they are affirmed by the structure of many aspects of our education system (Beach, 1994). For example, basic skills instruction and critical thinking skills curricula are designed to help individuals acquire, carry, and apply general skills in new situations. Vocational education programs are structured to resemble aspects of their target work settings, as isomorphs, so as to facilitate transfer. Packer (in press) takes this point a step further and argues that existing conceptions of transfer and our schools both draw on a political and ideological position that is dominant in American society, one that reflects a functionalist epistemology in which progress is marked by adaptation to and acceptance of existing social conditions (e.g., William James's philosophical doctrine that considers mental phenomena as a system of functions geared to adapting the organism to the environment).

One alternative stance toward transfer phenomena understands continuity and transformation in learning as an ongoing relation between changing individuals and changing social contexts. Individual and contextual agency for transfer are not ontologically independent of one another. At the same time, the role of individuals is not reduced to that of social context, nor is the role of the social context reduced to a group of individuals. To paraphrase Cole (1996), our distinctiveness as humans lies in our ability to modify our world through the construction of cultural artifacts in texts, technologies, symbols, and signs, along with our corresponding ability to reconstruct the modifications in subsequent generations through our schools, families, communities, and work. We thus transform our own learning and development. This stance is consistent with a number of learning and developmental perspectives: cultural-historical activity theory (Cole, 1996; Davydov, 1990; Engeström, Engeström, & Kärkkäinen, 1995; John-Steiner, Mehan, & Mahn, 1998; Leont'ev, 1978; Moll, 1992; Vygotsky, 1987; Wertsch, 1998), situated learning (Brown, Collins, & Duguid, 1989; Greeno, Smith, & Moore, 1993; Kirshner & Whitson, 1997), sociogenetic development (Kindermann & Valsiner, 1995; Valsiner, 1994), and discursive psychology (Gee, 1992; Harré & Gillett, 1994; Shotter, 1993). These perspectives, along with the related works of Jean Lave (1988), Barbara Rogoff (1990), Geoff Saxe (1991), and Rick Shweder (1991), share the notion that learning, development, and education are inherently cultural as well as personal enterprises, and, by extension, so is the phenomenon of transfer. It is on this basis that these perspectives will collectively be referred to as "sociocultural," although we should keep in mind that there are also many productive differences among them. The term *sociocultural* has been used by some as an alternative to cultural-historical activity theory, to deemphasize the historical analysis of social and psychological development. This is not my intention. Rather, sociocultural is used here to refer to a cluster

of theories that share a premise that learners and social organizations exist in recursive relation to one another.

Ultimately, the purpose of this chapter is to offer a reconceptualization of transfer as consequential transition among social activities, and to illustrate the concept's viability with studies from our ongoing program of research (Beach, 1993, 1995a, 1995b, 1997, in press-a-d; Beach & Vyas, 1998; Gover, in press; Hungwe, 1999; Hungwe & Beach, 1995; Reineke, in press; Saito & Beach, in press). It is a reconceptualization that is consistent with the second philosophical stance, a Buddhist ontology of experience, the experience of continuity and transformation across social contexts that emerges from changing relations between persons and contexts.

Given the two rather different philosophical stances toward the nature of transfer, their differential representation in studies of transfer, and the continued centrality of transfer issues to education, we need to think carefully about where we have come from and what we have learned using the transfer metaphor before setting out anew. The following three sections of this chapter are therefore devoted to examining the historical relation between the concept of transfer and education, deconstructing an obstacle to progress in thinking about transfer, and analyzing the shortcomings of the transfer metaphor. These sections serve as the basis for how transfer is reconceptualized along sociocultural lines in the remainder of the chapter.

The brief historical analysis that follows is motivated by the need to see our way beyond where we are now. More extensive historical accounts of learning transfer have been written by others and need not be repeated here (Hilgard, 1996; Lagemann, 1988; Shulman & Quinlan, 1996).

MAPPING THE TERRITORY: A MOTIVATED HISTORY OF TRANSFER IN AMERICAN EDUCATION

Efforts at expanding and reforming American public education early in this century made learning transfer the central issue taken up by a fledgling educational psychology. Major figures in American education and psychology during the period 1890 to 1940—Edward L. Thorndike, John Dewey, Charles Hubbard Judd, William James—saw the facilitation of learning transfer as central to the future success of American education, although they strongly differed in their opinions about what transfer was and how it could be supported through schooling. By this time, American schools were no longer tailored purely to the elite or to the trades, where transfer was seen as less of an issue. Public schools were to serve all youth, and therefore education was to prepare them for citizenship along with all forms of livelihood. Thus, public education needed to be concerned with the portability of learning, knowledge, and skills in ways that it had never been before—portability to an indeterminate set of future activities located in families, communities, and workplaces. Age-based classrooms and school subject divisions that emerged with public education also generated concerns about learning transfer between subjects and grades in the schools.

E. L. Thorndike's view of transfer (Thorndike & Woodworth, 1901) was an empirical response to the law of mental discipline's "mind as muscle" metaphor. Thorndike championed transfer as a function of identical elements between tasks, locating agency for transfer in the structuring of the tasks rather than in a generic exercising of the mind through study. C. H. Judd (1915) took a contrasting approach to transfer, plying both sides of the Cartesian plane between person and environment and arguing for a concept of transfer mediated by gestalt-like mental generalizations derived from the structuring of the environment. Judd's work differs not only from Thorndike's behaviorism but also from some cognitive approaches to transfer that emphasize the mental aspects of representational processes (Greeno, Smith, & Moore, 1993). John Dewey (1916) criticized the appropriateness of both views of learning transfer for shaping a progressive public education, arguing for a form of "transfer" that emphasized the importance of meaning making, flexibility, and the role of institutions beyond the school in its facilitation. Dewey believed that

even the schools were insufficiently broad contexts for educational reform and research. Schools were not separate institutions; they were in and of the surrounding social order. One had to discover ways to increase educational efficiency via the creation of social systems in which teaching and learning could be pursued across a variety of institutions, in and out of school. (Shulman & Quinlan, 1996, p. 403)

The scientific functionalism of Thorndike's educational psychology dovetailed with the functionalist epistemology of a public education tasked with preparing all students to be productive members of a society viewed as static, neutral, and hermitic. Thorndike won, and Dewey and Judd lost in terms of their influence within educational psychology (see Packer, *in press*, for a more detailed account). For a period of time Dewey also lost authority within the larger educational community, despite the early progressive educational critiques against the creation of a science of education, of which Thorndike and Judd were strong proponents (Cremin, 1961).

GETTING SIDETRACKED: OBSTACLES TO MAKING BETTER SENSE OF TRANSFER

A major obstacle to moving forward in our thinking about transfer has been a series of arguments that vacillate between binary oppositions: cognitive versus social processes, mental versus environmental agency, intentional versus spontaneous elicitation, generalization versus situational specificity, epiphenomenon versus explanation (Cox, 1997). Some accounts attempt to mediate by suggesting that transfer encompasses both poles of one or more of these oppositions, but ultimately contribute to the obstacle by not providing a conceptual means for uniting them or moving beyond them. The intertwining of transfer with the history of American public education partially explains how this obstacle has been maintained.

Constructs that offload agency and explanation for the phenomenon into the head or onto the environment afford an ongoing but unresolvable debate about

the relative contributions of both. Suggestions that agency for transfer exists in both simply sidestep the issue without accompanying new theory, new units of analysis, and new means of facilitation to bridge or dissolve personal and social agency in transfer. The ongoing but repetitive nature of the debate is maintained, in part, by its refraction through educational ideologies and programs designed to facilitate, for example, the formation of general cognitive representations and processes for critical thinking, or the creation of authentic understandings by using real-world tasks in the classroom.

Until recently, the strong association of mental cognitive constructs with the phenomenon of transfer (as opposed to the more content-driven cognitivism of J. Bruner, J. Piaget, H. Werner, E. J. Gibson, and others) has contributed to the obstacle. The strength of this relation has been such that criticisms of the viability of these constructs have been responded to by some as an attack on the phenomenon itself. This has resulted in inaccurate claims that those who find the cognitive construct inadequate must therefore believe that transfer does not occur (Anderson, Reder, & Simon, 1996, 1997). Greeno (1997) points to this as a category error that collapses theoretical constructs and the phenomena we seek to understand. Sociocultural critiques also contributed to this obstacle by providing pointed criticism of cognitive research on transfer (Laboratory for Comparative Human Cognition, 1986; Lave, 1988; Rogoff & Gardner, 1984) while generating research mainly on the intricacies of learning and development *within* single social practices, and thus largely avoided issues of transfer (Beach, 1997). This combined action de facto ceded the phenomenon of transfer to a single theoretical perspective.

Long-standing debates that split the agency for transfer between persons and environments, the reification of this divide in various education programs, a category error that confounds a particular theoretical stance toward transfer with the broader phenomenon, and a focus on within-practice analyses by sociocultural researchers combined to divert us from exploring better ways to understand and support learner continuity and transformation across institutions, local practices, problems, and tasks. This chapter is one attempt to move back on track, and toward a conception of transfer that is consistent with the dialectical concept of dependent origination, and with the sociocultural premise that learners and social organizations exist in a mutually constitutive relation to one another.

MARKING THE CREVASSES: AN ANALYSIS OF THE TRANSFER METAPHOR

Back on track, our expedition beyond the metaphor of transfer benefits from grounding in the lessons of extant theory and educational research that use the transfer metaphor. The larger purpose is not to critique particular lines of transfer research, something that has been done ably and repeatedly elsewhere (Beach, in press-a; Cobb & Bowers, in press; Cox, 1997; Greeno, 1997; Gruber, Law, Mandl, & Renkl, 1996; Guberman & Greenfield, 1991; Kirshner & Whitson, 1997; Laboratory for Comparative Human Cognition, 1986; Lave, 1988; Lobato,

1996; Pea, 1987; Rogoff & Gardner, 1984), but to set a new course for the entire endeavor. Our preparation to cover new ground includes marking the location of difficulties in studies using the transfer metaphor. The process allows us to learn from the difficulties and thus, it is hoped, avoid most of them. This is particularly important because part of our expedition involves an expanded notion of the phenomenon we have sought to understand as transfer.

Most efforts at defining, studying, and supporting transfer in education over the past three decades have involved a form of cognitivism that emphasizes mental representations, schemas, strategies, and models. However, many of the shortcomings of the metaphor are not, strictly speaking, unique to cognitivism. Hence, they will not automatically disappear upon offering an alternative conceptualization. They run deeper in our cultural consciousness than academic psychology and are embedded within our folk notions of teaching, classroom learning, and the role of schooling in society (Bruner, 1996). Thus, we need to identify and understand these problems in order to progress. It is in this vein that six key areas of difficulty associated with the constructs and metaphor of transfer are identified subsequently.

Transfer defines a narrow and isolated aspect of learning. Transfer is variously defined as

the effect that knowledge that was learned in a previous situation (task A) [has] on learning or performance in a new situation (task B). (Mayer & Whitrock, 1996, p. 48)

the degree to which a behavior will be repeated in a new situation. (Detterman, 1993, p. 2)

prior learning affecting new learning or performance [in which the new learning or performance] can differ from original learning in terms of the tasks involved (as when students apply what they have learned on practice problems to solving a new problem), and/or the context involved (as when students apply their classroom learning to performing tasks at home or work). (Marini & Genereux, 1995, p. 2)

The common thread among these definitions is that the products of learning from one task or situation influence learning on a later task or situation. An analysis of a person learning something on a second task (B) after having learned something during a prior task (A) contains five possible relations between the old and new learning. These possibilities are not mutually exclusive.

Possibility 1: Some learning occurs prior to A and B but is excluded from learning on both because it is not seen as relevant.

Possibility 2: Some learning occurs prior to A and B and is used in learning A and B because it is seen as relevant to both.

Possibility 3: Some learning occurs prior to A and B but is used only in learning B because it is seen as relevant to B and not A.

Possibility 4: Some learning occurs on A but is not used in learning B because it is seen as irrelevant to B.

Possibility 5: Some learning that occurs only on A is used during learning on B because it is seen as relevant to B.

Of these five potentially coexisting relations between old and new learning, only the fifth counts as transfer. Transfer is a very narrow band of all that potentially goes on in learning task B. Furthermore, it exists in conceptual isolation from the other possibilities. An expanded definition of what counts as transfer in educational research is needed.

Transfer has an agency problem. Most current accounts of learning transfer attribute cause or agency for the process to the abstraction and representation of knowledge by individual minds, and also to the similarities between routinely encountered socially organized units such as tasks, practices, and institutions. This dual attribution of agency also appears in what Salomon and Perkins (1989) distinguish as the "low and high roads of transfer." While current accounts of transfer acknowledge that both forms of agency provide impetus for the process, they are generally assumed to operate together as an interaction. The individual's psychological processes of abstraction and representation interact with the shared features of tasks to produce learning transfer. Interaction describes a relation between the two forms of agency, perhaps even a causal one. However, interaction cannot explain how the two forms of agency affect each other to produce transfer.

An analogy may be useful here. A beginning cyclist comes to understand that speed and balance interact to allow her to ride smoothly. After many bumps and bruises, she also learns that the greater her speed, the easier it is to balance and therefore arrive at her intended destination. Understanding this as an interaction does not mean that she understands how her increased speed helps her balance to reach her goal. It only tells her that it does. Similarly, demonstrating that individual psychological processes interact with task features to produce varying degrees of transfer does not provide an account of how these two forms of agency produce transfer. Providing a more viable account of agency or causation in transfer should highlight new possibilities for its study, and for how we might support it through instruction.

Transfer is no different than "just plain learning." The transfer metaphor requires that transfer differ from our usual day-to-day learning in some way. Analytic and pedagogical advantages to focusing our efforts on transfer exist only if transfer is understood as different from "just plain learning" in an important way. Some current accounts distinguish between learning and transfer by suggesting that learning is relatively effortless and occurs across very similar problems, whereas transfer is conscious and effortful and occurs across quite different problems (Salomon & Perkins, 1989). A second distinction, related to the first, is that transfer involves the application or use of prior learning products—knowledge and skill—in learning a new problem, but does not include learning as part of the transfer process. Neither presents a particularly compelling case for distinguishing transfer from just plain learning. This moved Detterman (1993) to deem transfer an epiphenomenon that explains nothing about learning and can better be explained by more elementary cognitive processes. An analytically useful and practically important distinction needs to be made between transfer and just plain learning if the concept is to help us understand learning continuity and transformation across multiple tasks and situations.

Transfer environments are assumed to be static. The transfer metaphor suggests that persons carry knowledge and skill from one task or situation to another. Changes in the tasks or situations do not fit well with the metaphor. Most current notions of transfer presuppose that the tasks across which transfer occur remain unchanged during transfer. Although the transferring individual may create analogical bridges (Gentner & Gentner, 1983) or abstract schemas (Gick & Holyoak, 1983; Reed, 1993) that address both tasks, changing the structure of the tasks would be out of bounds. The processes of researchers and teachers making tasks not too similar, yet not too different, are also excluded from consideration as part of transfer. Rather, the task relations produced by their efforts are said to affect transfer. A similar logic applied at the level of institutions would exclude changes in the family, the school, or the workplace from consideration as part of transfer processes between them.

One effect of this logic is an overemphasis on the role of the individual learner as reproducer of existing relations between fixed tasks. A corollary effect is the exclusion from transfer of those who construct tasks or collectively and historically change relations between institutions. Often, changes in tasks and situations do not occur within the same time frame or at the same rate as changes for the individual learner. Studies that use the learner as the sole temporal point of reference for studying and facilitating transfer are methodologically unable to include the genesis and dynamics of tasks and situations. A model that includes the creation and interlinking of tasks and situations as well as the continuity and transformation of individuals is needed.

Transfer assumes a "launch" model of person-environment relations. The transfer metaphor assumes what Kindermann and Skinner (1992) have called a launch model of person-environment relations.

The causal process represented by this model is analogous to a catapult, in which the initial forces of the contextual antecedent are the major determinants of the shape of the curve of the outcome. Phenomena for which launch models may be useful representations are those that are open to influence from the environment at one point and subsequently become "sealed off." (pp. 166-167)

The launch model has it that the initial task or situation through which a person learns largely determines what the person will do in a new task or situation that, unlike the first, does not alter the course of the individual's learning. It implies that earlier learning determines the trajectory of later learning because later environmental influence on learning is minimal. This is consistent with transfer as the application of prior products of learning, and with instructional efforts aimed at the creation of general schemes and strategies for transfer (e.g., Dansereau, 1995; Singley, 1995). It is also consistent with the rhetoric of the American school-to-work transition movement. Schools are where learning occurs, and failure in the workplace is largely a function of inadequate learning in school (Secretary's Commission on Achieving Necessary Skills, 1991). This affords an abdication of responsibility for supporting learning in the workplace.

The transfer metaphor suggests that when prior task-based learning is well applied to a new task, the learning that takes place when encountering the new

task is minimal. However, there is no a priori reason to assume that later tasks and situations are "sealed off" from their influence on learning, whereas tasks and situations encountered earlier are highly influential. We need to adopt a model of person-environment relations that acknowledges the possibility, if not the certainty, that earlier learning contexts do not inoculate the person against learning in a new context. This may be possible only if we move away from the metaphor and associated constructs of transfer.

Transfer is difficult to intentionally facilitate. Learning transfer seems to occur on a daily basis throughout our lives, yet attempts at intentional facilitation are highly effortful and are often unsuccessful (Beach, 1993; Greeno, 1997; Lave, 1988; Mayer & Whitrock, 1996; Salomon & Perkins, 1989). The difference in the frequency of occurrence between intentionally facilitated transfer and transfer occurring without facilitation is sufficient to warrant concern. Scanty evidence that perfecting instructional instantiations of the transfer metaphor will resolve the discrepancy to any significant degree gives cause to reconsider the viability of the metaphor and associated psychological constructs.

Studies of learners moving across institutions suggest that the metaphor and accompanying constructs are at least partly responsible for the apparent difficulty in intentionally facilitating transfer. The difficulties may lie in the narrow definition of transfer as a phenomenon and in how we conceive of intentional facilitation. Generalization, or continuity and transformation, that has not been facilitated through instruction or the careful design of tasks is rarely studied. When it has been, the transfer metaphor was not invoked, presumably because it was orthogonal to understanding the processes involved in generalization between school and work (Beach, 1993; Saxe, 1991), home and school (Lareau, 1989), and school and community (Eckert, 1989; Heath, 1990).

LIGHTENING OUR LOAD: LEAVING THE TRANSFER METAPHOR BEHIND

These difficulties are serious enough that we believe the transfer metaphor and associated psychological constructs should be left behind in favor of a metaphor and set of concepts that broaden our vision of generalization across changing forms of social organization. In leaving the transfer metaphor behind, though, we need to attend to two simplifying assumptions that originate with it. These assumptions distinguish task-to-task transfer from transfer between larger forms of social organization, and intentional from unintentional transfer. Although simplification is always necessary for analysis, these simplifying distinctions need to be reconsidered as different levels of analysis, and as general and special cases, rather than as independent forms of transfer.

The law of mental discipline was concerned with a broad form of transfer. Exercising the mind in one discipline or domain was believed to generalize to many others. With the critiques of formal discipline by Thorndike and Judd, empirical concerns about transfer shifted to the level of specific tasks and problems. Thorndike suggested that learning transfer could be effectively facilitated

only at the local level of the task. Although Judd claimed that transfer could occur more broadly (e.g., it may occur across the disciplines), his approach to facilitation was also located within the task or problem. Here we see an important distinction between the process of transfer and the process of facilitation. Transfer among tasks and problems was assumed to be a microcosm of the larger educational concern: the portability of knowledge and skills across grades, subject matter, and ultimately beyond the school to families, communities, and workplaces. Yet, facilitation was seen to be a very local instructional process.

Most research on transfer continues in this vein today, examining transfer between tasks (Holyoak & Koh, 1987), problems (Mayer, 1992), and well-defined local domains (Bransford, Goldman, & Vye, 1991). Others have acknowledged the larger issue at stake by studying transfer between larger socially organized situations (Beach, 1995; Hungwe, 1999; Nunes, Carraher, & Schilemann, 1993; Reineke, *in press*; Saxe, 1991) but have not directly taken up issues of facilitation (an exception to this is Martin, Shirley, & McGinnis, 1988). Given that it is generalization across the broader domains of human experience with which education is ultimately concerned, analyses of local attempts at facilitation across tasks and problems need to be understood within an interpretive framework that encompasses relations between larger social practices and institutions (Cole, 1996; Lemke, 1997). It may also be that relations between larger forms of social organization are a fruitful starting point for understanding local attempts at facilitating generalization across tasks and problems.

A simple count of studies of transfer could convince us that transfer necessarily involves some intention to do so by the person doing the transferring and/or others who may assist in the process (Pressley, 1995; Reed, 1993). Most research efforts have focused on intentional transfer. Yet, common sense dictates that transfer most frequently occurs without anyone thinking about how to apply prior learning or reason by analogy on a new problem or situation. In other words, it generally occurs without any intention to do so on the part of the person transferring or those assisting. In fact, Detterman (1993) argues that true transfer is, by definition, spontaneous rather than provoked by a teacher, peer, parent, or coworker. Thus, it makes sense to consider intentional attempts to generalize knowledge, skills, and identities as special cases of a larger set of phenomena that generally do not involve conscious reflection on how to apply prior learning in new situations. It may also be that unintentional generalization is a useful starting point for understanding ways to intentionally facilitate generalization.

MOVING FORWARD: A SOCIOCULTURAL VIEW OF GENERALIZATION AS CONSEQUENTIAL TRANSITION

Any sociocultural reconceptualization of transfer should be true to the premise that underlies all sociocultural approaches to learning and development: that learners and social organizations exist in a recursive and mutually constitutive relation to one another across time. In being true to this premise and to the

underlying philosophical stance that our experiences of continuity and transformation across time and social situations are a function of neither the individual nor the situation, but rather of their relation, it becomes possible to move beyond the transfer metaphor and its associated constructs.

Expanding the Phenomenon of Concern

The process of placing boundaries on educational phenomena is never fully independent of the processes by which we create constructs to study the phenomena. Yet, as we can see from the history of transfer research, the danger of losing analytic power by confounding our conceptual tools with the phenomenon we are trying to understand is quite real. I therefore sketch the outlines of the set of phenomena we are seeking to understand as generalization. The sketch encompasses but goes beyond what has historically been studied as transfer. Then I propose a construct—consequential transition—that can be used to more explicitly characterize and study the generalization.

Generalization, defined as the continuity and transformation of knowledge, skill, and identity across various forms of social organization, involves multiple interrelated processes rather than a single general procedure. A similar point is made by Cox (1997) in his developmental-historical analysis of transfer, suggesting that even early Gestalt notions questioned the existence of a general procedure for transfer. Generalization as we are interested in it consists of a set of interrelated social and psychological processes and therefore requires multiple levels of explanation and educational facilitation.

The decontextualization of mediational means (Wertsch, 1985), or the formation of symbols and concepts at ever increasing distances from particular contexts and referents (Hatano & Inagaki, 1992), does not provide a sufficient basis for understanding the transformative aspects of knowledge, skill, and identity generalization. Recent “thick descriptions” of children learning science and math (Carraher & Schilemann, in press; Nemirovsky, in press) propose forms of generalization that do not involve a distancing from the particulars of the social world. Davydov (1990) argues from the position of dialectical materialism that curriculums and teaching should support generalization that moves toward an integration of the diverse aspects of a concept and reveals the interconnected nature of its different aspects. Movements toward abstract concepts that reveal common properties in a class of things or phenomena are seen as impoverished descriptions of reality (Falmagne, 1995). Van Oers’s (1998) analysis of children’s play activity in a classroom shoe store provides a wonderful description of how generalization can be obtained without decontextualization, by the embedding of contexts in other contexts.

This process is called an activity of *continuous progressive recontextualizing*. The development toward more abstract forms of activities is one of the results of continuous progressive recontextualizing. On the basis of our observations, we have reason to assume that it is certainly not typically characterized by decontextualization or disembeddedness. Rather, the important thing was the possibility for the

actors to create a new sign-based context related to their previous activities that made their new activity meaningful. (p. 141)

The forms of generalization that concern us are never distanced or decontextualized in their relation to various forms of social organization. They are not located within the developing individual, nor can they simply be reduced to changes in social activities. Rather, these forms of generalization are located in the changing relation between persons and activities (Beach, 1995b; Beach, in press-d; Lemke, 1997).

Generalization at the intersection of persons and activities cannot happen without systems of artifacts, symbolic objects that are created with human intent (cf. Cole, 1996). Whitson's (1997) Peircean analysis of a case of inappropriate transfer, Walkerdine's description of students' mathematical mastery (1998), Lemke's (1997) interconnected ecosocial systems, Evans's (in press) reanalysis of Noss and Hoyles's (1996) study of "banking maths," and my studies of adults becoming bartenders (1993) and Nepali students becoming shopkeepers (Beach, 1995a, 1995b) all emphasize the centrality of symbols, technologies, and texts, or systems of artifacts, in creating continuities and transformations through social situations. The processes of generalization and systems of artifacts weave together changing individuals and social organizations in such a way that the person experiences becoming someone or something new, similar to Dewey's (1916) notion of development as "becoming." Thus, the experiences of continuity and transformation are important to, reflected on, and struggled with by individuals participating in multiple social activities: playing, studying, working, parenting, loving, and so on. Insofar as many of these experiences are life transforming, they have a developmental nature to them along with some notion of *telos* or progress. The developmental constitution of the phenomenon has also been noted by Saxe (1989, 1991).

Experiences such as learning algebra after years of studying arithmetic, becoming a machinist, founding a community organization, teaching one's firstborn to walk, an elementary school class writing a letter to a local newspaper, collaborating with NASA scientists on a classroom project via the Internet, making the transition from student to teacher, and negotiating one's identity as an African American between home and the school are all potential examples of the sort of generalization we are concerned with. Each of these experiences can involve transformation, the construction of new knowledge, identities, ways of knowing, and new positionings of oneself in the world. They are consequential for the individual and are developmental in nature, located in the changing relations between individuals and social activities. The relations involve the genesis and maintenance of systems of artifacts and all that is embodied through them, including knowledge, skill, and identity. The forms of generalization that concern us go far beyond learning transfer, but cover an educational terrain that has been reduced metaphorically to the carrying and application of knowledge across tasks.

Transfer as Consequential Transition

At its core, the concept of consequential transition involves a developmental change in the relation between an individual and one or more social activities. A change in relation can occur though a change in the individual, the activity, or both. Transitions are consequential when they are consciously reflected on, often struggled with, and the eventual outcome changes one's sense of self and social positioning. A college student becoming a teacher, a worker trying to adapt to a management-reorganized job, a middle school student doing well in math for the first time in his life, and high school students taking part-time work in fast food restaurants are all potential examples of transitions that are consequential both for the individual and for the particular social organization. Etienne Wenger's outstanding volume on communities of practice and the negotiation of their boundaries speaks to a similar set of phenomena and concerns (Wenger, 1998) but emphasizes the practices themselves as a unit of reflection and analysis.

We have identified four primary types of consequential transition: lateral, collateral, encompassing, and mediational. Lateral and collateral transitions involve persons moving between preexisting social activities. Encompassing and mediational transitions have persons moving within the boundaries of a single activity or into the creation of a new activity. This typology of transitions is necessarily preliminary, but it expresses different principal forms of relational change between individuals and social activities. Each potentially involves the continuity and/or transformation of knowledge, skill, and identity embodied in the relation. Each has potentially different implications for the learner, the social organization of learning, and what means are available to facilitate the consequential transition.

Lateral Transition

Lateral transitions occur when an individual moves between two historically related activities in a single direction. Examples would include moving from school to work (e.g., a student becoming an airline pilot) and moving from one subdiscipline to another (e.g., a student taking a first course in algebra after many years of arithmetic). Participation in one activity precedes and is replaced by participation in another activity during lateral transition. Lateral transition most closely resembles classic transfer in its unidirectionality. Lateral transitions generally involve some notion of progress embedded in the particular sequence of activities and thus in the individual's movement between the activities. Often, the activity one is in lateral transition to is considered a developmental advance beyond the previous activity, which is seen as preparation for the new activity. For example, high school students saw themselves as becoming shopkeepers during their apprenticeships to shopkeepers, not as students who happened to be learning about shopkeeping (Beach, 1995b). The unidirectional notion of progress associated with lateral transitions was closely tied to explanations of how and

why the students transformed their mathematical reasoning in the process of becoming shopkeepers.

Italian novelist Italo Calvino provides a lush description of a lateral transition from Tamara, a city of signs, to the surrounding countryside, previously a world of natural objects, through the eyes of Marco Polo reporting on his expeditions to Kublai Khan.

Finally the journey leads to the city of Tamara. You penetrate it along streets thick with signboards jutting from the walls. The eye does not see things but images of things that mean other things: pincers point out the tooth-drawer's house; a tankard, the tavern; halberds, the barracks; scales, the grocer's. Statues and shields depict lions, dolphins, towers, stars: a sign that something—who knows what?—has as its sign a lion or a dolphin or a tower or a star. Other signals warn of what is forbidden in a given place (to enter the alley with wagons, to urinate behind the kiosk, to fish with your pole from the bridge) and what is allowed (watering zebras, playing bowels, burning relatives' corpses). If a building has no signboard or figure, its very form and the position it occupies in the city's order suffice to indicate its function: the palace, the prison, the mint, the Pythagorean school, the brothel. The wares, too, which the vendors display on their stalls are valuable not in themselves but as signs of other things: the embroidered headband stands for elegance; the gilded palanquin, power; the volumes of Averroes, learning; the ankle bracelet, voluptuousness. Your gaze scans the streets as if they were written pages: the city says everything you must think, makes you repeat her discourse, and while you believe you are visiting Tamara you are only recording the names with which she defines herself and all her parts.

However the city may really be, beneath this thick coating of signs, whatever it may contain or conceal, you leave Tamara without having discovered it. Outside, the land stretches, empty, to the horizon; the sky opens, with speeding clouds. In the shape that chance and wind give the clouds, you are already intent on recognizing figures: a sailing ship, a hand, an elephant. (1972, p. 15)

Lave and Wenger's (1991) account of an Alcoholics Anonymous group contains the distinction between lateral transitions, which are linear and are generally seen as irreversible, and collateral transitions, which are nonlinear and highly negotiated. Becoming an alcoholic involves a massive and irreversible transformation in knowledge, skill, and identity in the eyes of AA members. However, becoming a nondrinking alcoholic generally involves much back-and-forth collateral participation in the community of drinkers as well as nondrinkers, even though becoming a nondrinking alcoholic is what constitutes progress. It is to this far more complex form of transition that I now turn.

Collateral Transition

Collateral transitions involve individuals' relatively simultaneous participation in two or more historically related activities. The notion of collaterality was first developed in the dissertation work of Reineke (1995), in which he examined children's homework as it moved between school and home (see Reineke, in press, for an expansion of this work). Examples of collateral transitions are daily movement between home and school, participating in part-time work after school, and moving between language arts and science classes during the school week. Collateral transitions occur more frequently in life than do lateral forms, but they are more difficult to understand because of their multidirectionality. Back and forth movement between activities may or may not have an explicit notion of

developmental progress tied to the movement itself. As we can see from the following example, development during collateral transitions can run in opposition to societal notions of progress as often as it runs with them.

During our study of Nepali students becoming shopkeepers, we also followed shopkeepers attending adult education classes (Beach, 1995a, 1995b). Schools did not exist in their village when the shopkeepers were of school age, and hence the evening adult education class was their first participation in schooling. The shopkeepers collaterally participated in both school and work, but did not see themselves as becoming students. Instead, they attended literacy and numeracy classes to gain skills in arithmetic and written literacy that would be of use to them as shopkeepers. They were not becoming better students so much as better shopkeepers. This runs contrary to a Nepali societal notion that participation in school constitutes a form of developmental progress in and of itself.

Collateral transition did not fit with extant American notions of developmental progress in our study of high school students learning to work part time in a fast food restaurant (Beach & Vyas, 1998). Students learned nothing beyond what they already knew about math, science, and language from school. Furthermore, the skills they acquired in making sandwiches were seen as cognitively low level and low in social status by the fast food corporation. It is not surprising that this particular collateral transition between school and work does not fit our existing conceptions of development progress. Yet, our findings do suggest that high school students develop during this collateral transition. Students struggle with and develop the ability to learn in a production activity devoid of a supportive agenda for their learning, unlike schooling.

As a final illustration of collateral transition, Bowers (1996) examined third-grade students learning arithmetic during a 9-week teaching experiment in which the students constructed new ways of symbolizing the process of combining and separating quantities (see also Cobb & Bowers, *in press*). These students also participated in daily mathematics lessons with their regular classroom teacher, who taught standard paper-and-pencil algorithms for combining and separating quantities. Bowers found that two thirds of the students became able to use the new ways of symbolizing the process to develop numerical meanings for the column algorithm in their regular math class. However, the remaining students simply switched between instrumental uses of standard computational algorithms in their regular classroom and their constructed means of symbolizing the combination and separation of quantities in their experimental class. Thus, collateral transition consisted of the transformation of knowledge for some and mathematical code switching for others. Other examples of collateral transition can be found in studies of teachers and students drawing community-based knowledge and wisdom into their classroom literacy practices (Moll, 1992), parents and teachers co-constructing math homework with their children/students (Reineke, *in press*), and the relation of social class and parental involvement at home to elementary students' participation in school (Lareau, 1989).

More than any other form of transition, collateral transition raises questions about societal notions of developmental progress. These notions generally value

knowledge and skill proportional to the degree to which they are seen as higher in a hierarchy of distance from their origins in particular social activities. Collateral transitions make an exclusive concentration on this vertical dimension of developmental progress problematical. Engeström (1996) eloquently describes this concern in a discourse on the novel *Borderliners* by Peter Hoeg.

Traditional developmental theories are about progress, about climbing upward on some developmental ladders. In some theories, the ladders are very well known and fixed; in others they are more locally constructed and culturally contingent. But developmental movement happens along a vertical dimension, from immaturity and incompetence toward maturity and competency. Peter, too, realizes this. . . .

The school is an instrument dedicated to elevation. It works like this. If you achieve in the way you're supposed to, time raises you up. That's why the classrooms are arranged as they are. From primary One to Three you're on the ground floor, then you move to the second floor, then the third, then to Secondary on the fourth, until at last—at the very top, in the assembly hall—you receive your certificate from Biehl. And then you can fly in the world. I've been wondering why it is so hard for them, why there are so many rules. And it occurred to me that it is because they have to keep the outside world out. Because it's not everywhere out there that raises it up. (Hoeg, 1994, p. 79, cited in Engeström, 1996)

Encompassing Transition

Encompassing transitions occur within the boundaries of a social activity that is itself changing. In the broadest sense, all social activities are changing, even if only through collective efforts to maintain the constancy of activity through rituals, routines, revivals, and rules. One form of encompassing transition is captured in Lave and Wenger's conception of legitimate peripheral participation. The activity is stable relative to the changing individual becoming a full participant in that activity. "By this we mean to draw attention to the point that learners inevitably participate in communities of practitioners and that the mastery of knowledge and skill requires newcomers to move toward full participation in the sociocultural practices of a community" (Lave & Wenger, 1991, p. 29). A second form of encompassing transition occurs when activities undergo rapid change relative to the lives of their participants. Examples are experienced teachers responding to new education reform initiatives and conventional machinists learning to run newly introduced computer-controlled machines.

Like lateral transitions, encompassing transitions generally involve a clear notion of progress, although it is associated with the direction taken by the changing activity rather than the direction of individuals moving between activities. Unlike either lateral or collateral transitions, encompassing transitions take place within a single activity with boundaries that change, albeit at different rates with different consequences relative to the individual. It should be noted that this sense of boundary is not absolute or hermitic. Rather, an activity boundary is one that can be crossed developmentally (Engeström, Engeström, & Kärkkäinen, 1995; Gutierrez, Rymes, & Larson, 1995), and through the use of boundary objects sufficiently flexible to be adapted across multiple activities (Star, 1989, 1996).

Individuals participating in encompassing transitions often experience the process as adapting to existing or changing circumstances in order to continue

participation within the boundaries of the activity. Encompassing transitions can result in generational reversals in expertise and instructional roles. Younger generations of participants often assist older generations in acquiring necessary knowledge and skills and are seen as more expert. This generational reversal in roles in the face of rapid societal change was first noted by Margaret Mead in her classic ethnography, *Coming of Age in Samoa*. Many of us experience it today when we request assistance from our students, daughters, or sons in learning a particular piece of computer software.

Our research on machining activity changing with the introduction of computerized machines illustrates an encompassing transition (Beach, in press-b; Hungwe, 1999; Hungwe & Beach, 1995). Machining parts traditionally involved machinists using lathes, milling, and grinding machines that were controlled via mechanical linkages, dials, levers, and gauges. The recent introduction of computer numerical control (CNC) machines into American manufacturing also introduced symbol-based computer programs that mediate the relation between the machinist and part creation. Traditional machinists learn CNC machining by transforming prior machining knowledge and skills into the representations and organizational structures of the program code, and by adapting to the asynchronous nature of their actions that control the machines through the program. Many from the upcoming generation of machinists have not had years of mechanical machining experience prior to learning on CNC machines. Thus, the nature of becoming a machinist, their status within the machining community, and their identity as craftsmen differs from the previous generation of machinists with whom they work. Becoming a machinist at different periods in the technological transformation of machining activity illustrates the heterochronous relation of changing persons and changing activities that is characteristic of encompassing transition. Heterochronicity, or differential rates of change between persons and activities, has also been studied as a key feature in the genesis of after-school computer clubs (Nicolopoulou & Cole, 1993) and in the development of a school-based court of law (Wilcox & Beach, 1996).

Mediational Transition

Mediational transitions occur within educational activities that project or simulate involvement in an activity yet to be fully experienced. Examples of this form of transition are particularly prevalent in vocational and adult education (Beach, 1993) but can also be seen in activities as diverse as a school play store (Walker-dine, 1988), instruction in writing (Palincsar & Brown, 1984), learning the concept of area (Sayeki, Ueno, & Nagasaka, 1991), and community- and work-based apprenticeships (Lave & Wenger, 1991). Mediational transitions exist along a continuum from classroom-based activities that have "as if" or simulated relations to the world beyond the school, to partial or peripheral participation in the activities themselves. No matter where they are on the continuum, however, they always maintain a "third object" or mediating status with regard to where the participants are currently and where they are going developmentally, roughly equivalent to Vygotsky's concept of a zone of proximal development (Vygotsky,

1978). Thus, mediating transitions always embody a particular notion of developmental progress for participating individuals.

An example of mediating transition is provided in an earlier study of mine that examined how adults participating in a private vocational school learn to become bartenders (Beach, 1993). The bartending class occupied a middle position between where its students were—highly literate part-time actors, restaurant managers, graduate students—and where they were going—part- or full-time work as bartenders or supervising bartenders. Drink recipes were initially memorized from written materials, but the press to achieve speed as well as accuracy in drink mixing meant that students were assisted in shifting away from written materials toward mnemonic materials more closely associated with the mixing of the drinks themselves. The vocational school activity existed as a bridge between two other systems of activity and embodied a clear developmental agenda for its students.

These four forms of transition—lateral, collateral, encompassing, and mediational—as diverse as they may seem, share a common set of features that justify engaging them as a whole. Each potentially involves the construction of knowledge, identities, and skills, or transformation, rather than the application of something that has been acquired elsewhere. Consequential transitions therefore involve a notion of progress for the learner and are best understood as a developmental process. Each is consequential and often involves changes in identity as well as knowledge and skill. Therefore, individuals and institutions are often highly conscious of the development that is taking place, and they have particular, sometimes publicly debated, agendas for how and why it should or should not happen. Finally, consequential transition consists of changing relations between persons and social activities represented in signs, symbols, texts, and technologies or, more generally, in systems of artifacts. This not only acknowledges the recursive relation between persons and activities, but makes it the explicit object of study.

Studying Consequential Transitions

Studying and facilitating consequential transitions requires new methodology. By methodology, I do not mean the particular nuts-and-bolts methods or tools of analysis, of which we already have many at our disposal. Rather, drawing on Valsiner's broader notion of methodology (Kindermann & Valsiner, 1989; Valsiner, 1989), I use the term to refer to new ways of constructing data, thinking about designs/methods, and asking appropriate questions that relate the construct of consequential transition to the generalization phenomena we are concerned with. I take up four key aspects of a methodology for studying consequential transitions and illustrate what such a methodology "buys" us with findings from several of our research group's studies.

Developmental Coupling as a Unit for Studying Consequential Transitions

The concept of coupling comes from the work of Varela, Thompson, and Rosch and their book *The Embodied Mind* (1991; see also Maturana, 1975;

Varela, 1981). In it they draw on post-Darwinian evolutionary biology and connectionist theory to describe coevolution as a changing relationship between a species and its environment, a structural coupling of the two systems over time—not as a property of the species, the environment, or an interaction between separable systems. I think of the concept of developmental coupling in a similar manner.

A developmental coupling encompasses aspects of both changing individuals and changing social activity. The coupling itself is the primary unit of study and concern rather than the individual or the activity per se. The coupling assumes that individuals move across space, time, and changing social activities rather than being hermetically situated within an unchanging context. If a context does appear unchanging, it is because much collective effort is being put into maintaining it in place. The coupling itself transforms or develops. Its directionality and causal relations are not efficient or antecedent/consequent; rather, they are correlational or relational in nature. Finally, developmental coupling necessarily involves artifacts: objects that embody human intention and agency in some form and that extend beyond a particular individual participating in a particular social organization at a particular time (see Beach, in press-d, for a more detailed discussion). The coevolution of bees and flowers as developmental systems provides a nice analogy for thinking about the developmental coupling of persons and activities.

On the one hand, flowers attract pollinators by their food content and so must be both conspicuous and yet different from flowers of other species. On the other hand, bees gather food from flowers and so need to recognize flowers from a distance. These two broad and reciprocal constraints appear to have shaped a history of coupling in which plant features and the sensorimotor capacities of bees coevolved. It is this coupling, then, that is responsible for both the ultraviolet vision of bees and the ultraviolet reflectance patterns of flowers. Such coevolution therefore provides an excellent example of how environmental regularities are not pregiven, but are rather enacted or brought forth by a history of coupling. (Varela, Thompson, & Rosch, 1991, p. 202)

Our first illustration of developmental coupling is from the previously mentioned study of arithmetic reasoning during transitions between school and work in rural Nepal (Beach, 1995a, 1995b). It involves instances of both linear and collateral transition. The second is from a study of machinists making an encompassing transition from mechanical to computerized technology within a large American automobile manufacturer (Beach, in press-b; Hungwe, 1999; Hungwe & Beach, 1995).

From School to Work, and From Work to School in Rural Nepal

The initial purpose of the study was to understand how adolescents' and adults' arithmetic reasoning changed during transitions between school and work in a Nepali village. At the time of the study, two major societal changes in relations between school and work were under way in rural Nepal. One change involved increasing numbers of high school graduates and dropouts becoming merchants in local shops. As a high school education became less valuable in obtaining work outside of agriculture, shopkeeping became an option for those who did

not want to continue with their family in subsistence agriculture. The other change consisted of increasing numbers of shopkeepers attending adult education classes. Adults had previously not attended school because schooling was outlawed in the kingdom when they had been of school age. The shopkeepers saw the classes as providing them with written forms of literacy and arithmetic that would be of benefit in their shops. These societal-level changes were simulated voluntarily at a local level by apprenticing graduating high school students to local shopkeepers, and by enrolling shopkeepers in adult education classes. Changes in arithmetic reasoning were then tracked over a period of several months as the students participated in shopkeeping and as the shopkeepers participated in schooling.

The students constructed a new form of arithmetic reasoning in their lateral transition to shopkeeping. They shifted away from using written column algorithms toward decomposition and iteration calculation strategies that included monetary and measurement structures. The students also created a previously unseen system of written notation to support these strategies. This transformation in arithmetic reasoning had its origins not in schooling or shopkeeping but, rather, in the transition process between the two activities. Power and status played a role in this transition and in the arithmetic reasoning of the students. Prior to the introduction of schooling in the village, arithmetic originating outside of school had the status of *hisaab*, or mathematics. With the introduction of schooling, *hisaab* gradually became those calculations associated with column algorithms and paper and pencil notation, relegating other forms of arithmetic to *andaji*, or estimation. The students were clearly reluctant to move away from some form of written notation, having spent a decade studying *hisaab* in school. At the same time, they clearly saw themselves as becoming someone new, a shopkeeper, and found column algorithms often unwieldy in the context of converting prices across different systems of measurement and totaling customer purchases. More than half of the students participating in the study in fact went on to become shopkeepers.

The transition for shopkeepers attending adult education classes was collateral. Shopkeepers attending the classes were doing so because they wished to expand the nature and complexity of the goods they could sell. They consequently used the adult education classes to supplement their already-existing repertoire of arithmetic strategies with written column algorithms. Shopkeepers were not on a linear trajectory to becoming students; rather, they were enhancing their economic viability as shopkeepers. A clear illustration of this in the shopkeepers' arithmetic reasoning was their rapid forgetting of the arithmetic operations signs upon completing the class. The reason for this was that operations signs are not needed for column algorithms when the practices within the activity make explicit what needs to be done with the numbers.

Lateral and collateral transitions and the particular couplings that developed between the individuals and the activities appeared quite different. They differed despite the fact that both were transitions between school and work, and both shopkeepers and students became able to deploy a variety of written and nonwritten strategies and artifacts. Therefore, neither the nature of the particular activities

nor the participants' different backgrounds offer adequate explanations of these consequential transitions. Nor does an interaction between persons and activities, because it requires the two to be analytically separable though they always co-occur in life. This would create a "black box" where the recursive relation between persons and society is played out.

Although developmental coupling is a viable concept for understanding changing local relations between persons and activities, it remains only a partial explanation of consequential transition. A more macro-level explanation exists in conjunction with local ones and involves two additional methodological concepts: leading activity and heterochronicity. These are described subsequently, after first illustrating developmental coupling during an encompassing transition.

From Mechanical to Computerized Machining Activity

This illustration comes from a compendium of studies in which we followed machinists during a major encompassing transition from mechanical to computerized machining in American industry. It is a revisitation of work that was begun almost a decade ago with Laura Martin and Sylvia Scribner (Martin & Beach, 1992; Martin & Scribner, 1992).

Over the past 30 years, American machining has undergone tremendous change in response to economic pressures from abroad. One major change has been from the making of parts with mechanically controlled machines to the use of program or computer-controlled machines to cut metal, ceramics, and plastic parts. Machinists with experience (ranging from a couple of years to several decades) on mechanically controlled machines find themselves in transition because the activity in which they participate is itself transforming. We set out to study the process of transition from mechanical to computer numerical controlled machining among these machinists.

In his dissertation, Kedmon Hungwe (1999) describes a developmental coupling consisting of three components: artifact, object, and machinist's role. A change in any one or two of the three components constitutes transformation, the creation of a new relation between machinist and the activity of machining. Rather than define each component statically, I describe each as it changes during the encompassing transition from mechanical to computerized machining.

The creation and use of artifacts shifts from primary to secondary artifacts during the course of the transition. Primary artifacts bear a direct material relation to the cutting operation of the machine and to the parts being made. They consist of levers, dials, and gauges as well as the smells, sights, and sounds of tools cutting metal. They are deployed in real time with the operation of the machine. The shift to secondary artifacts in the form of written program codes means that the system of artifacts used to control the machine no longer directly draws on the structure of the machine and the cutting process for its organization (see Wartofsky, 1979, for a detailed exegesis of his concept of primary and secondary as well as tertiary artifacts: social objects that embody human intent). Programming does not operate in machine time; rather, it occurs prior to the operation

of the machine, often in an office removed from the shop floor. Traditional machinists learning computerized machining struggled with apparent but not always actual similarities and differences in the organization of the two systems of artifacts.

What constitutes an "object" shifts from the actual parts produced by the machinist to a computer program that can be used to produce thousands of parts. With minor adjustments, a program can direct a machine to produce a new part that is a modification of an old one, avoiding the lengthy setup required (for each change in a part) on mechanical machines. Thus, the program controlling the machine is, in the long term, often more valuable to the company than the parts. Machinists doing programming are often concerned with the elegance and efficiency of the program as an object in its own right. While this seems quite natural for younger machinists who have learned machining largely on computerized machines, the shift in objects is difficult for highly skilled tool and die makers who may have spent 20 years on mechanical machines prior to learning computerized machining.

The third component, that of the machinist's role, is directly tied to the machinist's identity as a highly skilled craftsman. The expansion of the activity to include computerized machining split the machinist's job into operator and programmer. Machine operation consisted of setting up the machine and monitoring it during its operation. Control of the machining processes rested in the hands of the programmer. Neither operators nor programmers had total responsibility for crafting the part and experienced a resulting loss of identity as a craftsman. This was sufficiently profound for some of the more experienced machinists that they left computerized machining and returned to work with mechanical machines, despite a decrement in status, though not in pay. In contrast, younger machinists who had trained on computer-driven machines saw computerized machining as a way of increasing their status and making themselves more marketable within and beyond the company.

The consequential transition from mechanical to computerized machining was of the encompassing form. Developmental changes in the relation between machinists and machining activity took place within the confines of the activity, which was itself changing. Instances of pure continuity in knowledge, skill, and identity were rare, as were pure instances of discontinuity. Most of what we found in the transition were transformations in the relations among artifacts, objects, and role: a developmental coupling that embodied aspects of identity in addition to knowledge and skill.

Leading Activity and Heterochronicity

Consequential transitions cannot adequately be understood only at the level of local developmental couplings between persons and activities. Activities exist in relation not only to individuals but also to broader institutional, societal, and cultural forces. An activity is

the nonadditive, molar unit of life for the material, corporeal subject. In a narrower sense, it is the unit of life that is mediated by mental reflection. The real function of this unit is to orient the subject in the world of objects. In other words, activity is not a reaction or aggregate of reactions, but a system with its own structure, its own internal transformations, and its own development. (Leont'ev, 1981, p. 46)

Activities such as machining, bartending, and schooling are developmental entities in their own right. Relations between various types of activity are not neutral or simply additive for individuals participating in them, however. As Leont'ev describes it, human life

is not built up mechanically . . . from separate types of activity. Some types of activity are leading ones at a given stage and are of greater significance for the individual's subsequent development, and other types are less important. Some play the main role in development and others a subsidiary one. (1981, p. 95)

For example, playing followed by schooling, working, and retirement is a sequence of leading activity categories characteristic of most European and North American societies. Each leading activity serves as preparation for the next. In some subsistence agricultural societies, the sequence of leading activities may simply be play followed by work that is highly integrated with family and community. This should not be interpreted as meaning that a given society defines a developmental sequence of activity categories that in turn fully dictate individual development. Rather, whether or not an activity is "leading" and therefore dominant in influence relative to other activities in which the person may be participating is co-determined by both the sequence of activity categories characteristic of a society and the period in an individual's history at which she or he participates in the activity (Beach, 1995a). Changes in persons, activities, and societies are heterochronous with respect to each other. This means that the general rate of change for individuals is less than that for activities, which in turn is less than that for societies. That being said, the most revealing cases of consequential transition are instances in which activities and societies change rapidly within the time span of the individuals participating in them. Heterochrony (see Hutchins, 1995, for an elaboration of the concept within distributed technological systems), or the timing of relations among persons, activities, and more macro-social processes, often determines the nature of the consequential transition and the developmental coupling.

I return to the Nepal study to illustrate how the concepts of leading activity and heterochronicity are useful for understanding consequential transitions. Two generations of villagers with radically different relations to the transition between school and work lived in the village at the time of our study. The younger generation had spent an extensive period of time in school before apprenticing to shopkeepers but had not done shopkeeping work prior to this time. The older generation had not had the opportunity to attend schools when they were of school age and had spent a minimum of 4 years working as shopkeepers before attending adult education classes. These two generations of villagers differed in

their temporal relation to schooling and shopkeeping, and to broader changes in Nepali society. Heterochronicity among the villagers' lives, the activities, and the society figures prominently in our understanding of what actually happens during transitions between schooling and shopkeeping.

Students apprenticed to shopkeepers were making a lateral transition from one leading activity to another, following a school-to-work sequence characteristic of generations to come in Nepali society. However, the two activities are defined by motives that bear little relation to one another, at least in rural Nepal. The motives are learning for a credential, with learning up front as the object of the activity, and becoming a shopkeeper, with selling goods for profit up front as the object. These unrelated motives allow schooling and with it school forms of arithmetic to achieve a status disconnected from and above that of arithmetic embedded in village work activities. We have evidence that the difference in status partially explains students' reluctance to drop the more visible portion of arithmetic originating in school while learning to become shopkeepers.

On the other hand, shopkeepers enrolled in the adult education class were participating in a collateral transition between a leading activity and a nonleading activity, following a work-to-school sequence characteristic of only a couple of previous generations in Nepali society. The motive for the shopkeepers' participation in the adult education class was to acquire additional knowledge and skills that could benefit them in the running and expansion of their shops. This was reflected in their developing a flexible repertoire of arithmetic artifacts, organizations, and operations through the adult education class, in contrast to the students becoming shopkeepers.

School and work are clearly categories of leading activities in rural Nepali society. However, the period in the development of an individual or a generation of individuals at which they participate has as much to do with whether it is leading or not as the societal sequence of activities. It is in this way that activities mediate between large-scale societal change and the local coupling of individuals with activities. A similar heterochronic relation can be found in the machining study. Individuals who participated in mechanical machining prior to the introduction of computerized machining exhibited a different developmental coupling in learning of computer-controlled machines than did those who became machinists after computerized machining had become widespread in American industry.

A Horizontal Notion of Development

If we are to take seriously the notion that consequential transitions are developmental phenomena, then we must address what constitutes *telos* or progress in consequential transition. Most grand notions of human development characterize progress as movement through some form of vertical hierarchy, toward greater levels of abstraction and away from the tangibilities of our world. While genetic epistemology displays this most clearly, Vygotsky's cultural-historical theory is not an exception, a point that has also been made by Engeström (1996) and by van Oers (1998). Notions of progress are important to study and critique. They

often serve as a focus for practical action and thus should be taken seriously by any developmental theory. This is rather different, however, from a theory promoting a particular notion of progress. Theories possessing a singular notion of developmental progress run the risk of having this notion wander away from being an analytic tool to become a prescription for action, a yardstick for progress, or a call for reform. This is particularly true in the education arena. If we accept the premise that a society expresses its agendas for individual progress through its institutions and activities, embedding that notion of progress in a theory of learning and development will, at best, reduce the analytic tension between the theory and the phenomenon, and thus any analytic power. At worst, it will create a measuring stick for developmental progress derived from those who hold dominant and controlling interests in that society and will silence, coerce, and stigmatize others. Thus, the concept of consequential transition needs to include notions of developmental progress without an a priori privileging of one notion over the other.

Contrasting views of what constitutes developmental progress during consequential transition clearly emerge in our study of high school students becoming part-time crew in a fast food restaurant (Beach & Vyas, 1998). It is a collateral transition between two long-associated activities: the high school and the fast food restaurant. The fast food restaurant industry is a major employer of high school-aged youth in the United States. Becoming a fast food restaurant crew member runs against extant notions of what counts as individual progress in American society. Because fast food restaurants are the largest single employer of high school students in the United States, they provide many students with their first work experience outside the home. Thus, many students who participate in school activity with learning as its defining object first encounter the need to learn in a work activity at the fast food restaurant, where production rather than learning is the object of the activity.

The United States has seen a recent increase in attention to issues of school-to-work transition. A report published in 1988 by the W. T. Grant Foundation, *The Forgotten Half: Non-College Youth in America*, pointed out that slightly more than 50% of America's youth do not attend 4-year colleges. By indicating that a majority of American youth do not fit our society's dominant model of intellectual and economic progress, the report initiated a series of heavily funded school-to-work programs designed to facilitate, sanction, and formalize an alternative pathway to personal and economic success, one that does not involve obtaining a 4-year college degree.

Fast food work is considered by the school-to-work movement only as an example of what school-to-work should not be: preparation for low-knowledge, low-skill, low-wage employment. A highly influential report issued by the U.S. Department of Labor in 1991, *What Work Requires of Schools*, describes the economic future of American society as being in "high skill, high tech, high wage, knowledge-intensive" jobs (p. 22). This rhetoric has been widely adopted by American industry and education policymakers. It has embedded in it a

metaphorical marking of individual progress as proceeding upward through a hierarchy of knowledge and skill. The final section of the report is devoted to outlining a series of generic work-related skills and abilities that all students should acquire in school, independent of whether they will attend college, and independent of the particular job they may eventually acquire. This conceptualization of skills and abilities is based on assumptions of individual epistemological progress toward greater levels of abstraction and decontextualization.

The (dominant) notion of human progress in American society and, as noted earlier, in major developmental theories is upward through a hierarchy of knowledge and skills, and away from the specifics of human activities. Our research has led us to question the fruitfulness of such a singular notion of developmental progress. The collateral transition that students in our study make is between schooling, heavily invested in the dominant notion of progress, and participation in fast food restaurants, which runs counter to that notion. This provides an opportunity to examine how we might characterize couplings between individuals and activities, and relations between activities and society as developmental, though they may run counter to a dominant notion of progress.

The corporate-designed training for fast food crews consists of videotapes specific to each restaurant work station and a written mastery test completed at the end of each video. Successful completion of a test for a particular work station should be followed by training at the actual station with a more experienced member of the crew. The corporation's view of knowledge and skill is consistent with the place occupied by fast food work within the intellectual hierarchy of American jobs. In other words, it is near the bottom. Each of the training videos breaks a station job down into a series of behavioral elements and repeats the sequence three times for the viewer. For example, some of the elements in making a cheeseburger are as follows:

1. Place the heel bun and then the burger centered on the wrapper.
2. Place cheese on the burger, followed by three pickles arranged in a semicircular fashion. Use one pickle if they request "light pickles"; use four if they request heavy.
3. Squeeze on mustard and catsup starting from the outside of the burger and moving to the inside in a circular motion. If they request "heavy," your motion should be slower. If they request "light," it should be faster.

This view of knowledge and skill separates it developmentally from that which is acquired in school because it does not advance students' understanding of a particular subject matter such as math, science, or language arts. Thus, the corporate view of knowledge and skill is both consistent with the societal hierarchy of jobs and places a developmental boundary between it and schooling. However, this is not to suggest that becoming a crew member is unrelated to one's participation in school. In fact, the structure of learning activity in school has everything to do with what needs to be learned in a production activity such as fast food work.

The official training curriculum has little to do with what actually takes place in becoming a fast food crew member. Because of high turnover rates among employees, most new crew were hired to immediately fill vacant positions in the store and never saw a training video. Though some had a period of introduction that was marked as training, most started out by operating a particular station where they were needed to maintain the collective production of the crew. The activity is highly time driven and places pressure on the crew member to perform his or her job rapidly and accurately. Speed becomes more important than accuracy at times when the shortage of one particular product holds up the production of other members of the crew. This places the students in the position of needing to learn how to learn while maintaining production, something that runs counter to their participation in schooling. The students developed new means for learning while maintaining production and were assisted in this by the more experienced members of the crew who may or may not have been designated as the students' trainers. Learning to learn in a production activity was not easily and smoothly achieved by the high school students. Rather, the students struggled with creating opportunities to learn in the midst of production.

There are multiple reasons for viewing the collateral transition of youth between school and fast food work as having nothing to do with development or progress. Certainly, this is true in the vertical sense of development. Nothing new was learned about school subjects, nor were there many opportunities to use knowledge of math, science, or written literacy on the job. The corporate view is consistent with this. Knowing how many pickles and how much mustard to place on a burger is local declarative knowledge that resides at the bottom of any hierarchy of developmental progress. Furthermore, knowledge and skills gained at the restaurant are not seen as sufficiently abstract and conceptual to generalize to other more societally valued activities.

We propose an alternative conception of developmental progress that is horizontal. First ventured by Engeström (1996), horizontal development is closely tied to the concept of consequential transition as it is defined here. Horizontal development consists of the transformation or creation of a new relation between individuals and social activities, not continuities or discontinuities experienced by the participants at some points in the transition. Horizontal development is never removed or distanced from social activities. The appearance of distancing, decontextualization, or vertical development is a special case of horizontal development—one that generally involves new layers of symbolic mediation that give the appearance of generality. This is because their referents are assumed to be unchanging while new layers of mediation are added. As can be seen from our studies of machinists, however, referents shift with the addition of new layers of symbolization.

Although vertical-appearing versions of horizontal development are generally tied to dominant societal notions of human progress, this does not mean that such notions should simply be deconstructed and ignored. What, then, does it mean to "find" development in how high school students learn to learn in

becoming fast food crew members? First, it means that if our society's dominant notion of progress were embedded in our theoretical framework, it would have precluded the possibility of seeing collateral transition as a form of horizontal development. Second, the fact that horizontal development does occur is consistent with a very local notion of progress bounded within fast food crew activity. It is related to other notions of developmental progress and activities, even if in opposition to them. Finally, it would be disingenuous to suggest that by showing that students are struggling to figure out how to learn in a production activity and that there is a developmental coupling, we are suggesting that there is more of value to becoming fast food crew than society acknowledges, that it is satisfying work that prepares students for future work, or that it allows workers to survive economically. It does, however, allow us to pose new questions about how horizontal development can take on the appearance of vertical progress during consequential transitions. It also allows us to move our beliefs about human progress out from behind psychological theorizing into the realm of education and society where they can be studied, critiqued, and, when deemed appropriate, altered.

A BRIEF REFLECTION ON OUR EXPEDITION

We have traveled a great distance in this chapter, beginning with the classic Buddhist philosophical concept of dependent origination. Dependent origination locates experiences of continuity and transformation in the interdependence of persons and social organizations. We discussed its relevance to current sociocultural perspectives on learning and development that share with it the premise that relations between persons and culture are recursive. We described the contrasting Platonic stance that locates epistemological continuity across space and time within the individual. The predominance of the Platonic position within American education and psychology was not just a function of shared cultural roots. The chapter's brief history of American education and transfer research showed how the needs, beliefs, and values of a growing public education movement intertwined with a fledgling scientific psychology to maintain a view of the individual as holder of knowledge, skill, and continuity, and as a perceiver of continuity in the world. That it has continued to predominate in the face of several decades of arguments across the Cartesian plane—problem isomorphisms versus abstraction/generalization strategies—is testament to this. Cognitive and sociocultural perspectives have each made their own contribution to this.

We moved on to an analysis of constructs based on the transfer metaphor. This was done to ground our journey in a full understanding of the "soft spots" of the transfer metaphor and its constructs: narrow definition, split agency, difficulty of facilitation, assumption of a static context, a launch model of person-environment relations, and difficulty distinguishing transfer from just plain learning. Task versus situation levels of analysis and intentional versus unintentional generalization were reconstrued as related phenomena rather than independent forms of transfer. One of the more important lessons learned was the need

to discard transfer as a metaphor for what it is we are trying to understand and support.

I proposed a broadening of the phenomenon of concern to continuity and transformation in knowledge, skill, and identity across changing forms of social organization. Generalization is the shorthand term used for this broadened area of educational concern. In the present account, generalization is highly contextualized, involves multiple processes rather than a single procedure, includes changing social organizations as well as individuals, and reflects some notion of progress.

The construct of consequential transition was then introduced as a tool for understanding and facilitating this phenomenon of generalization. Consequential transition is consistent with the Buddhist philosophical concept of dependent origination and accepts the recursive nature of changing persons and social organizations. This concept of transition involves some form of consequential change in the relation between the individual and one or more social activities across time. Four forms of consequential transition—lateral, collateral, encompassing, and mediational—were illustrated through our studies. A new series of methodological tools for studying consequential transition—developmental coupling, leading activity, heterochronicity, and horizontal development—were also illustrated through our research. This leaves us moving in the direction of what all of this may mean for the practice of education.

TOWARD DISTANT SUMMITS: CONSEQUENTIAL TRANSITION IN EDUCATION

To the initial concern of how education can prepare children, adolescents, and adults to adapt to existing society, thereby maintaining some degree of continuity in collective values and beliefs, we add a second: how to prepare individuals to participate in the transformation of society. It is this second concern to which consequential transition is directed, although it necessarily presupposes the existence and legitimacy of the first. It is a concern that echoes from the writings of both Dewey and Vygotsky (Dewey, 1977; Prawat, in press; Vygotsky, 1987). Consequential transition is the conscious reflective struggle to reconstruct knowledge, skills, and identity in ways that are consequential to the individual becoming someone or something new, and in ways that contribute to the creation and metamorphosis of social activity and, ultimately, society.

Lateral and collateral transitions sanction a broader educational focus on students' participation across schools, families, workplaces, and communities. When in the student's life experiences these transitions occur, what the activities are, what the direction of the transition is between them, and how they relate to macro-level changes in society have everything to do with the development of knowledge, skill, and identity. Though consequential transitions emphasize the transformative or developmental aspects of education, they also situate the more stable-appearing reproductive aspects as a particular claim on societal values and beliefs about knowledge and skill, placing the oft-maligned "instructional

delivery of subject matter" within a set of concerns that are broader than just constructivist versus transmission models of teaching and learning.

Encompassing and mediational transitions sanction educational practices that enact change in the educational activities themselves and, thus, developmental changes in the coupling of students with activities that support learning. This may involve the expansion of classroom activities beyond the current schools and an expansion of our definition of schooling. It may involve the genesis of "third activities" that not only bridge the classroom with productive activities beyond but also give developmental direction to their relation. It may also involve local curricula affording student experiences in creating new systems of artifacts for particular mathematical, historical, literary, or scientific purposes: producing culture in addition to mastering that which already exists.

This is provocative stuff, and the big educational challenge does not appear to be how schools and teachers can facilitate students' transferring of knowledge and skills. In fact, as Bereiter (1995) notes, attempts to act on this challenge have "added up to a sense that you cannot really teach people to act more intelligently, except in particular situations on particular tasks. This is a conclusion that, quite understandably, acts as a wet blanket on smoldering hopes for improving the human condition through education" (p. 32). Our sociocultural reconceptualization of transfer as consequential transition also presents some challenges for how we do education, but, I believe, without the wet blanket.

Clearly, consequential transition happens without the intervention of teachers or schools. It happens at work and in our homes and communities. It also happens between school and these institutions. Therefore, schools need not struggle to be society's sole source of consequential transitions. Nor should we expect that all that we value in mathematics, science, history, literature, cultural understanding, and the arts can and should be invoked through consequential transition. This being said, there is much that we have yet to figure out about how schools can support students in becoming someone or something new, negotiating the boundaries of multiple and sometimes contradictory activities, and changing their participation in these activities as the activities themselves change.

The relation between changing students and social activities—their developmental coupling—is key not only to studying consequential transitions but to shaping their existence and course. If we accept that students' learning can change their relation to an activity, as can teaching, changes in curricular content, and new educational goals, then a myriad of possibilities are before us. We need to address what sorts of consequential transitions we wish to support through education, and which we choose to work against, for much that is consequential may not be what we hope for. Becoming a gang member, becoming homeless, becoming a dropout, and becoming a racist are all highly consequential transitions. The concepts of consequential transition, developmental coupling, heterochrony, and horizontal development do not allow such decisions to be hidden behind social scientific theorizing. Rather, decisions about which consequential transitions to support and which to work against need to be made "out in the open," based on what we negotiate as our collective beliefs and values for our society.

There are, however, areas in which our program of theorizing and research can be of particular use as we move into the rich tradition of educational "design experiments": Cole's after-school computer clubs (Cole, 1996), Engeström's developmental work research (1993), Palincsar's reciprocal teaching (Palincsar & Brown, 1984), Moll's funds of community knowledge (Moll, 1992), Cobb's elementary math classrooms (Cobb, Gravemeijer, Yackel, McClain, & Whitenack, 1997), and Rogoff's communities of classroom practice (Rogoff, 1990).

We need to figure out how identity making, or identity craftwork as Lave (1996) describes it, can become an institutionally sanctioned part of acquiring knowledge and skills in classrooms in ways that it currently is not, but is in most other activities in which students participate. As Gover (in press) points out,

One would never think of claiming, for example, that their identity as individuals is entirely separable from the various kinds of knowledge they possess. After all, it is only by virtue of such knowledge (or its lack) that we are positioned relative to those around us. Looking at particular domains may make this more explicit. First, in the family-of-origin, one learns many things we would all recognize as basic to identity: how to talk, work, argue, play, love, and so forth. Next, qualified by the "directive force" of our own personal and cultural backgrounds (D'Andrade & Strauss, 1992, p. xi), we learn to negotiate the community's various ethnic and institutional cultures, a process synonymous with learning how to weave our identities into the larger society. Finally, in the workplace, our identity as workers is obviously tied up with what we know regarding our specific job or career. For example, one's identity as a doctor or mechanic cannot be divorced from the knowledge which allows one to assume such titles.

We need to understand how to "transfer" opportunities for learning by expanding the boundaries of school activity into culturally productive activities that are beyond its current purview and by creating new activities that mediate participation in schooling with the activities of other institutions. As Lemke (1997) describes it,

We need to extend the networks of the classroom and the school. To extend them into professional communities of practice. To extend them into the sphere of private life. To extend them into the sphere of direct political activity. To extend them into libraries and information worlds where there are no preferential barriers to crossing from one domain to another at will. To extend them into productive activities of our ecosocial system: industrial, agricultural, financial, informational. Most of all, we need to extend them outside the networks that define only masculine, heterosexual, middle-class, north-west European cultural values and historical traditions as normative and that seek to deny the already pervasive interpenetration of other networks and practices in our ecosocial systems. (p. 54)

This will not be easily accomplished, however, given the often competing or contradictory agendas of learning in school and agendas of other activities that place the achievement of consensus in a community, production on the job, or the raising of children in a family at the forefront, and where learning is organized as a partial means rather than an ultimate end.

Finally, we need to consider how to support students in learning to produce culture as well as reproduce it. In a recent article (Saito & Beach, in press), we make the point that most classroom-based problem solving works against the

creation of new systems of artifacts by students and against the use of student-generated artifacts by other students. The notion that each student learns by recapitulating the entire process of solving a problem, although the problem may have been solved many times by others elsewhere, enacts the importance we place on each student reconstructing and coming to own preexisting cultural forms and functions. However, if we value the abilities that produce culture as well as reproduce it, then we need to consider how to foster students' experiences in doing so. One possibility for facilitating consequential transitions in schools involves opportunities for the longer term narrowing of distances between problems and solutions through the creation of new systems of artifacts. It also means the sharing of those artifacts with others, others who need not struggle with and relive the full history of the problem and its solution. Ultimately, this may be what makes transitions consequential.

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Manuscript received December 28, 1998

Accepted March 31, 1999